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THE 4th EDITION

INTERNATIONAL STUDENTS CONFERENCE

RESEARCH IN ARCHITECTURE

Organized by

D Y PATIL SCHOOL OF ARCHITECTURE

in association with

MAHARASHTRA ASSOCIATION OF SCHOOLS OF ARCHITECTURE [MASA]

Principal
Prof. Shubhada Chapekar

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Prof. Nilesh Pore

International Students Conference
Research in Architecture

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Research in Architecture

Editor

Prof. Nilesh Pore

Hosted by

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Message from Chairman

It gives me immense pleasure to congratulate the Principal, Convener, students and the organizing committee, staff and all students on the success of the International Students Conference on Research in Architecture, 4th Edition.

The Unique platform gives wide scope for the aspiring students to project their innovative thoughts to the fraternity. Such kind of academic excellence will lead to sensitive architects and contribute to the greater good of the community and our Nation.

I wish all the best and hope for greater success in the coming years.

Dr. Ajeenkya D.Y. Patil
President
Ajeenkya D Y Patil University, Pune
Chairman, Ajeenkya D Y Patil Group

Message from Advisor

I am glad to welcome you all for this 4th Edition of International Students Conference on Research in Architecture, hosted by D.Y. Patil School of Architecture, Lohegaon, Pune. It's been a pleasure to be associated with this conference since its first edition and I am proud to see the exponential growth now spreading Internationally. The one of its kind conference is a land mark for the school towards its goal of being the center for Research and Innovation in Architecture. This edition of the conference hosted on hybrid platform; has a grand success as the previous three editions. My Best wishes to one and all associated with the students conference.

Dr. Sushant Patil
Trustee
Ajeenkya DY Patil University, Pune

Message from Principal

We at DYPSOA have pioneered in giving the students of Architecture the opportunity to amplify their knowledge and explore avenues in research. It has been a proud moment to have successfully hosted the 4th Edition of the National Students Conference on Research in Architecture 2022 and gives me great delight to pen down my thoughts and opinions.

This edition has offered a unique platform for a constructive dialogue with the students and experts in the field of Architecture. Also, providing an opportunity to participate in an offline as well as online mode. The conference has prioritized on broadening the students' knowledge and contribution towards the profession.

Research fosters critical thinking and analytical skills and helps in defining academic, career and personal interests. Through the 4th National Students Conference on Research in Architecture our purpose to promote innovative, diverse, and scholarly exchange of ideas has been met. I am overwhelmed to have received a varied array of topics which has not only displayed the participants enthusiasm but shown deeper understanding of the discipline.

The conference has aimed to deliver the most recent relevant research, best practices, and critical information to support higher education professionals and experts. It has provided a professional platform to refresh and enrich the knowledge base and explore the latest innovations.

I appreciate the institutions and research guides in inculcating the seed of research. A special mention to the eminent jury panel and paper reviewer for their time and valuable contributions.

I appreciate the convenor Prof. Nilesh Pore and his team of faculty and students for their commendable efforts in successfully hosting the conference. The integrated effort of the teaching and the non-teaching staff of D Y Patil School of Architecture cannot go unnoticed in bringing honor to our institute. The participants profuse response and confidence has reassured us to keep going ahead to the 5th edition of the conference.

Prof. Shubhada Chapekar
Principal

D Y Patil School of Architecture,
Lohegaon, Pune

Message from Advisory Committee

It is a pleasure to write for the **International Students Conference on Research in Architecture**, hosted by D Y Patil School of Architecture, Lohegaon, Pune, as a part of the advisory committee.

This event, started as a regional conference in the year 2019 has progressed as an international conference at the fourth edition this year 2022.

The fourth edition of conference was hosted in a hybrid mode.

The conference is meant to support the core education of architecture and to widen the students' knowledge by exploring avenues for research. It also provides a platform to the students of architecture to present their research to academicians and professionals as well as receive valuable feedback from them.

The advisory committee constituted:

1. Dr. Sushant Patil Advisor, Ajeenkya D Y Patil University
2. Prof. Shubhada Chapekar Principal, DYPSOA
3. Dr. Vasudha Gokhale, BOS, SPPU.
4. Dr. Prajakta Baste,BOS,SPPU.
5. Prof. Aparna Mhetras HOD, MArch, DYPSOA
6. Dr. Karthik Vora Design Chair, DYPSOA
7. Prof. Veena Shenvi Design Chair, DYPSOA

Best wishes to all associated with the conference.

Message from Convener

It was a privilege and honor to be the Convenor for the International Students Conference on Research in Architecture 2022, 4th Edition, conducted in a hybrid mode by D Y Patil School of Architecture, Lohegaon, Pune with the support from our knowledge partner, Maharashtra Association of Schools of Architecture (MASA). The response received for fourth edition of the conference from the schools of Architecture, students and faculty was overwhelming and beyond description.

This Conference is one of its kind which provides a platform for students, to identify topics and methods in architectural research and present them. It aims to inculcate research culture in architecture and encourage students to understand the values of interrelationship of various disciplines within. The conference is open for students of the undergraduate program, post graduate program as well as research scholars enrolled in any recognized University.

Research is an important aspect in architecture, which can contribute to bridging the gap between practice and academics. The first detailed poster was sent to various colleges in December 2021. And we started receiving the abstracts as per the given date of 15th November which was extended to 3rd January on request of many colleges. This year we received 193 abstracts for B Arch out of which 160 were selected for full paper submissions.81 for M Arch and 54 were selected for full paper submission. 7 for PhD and all 7 were selected for full paper submission. A paper reviewing committee was appointed to review the abstracts and full papers. The committee consisted of eminent experts in the field of Architectural research from practice as well as academics.

First Call for full papers was 15th February 2022 which was extended to 28 th February 2022. Full papers received were 71 for B Arch and 39 for M Arch. Out of which 32 were selected for Online presentation for B Arch & 10 for M Arch, as well 26 were selected for offline presentation for B.Arch and 11 for M.Arch. Two PhD scholars were selected for Offline presentation. The two days of the conference consisted of total 14 sessions with 5 sessions online of B.Arch,4 sessions Offline of B.Arch ,2 Online sessions of M.Arch, 2 offline sessions of M.Arch and 1 Offline Session for M.Arch. A special section was dedicated for Poster presentations of the candidates who's papers were selected only for publication. 4 posters were selected and inaugurated in the conference.

This Year our Advisory Board comprised Dr. Vasudha Gokhale, Dr. Prajakta Baste, Prof. Shubhada Chapekar, Prof. Kartik Vora, Prof. Veena Shenvi and Prof. Aparna Mhetras. Advisory committee members gave their valuable guidance from time to time, which helped in smooth conduct of the whole process.

The experience of hosting the conference on a hybrid mode was challenging as well gave opportunities for more participation from remote areas. I am sure each one of us has got enriched with the knowledge, guidance & insights shared by all the panel members as well as the paper presenters.

I sincerely thank our principal Prof. Shubhada Chapekar for her encouragement and guidance throughout the process of the conference. The Dedicated Core faculty Prof. Amit kaur, Prof. Adhreja Dey and Prof. Neha Bagade have enormously worked hard since the announcement of the conference. Student Volunteers Anoushka Sengupta and Anubhab Ghosh have tirelessly communicated with the students.

All my colleagues who were part of different committees and all the dear students who helped to conduct the conference smoothly.

All the members paper reviewing committee, panel members for all the sessions, We are very grateful to MASA - Maharashtra Association of Schools of Architecture for being our knowledge partner.

I thank our guests for the Inaguration ceremony, Dr. Abhay Purohit Sir, Dr. Thomas Mical Sir, Dr. Prajakta Baste Madam, Prof. Pushkar Kanvinde Sir, Dr. Kamaljeet Kaur Madam.

I thank our esteemed Chief Guest of Valedictory Ceremony Ar.Jayashree Deshpande Madam, Guest of Honour Dr. Mahendra Sonawane Sir, Guest of Honour Dr. Parag Narkhede Sir.

Last but not the least all the authors for taking out their time to write the research papers ,all paper presenters, participants and faculty of all the colleges for gracing the occasion by their presence.

Prof. Nilesh Pore
Associate Professor
DYPSOA, Lohegaon, Pune

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List of Winners

Sr. No.	*Category*	*Name of Winner*	*Name of Institution*	*Title of the Research Paper*	*Position Secured*
1.	B.Arch	**Tanya Jose**	SMEF's Brick College of Architecture, Pune	Redesign to Live Longer: Architecture and Mental Health	Best Paper
2.	B.Arch	**Alafiya Talib**	Allana College of Architecture, Pune	A Time Travel through the Residential Heritage Precinct of Shahjahanabad – The Havelis	First Runner Up
3.	B.Arch	**Sanika Bhide**	Indian Education Society's College of Architecture, Mumbai	The Sattriya Theatre: A Modern Perspective	Second Runner Up
4.	B.Arch	**Shweta Deshpande**	CTES College of Architecture, Mumbai	Reverence: Giving Dignity to Alzheimer's Patients	Special Mention
5.	M.Arch	**Swapna Hankare**	L.S. Raheja School of Architecture, Mumbai	Reinventing the Image of the City through Brownfield Landscapes	Best Paper
6.	M.Arch	**U.S. Bijayeeni**	CTES College of Architecture, Mumbai	Disaster Resilient Environment, Economy and Livelihood in the state of Odisha	First Runner Up
7.	M.Arch	**Nitaasha Rana**	School of Art and Architecture, Sushant University-Gurugram, India	Urban Wilderness and The City Dwellers – Case Study of Eco Restoration Chakkarpur Bundh	Second Runner Up
8.	M.Arch	**Nainika Choudhary**	School of Art and Architecture, Sushant University-Gurugram, India	Mapping the Change in Habitable Spaces in rural Haryana	Special Mention
9.	Ph.D	**Shruti Joshi**	MKSSS's, Dr. B. N. College of Architecture, Pune	Study of Gentrification Dynamics and Migration Patterns in City of Pune	Best Paper
10.	Ph.D	**Shilpa Dhawale**	Allana College of Architecture, Pune	Daulatabad Fort – A Study of Late Medieval Landmark of the Deccan	Special Mention

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12TH & 13TH APRIL 2022













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Redesign to Live Longer: Architecture and Mental Health

Tanya Jose and Ar. Rama Raghavan
E-mail: tanya.jose.me@gmail.com

Abstract: The spectrum of mental health is broad; it has several variables in relation to one's daily activities and interactions with the environment. However, one's physical environment is observed to affect the behavioral pattern of the user. This paper will focus on different parameters that affect the quality of life of the user. It presents a framework for experiential design that is reflective in the built environment that may enhance one's lives through a connection with the senses. Since research shows that engaging with stimulating environments yields greater mental benefits and increases longevity. In addition, with the introduction of COVID-19, the aspect of mental health has become a pressing concern, where homes have replaced workplaces, schools, gyms, where many are spending more time in them than ever before.

The intended audience are people who wish to break the boundaries of conventional dwelling norms to heighten the living experience that could potentially be a stepping stone for architects to redesign to live longer!

Keywords: *Isolation, Dwelling, Mental Health, Experiential Architecture, Sensory Stimulus.*

1. INTRODUCTION AND BACKGROUND OF STUDY

According to WHO definition, "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity. "While well-being is described as the state of being happy, healthy, or prosperous."

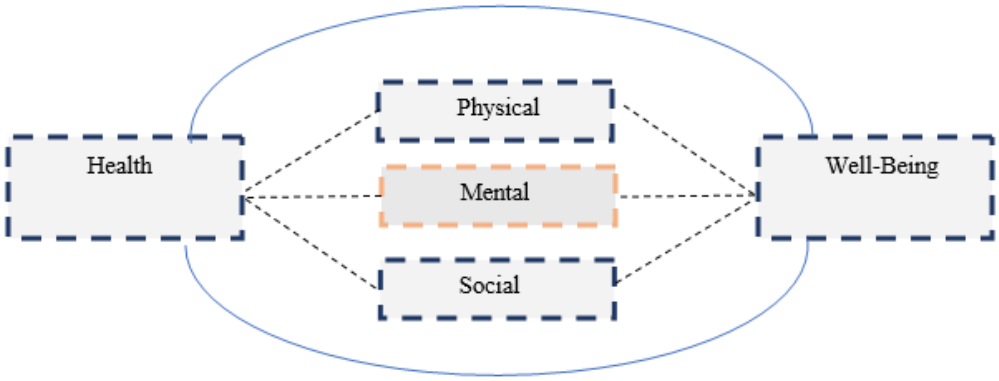

Figure 1: Relation of Health and Well-Being

It is observed often, the physical well-being has been given more priority than the mental and social wellbeing, especially in Architecture. The built Spaces do not consider the overall experience of the end-user. Moreover, the aspect of the Covid-19 pandemic has added fuel to the fire and study shows that deaths due to mental health in times of isolation have surged higher reaching an overwhelming 35% increase in India. Hence, the physical environment plays an important role in affecting the behavioral pattern of the user. The **aim** of this paper is to relate the study to the importance of the built environment with the senses and hence present a framework for designing an "optimal space" in the future based on the current scenario posed by the COVID-19 outbreak.

- **Objectives**: To study different parameters based on the Well Building standards with respect to the mind that affect the quality of life of the user.
- **Scope and Limitations of the Study:** The environments that force humans to engage stimulus in day-to-day activities, can push one to experience life exponentially by observing the world through the senses and mind. Thereby, strengthening the empirical evidence for bridging the gap between architecture and mental health and raising its priorities in both design research and design practice. However, the **limitation** of this study is that there are many

variables hence parameters to take into consideration when talking about built environment, activities and its relationship with mental health and may vary from person to person. Also pointing out that the study carried out is done in small sample sizes, not to be generalized to the wider public, and heterogeneity in parameters make it difficult to make direct comparisons between other studies.

2. LITERATURE REVIEW

Architects must pay more attention to the physical environment's impacts on the individual's body and mind health (Zhang, 2016) In the past, psychologists paid more attention to illness than health and happiness (Diener, 2009) Today it is more important to pay attention to improving positive emotions such as calmness, sympathy, attachment, and love in people (M. Bagheri, 2018) House quarantine has been considered as the first solution to maintain the physical health. However, this measure will threaten the mental health of people and cause problems such as boredom, stress and a sense of loneliness. (PariaAkbariaSeyed, 2021 Nov 1)The COVID-19 epidemic has underscored potential gaps in mental health services during emergencies (National Council for Scientific and Technological Development, 2020).

Architecture exerts a profound influence over our well-being, given that the majority of the world's population living in urban areas spend something like 95% of their time indoors. (Spence, 2020) While the physical structure of the house provides shelter, housing is more than a shelter, providing comfort, privacy and security, and affecting health at all levels of structure, psychology and community (S.F. Suglia, 2011) Since there were fewer studies in the field of mental health during this period, (PariaAkbariaSeyed, 2021 Nov. 1) tries to investigate the indicators of housing and mental health during the quarantine imposed by the outbreak of COVID-19, which is a significant subject for architects in relation to epidemic diseases. Placinga specific focus on some of the key physical factors (e.g., light, temperature, sound, and air quality) of indoor environmental quality that strongly influence occupant perception of built spaces, attention is also given to the value of multi-sensory variability. (Building and Environment, 2020) However, the majority of architecture tends to neglect the non-visual senses of hearing, smell, touch, and even taste. (S.F. Suglia, 2011) an experiential approach is the pursuit not of technology but of human sensual perception to invoke an animating force of design and creativity (Waterworth, 2016) Fundamentally multisensory nature of perception that one can really hope to explain a number of surprising atmospheric interactions, such as between lighting color and thermal comfort (Spence, 2020)or between sound and the perceived safety of public spaces ("Sound and safe", 2015), that have been reported in recent years.

In order to design buildings and environments that promote our health and well-being, it is necessary not only to consider the impact of the various senses on a building's inhabitants, but also to be aware of the way in which sensory atmospheric cues interact. Multisensory integration will help to explain how it is that our senses conjointly contribute to delivering our multisensory experience of space (Spence, 2020). A new framework emerges, accentuating the integration of diverse new competencies required to support the design and operation of built environments that respond to the multifaceted physical, physiological, and psychological needs of their occupants. (Building and Environment, 2020)

3. MATERIAL AND METHODOLOGY

A questionnaire was formulated to understand how the respective dwellings respond to the different parameters for the mind formulated by well building standards. To study the response of users living in three different typologies of houses. Interviews done in online method and offline method for 5 individuals from each of the 3 typologies based on 7 parameters namely acoustics, thermal comfort, furnishing, workspace light quality, air quality, maintenance, layout. Labelling the level of comfort in existing typologies from most desirable to least desirable on a scale ranging from 1-10.1 being least desirable whereas 10 being the most desirable rating. The response of the participants has been used to understand the correlation of the senses with the parameters. Recognizing preferences especially in times of isolation where one's mental health is affected due the monotonous lifestyle and less social interaction can lead to designs that provide an appropriate space to stay-in conditions

4. THE CONTEXT FOR THE STUDY

Dwelling referred to as a building or place of shelter to live in; place of residence; abode; home. Dwellings that were initially built for spending 30% of time in a day has exponentially increased in times of Covid-19, making it crucial to move away from the present dwelling norms and build for the future. Studying the context becomes crucial since the parameters for studying the well-being can only be judged when the dwelling is studied with its context.

Maharashtra is a hotspot that accounts for nearly 22.35% of the total cases in India as well as about 30.55% of all deaths. As of 10 May 2021, the state's case fatality rate is nearly 1.49%. Pune is the worst-affected city in Maharashtra, with about 930,809 cases as of 10 May 2021 even in comparison Mumbai Metropolitan Region (MMR) that have half the cases.

In Pune, the cases of the pandemic have surged the highest in the month of May 2021 which resulted in lockdowns and more quarantine time to prevent the spread of the virus. As a result, more time at home!!

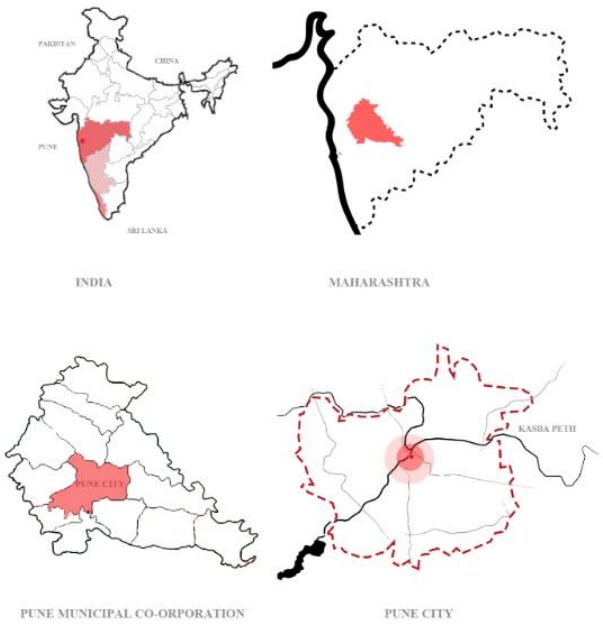

Figure 2: Most Affected Regions in India Due to COVID-19

In Pune, the Kasba Peth area have closer knit communities, densely packed with low living standards and a lack of sanitation. The houses are pressed up against one another leaving no space for circulation. This made it impossible to follow the guidelines for Covid-19 pandemic due to the pre-existing living conditions.

For the study, broadly categorizing the 3 typical layouts of dwellings namely

1. Wada
2. Apartments
3. Rowhouse.

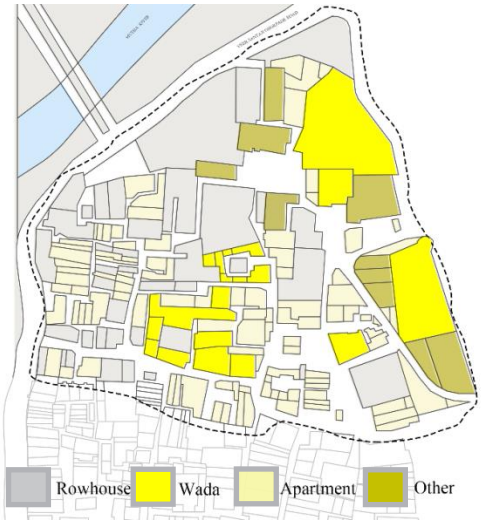

Figure 3: Plan Showing Typology Mapping of Studied Area

1. **Row House:** The first typology is the Row house system found in both core and fringe areas of Kasbapeth. The row houses are found around the fish market near the core are built-in timber and brick.

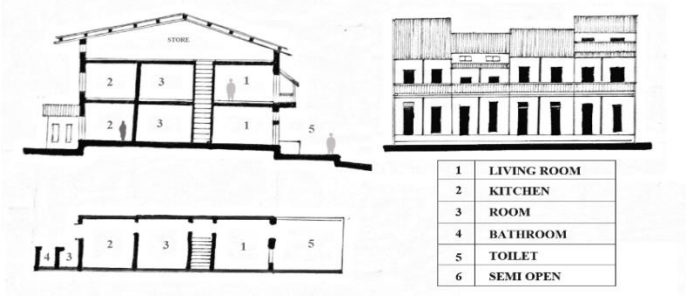

Figure 4: Plan, Sectionand Elevation of Rowhouse

2. **Wada:** Large, two or more storey, building typically with a group of rooms arranged around an open courtyard built with local materials such as bricks, limestone, and timber.

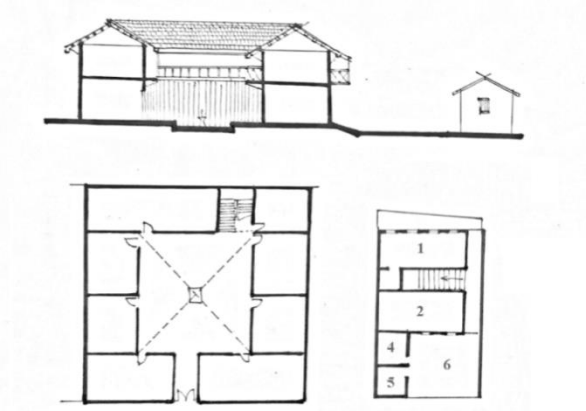

Figure 5: Plan, Section of Wada

3. **Apartments**: Towards the fringe region of this core, there are number of newer apartment systems built in RCC construction. Five to seven storey apartment buildings are found mainly in the mixed residential community the layout as shown in the Figure 6.

Sr No.	*Parameter*	*Typology*														
		Rowhouse					*Wada*					*Apartment*				
1.	Acoustics	4	6	7	9	8	3	4	5	3	3	5	4	6	5	5
		34					18					25				
2.	Thermal comfort	5	6	4	7	5	7	8	9	8	7	2	4	5	3	3
		27					39					17				
3	Furnishing	3	2	1	4	6	4	5	3	5	3	3	4	3	2	1
		16					20					13				
4	Light quality	5	7	8	6	8	7	8	8	6	7	5	4	2	4	3
		34					36					18				
5	Odour	2	3	3	1	2	3	2	3	4	5	4	6	6	4	7
		11					17					27				
6	Cleanliness	1	3	6	5	2	5	4	5	6	4	5	5	4	5	6
		17					24					25				
7	Layout	1	3	2	3	4	6	4	7	6	5	3	2	4	1	1
		13					28					11				

Figure 6: Plan, Section and Elevation of Apartments

With the new measures of quarantine and its effects on routine activities and livelihood of people. The interviews recorded shows the acknowledgement of the parameters regarding the experience of spaces during the pandemic. The following table shows the rating of individuals living in the typologies of Wada, rowhouse, apartment system based on the 7 parameters.

Table 1: Rating of People of Typology against Parameter

Average Rating of desirable factor = Total Rating/Total no. of people.

1. Rowhouse = 3
2. Wada = 4.8
3. Apartment = 3

5. RESULTS AND DISCUSSIONS

The response recorded from the user shows the following findings. The accounted parameters can be related to the senses they effect. Moreover, conclusions that people find the well-being standard better in the Wada typology of house when considering the mind whereas the newer flat system have a lower rating. This can be accounted for the following reasons.

- **Row House:** The row house typology shows the least desirable parameter is Odour and most desirable is Acoustics. This may be accounted for due the meat market in close proximity and since its in the core and away from the main roads less noise. Hence this typology shows neglect in sense of smell and vision.
- **Wada:** The typology of Wada's shows neglect in the parameter of acoustics whereas the most desirable parameter is lighting. From the average rating of the desirable factor, it can be observed that the Wada typology has a higher rating comparable to the rest. This could be due to reason that Wadas are comparatively spacious, and due to multiple members in Wada typology more human interaction and more acoustical issues. Hence, leading to discrepancies in sense of sound, touch.

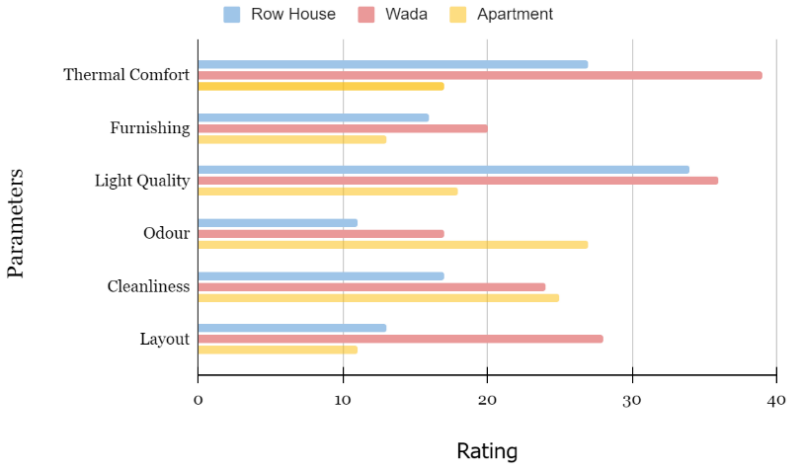

Table 2: Bar Graph Showing Rating against Parameter

- **Apartment:** In flat system, layout is shown to have the least rating and odour is most desirable in times of isolation. The most desirable and least desirable factors are very close from which one can infer that the wellbeing of people in times of isolation was the least. Since away from ground issues of odour, cleanliness comparatively lower. The reason can be again contributed to lack in parameters of light, layout, thermal comfort, and acoustics that affect sense of vision, touch.

Layout, odour are the least desirable parameters amongst the three typologies. This shows that in all the typologies combined, the sense of smell/taste and touch are neglected in the dwelling spaces of KasbaPeth. These results show that that there is a great neglect when designing dwellings with respect the senses. Because especially in times of isolation people complain about the monotony in daily activities and how the external environment is only increasing this feeling. Hence by acting on the sense of neglect according to user change can be introduced.

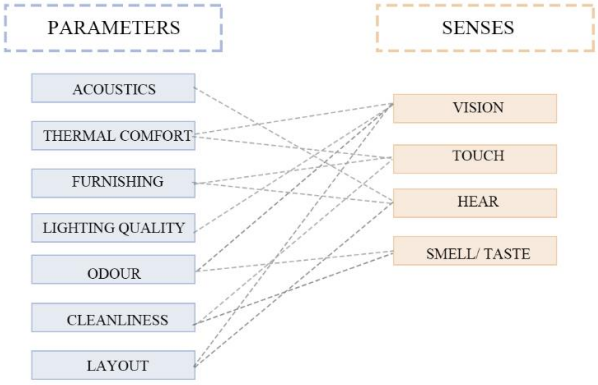

Figure 7: Correlation of Parameters with Senses

Hence, the results can help define the parameters that need to change in the future keeping in mind while designing the spaces in connection with the mind and senses. Defining the needs of the user and the context adjoining it can help understand the patterns of behavior living in order to design for the future.

6. NEEDS FOR FUTURE

From the following study there is a need to change the way dwelling spaces are built. Since the functionality has changed in the recent years. The reason for a space being least desirable may be a result of the space not arousing any interest and this arousal ofinterestis known as stimulation. However, from research patterns of human behavior can be speculated to some extent and certain conclusions can be drawn in how the senses can stimulate to arouse interest. The aim being to create the least desirable spaces into more desirable ones and the solution being involving the senses. These research's may not be directly applicable to the built environment but thoughtful implementation to these can prove to be beneficial. This implementation of the study is experiential design that can be defined as the response to the external environment in connection with the senses to navigate across a design. Today because we are habituated to closed white boxes, the mind isn't stimulated enough hence individuals face the feeling of entrapment that hinders mental development.

However, the primitive man living amidst nature was healthier both physically and mentally. Although the times cannot be directly comparable, the environment can be credited for the healthier state of mind. The role of nature to provide stimulating environments can be applied to the built environment through experiential design. Hence, the question for architects is "How to in-cooperate experiential design in dwellings?"

- **Vision:** The human brain usually shuts off if there are more than three to four colors at a time. By having a multichromatic spaces, it awakens the brain to interact with various hues.
- **For Example:** When in a forest the different hues keep the mind aroused.
- **Application:** Patterns and symmetry represent order and helps make sense of the world around.
- **Touch**: Uneven texture and surfaces stimulate the brain to be more aware of the surrounding.
- **For example:** Interaction of the sense of touch with the uneven texture of the stones, on a hill keeps the mind stimulated.

- **Application:** Texture, temperature, as well as the weight of materials tend to influence, emotions and behavior. This explains why concrete is deemed as a brutal material, unlike wood, which evokes feelings of warmth.
- **Hear:** Certain rhythms help stay psychologically calm whereas some keep one concentrated.
- **For example:** The rain noise is great at sound masking, which makes it easier to fall asleep and remain sleeping all night long.
- **Application:** The perception of sound in built is complex however can provide subtle cues as to the proportions of a space, even hinting at its function. The context becomes essential for this sense and must be treated carefully.
- **Smell/Taste:** The nose/tongue is known to be the most powerful generator of memories. Recollection typically floods the mind with visual images associated with the specific smell.
- **For Example:** When raindrops hit the earth and interact with dirt, rocks and plants, a fragrance surge up. The scent of wet earth is called petrichor. Literally: "essence derived from stone". The smell that is deemed to be comforting for many.
- **Application:** Understanding of material is often achieved by a perception of its smell, its and by the way in which it modulates the acoustics of the space. This sense is also heavily affected by the context.

From the following study shows a set relation between the parameters with context and senses that affects the consciousness of an individual. Therefore, the key to reduce and feelings of entrapment and monotony and increase well-being is by producing stimulating environments, since it relates back to the mind.

7. CONCLUSION

The findings support the study determining the preferences of users in current scenario and accordingly what needs to be changed in the future considering the shift in functionality of dwellings. Due to the outbreak of COVID-19, the aspect of mental health is being hampered and needs to be given equal importance in order to design for any such unforeseen pandemics. Hence, the importance of connection with the senses for the built environment should be prioritized as a criterion among healthy house factors. According to research by the Royal Institute of British Architects shows that engaging with stimulating environments yields greater mental benefits, hence increases one's life expectancy. Thereby, the framework of experiential design may prove to be beneficial not only for creating stimulating environments for dwelling but also other built environments. The key being stimulating one's consciousness. Since at the end our awareness is a response to the external environment. This defines consciousness as "an individual's response to the built environment in order to navigate an individual across any design." Looking to the future, the hope is that architectural design practice will increasingly incorporate our growing understanding of the human senses, and how they influence one another.

Therefore, the positive impacts of experiential architecture can help to achieve a multisensory approach to articulate the relationships between architecture, senses, mental health and built environment so that we may experience the human benefits in the design applications of our own homes.

> *"The ultimate meaning of Architecture is beyond just a building it directs our consciousness back to the world and to the self and being".*
>
> ***—Juhani Pallasmma***

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A Time Travel Through the Residential Heritage Precinct of Shahjahanabad—The Havelis

"Stewarding the past to conserve the endangered present"

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ABSTRACT: According to UNESCO, ***heritage is our legacy from the past with which we live today and pass on to future generations. Our cultural and natural heritage are unparalleled sources of life and inspiration***. Heritage structures are not just mere buildings of the past, they define the character of the place and give it its true potential. India has a kaleidoscopic spectrum of rich cultural heritage and a gold mine of valuable chronicles of the olden times, but the negligence these landmarks receive today is tremendous. One such example of forgotten heritage is "The Walled City of Shahjahanabad" in Delhi. Shahjahanabad is home to many heritage buildings and one such typology is the 'Havelis'. The main objective of the study is to critically examine the havelis and to prose the problems and issues faced by the owners residing in them. The paper analyses the existing condition of the havelis and compares it with its former glorious state. At present the havelis have very little architectural style left and have started looking as hideous buildings. A few recommendations have also been mentioned that could be implemented to enhance the quality of the space and make it vibrant and lively in terms of architecture and character.

Keywords: *Heritage, Shahjahanabad, Residential, Havelis, Architecture, Character.*

1. INTRODUCTION

1.1 Heritage and its Conservation

Heritage of the past is the seed that brings forth the harvest of the future, says Wendell Phillips. Heritage is a person's unique treasure of assets which provides an inherited sense of identity to an individual. It is a collection of values, traditions, culture and artefacts handed down by previous generations. These assets becomes more valuable due to their contribution to a nation's society, knowledge and culture. It helps us remember where we came from and where we belong, hence, becoming a crucial part of our entire existence.

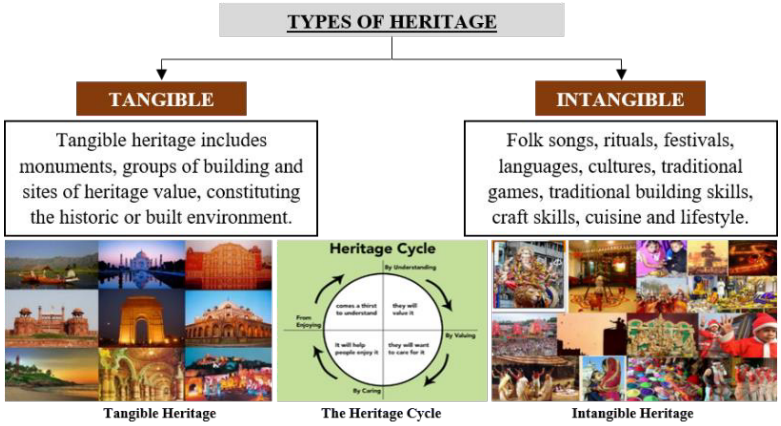

Figure 1: Heritage and its Types

Source: Author, www.irek.com

Conservation is the act to prevent the decay of historical buildings and to prolong its cultural life. Heritage conservation is crucial when it comes to recognizing, recording, documenting, analysing and protecting the heritage and cultural resources.

It provides a sense of identity and continuity to life in this fast changing world. These structures represent the history and culture of the nation and constitute together the architectural legacy of the place.

1.2 India and its Heritage Structures

India, being one of the oldest civilizations in the world, has a kaleidoscopic spectrum of rich cultural heritage. History of India is punctuated by a periodic blend of migrating people and the diverse cultures that come along with them. The number of heritage structures here is overwhelming, of which the protected ones include barely 25 edifices proclaimed as World Heritage Monuments by UNESCO, approximately 3,650 monuments under the custody of Archaeological Survey of India (ASI) declared as monuments of national significance.

Figure 2: India and its Heritage Structures

Source: www.irek.com

The highlights of the Indian heritage lie in the treasure trove of its art, architecture, classical dance, music, flora and fauna and the inherent secular ideologies of its people. India, despite being a gold mine of valuable chronicles of the olden times, the negligence these landmarks receive today is tremendous. One such example of forgotten heritage is "The Walled City of Shahjahanabad" in Delhi.

Aim: The aim of the research paper is to review the past and existing condition of the derelict Residential Heritage Precinct of Shahjahanabad and the factors affecting the tangible heritage.

1.3 Objectives

- To study the importance of conservation of the havelis of "The Walled City of Shahjahanabad" in Delhi, India.
- To analyse the existing condition of the havelis and compare it with its former glorious state.
- To critically examine the havelis and to prose the problems and issues faced by the owners residing in them.
- To propose measures to conserve the havelis so as to improve the life of the people and the quality of the place.

Scope of the Study: The research revolves around "The Walled City of Shahjahanabad" and the heritage value it holds. The general idea is to present an analytical study of the life of the place when it was in its full glory and what is made of the structures today. The main focus is on the havelis, which were the residential abode of the important people during the Mughal era. This study will be covered by stewarding and assessing the varied palpable aspects such as the infrastructure, its character, architecture, urban planning, pattern of development and the impact it has had ever since it's construction and till

date. The study will conclude by highlighting how the involvement of people and their thoughtful interaction with the place can help with its basic conservation.

Limitations of the Study: The precinct of Shahjahanabad is very vast and covering the havelis of the entire city is not feasible. Hence, the study has been limited to the havelis which are important and the ones which are in a dilapidated condition. The havelis were of immense importance and a major limitation of the study is that the place cannot be physically visited by the researcher which accounts for the research gap. The study is covered using secondary sources of information and by deriving inferences from the existing articles and theory.

2. LITERATURE REVIEW

2.1 The Old City of Delhi – "Shahjahanabad"

The city of Delhi, the capital of the Indian nation of diversity, is a city embellished with layers of history, a place where civilizations have lived, thrived, prospered and perished over centuries. The ethnic city today, built over and around a rich montage of heritage, provides an opportunity at every turn, allowing for the holistic coexistence of the past, present and the future. The pluralistic aura of Delhi is a result of its complex history, which in turn has produced a variety of traditions. It is manifested in the varied expressions of tangible and intangible, natural and manmade heritage. Delhi is home to many different architectural wonders and every region has a different story to narrate through its built and unbuilt fabric. One such extraordinary legacy found here is "The Walled City of Shahjahanabad" which has withstood the test of time and development.

Figure 3: The Old City of Shahjahanabad

Source: www.thedelhiwalla.com

Shahjahanabad was once the glorious capital of the Mughal Empire and a symbol of imperial grandeur and political power. Summoned by Emperor Shah Jahan in 1639, the mesmerizing city of Shahjahanabad was concentrated around the spectacular Qila-e-Mubarak, known today as the Red Fort. The city speaks volume in terms of its beautiful architecture and character of the place. It is a living example of diverse building techniques, materials, styles which are not limited only to the Sultanate, the Mughal and the Colonial but is a combination of all. It is the home to many heritage buildings and one such typology is the 'Havelis'

2.2 Havelis of Shahjahanabad

Havelis were the residential abode of the Imperial princesses, the great artists and amirs of the Mughal Court, the elites and the nobles. These havelis were the stately poetry that once adorned the streets of Shahjahanabad. Many different personalities have resided in these havelis and have spent a valuable amount of their livelihood here. Every wall, every pillar, every brick of the structure has witnessed the life of these people.

The tragic fact is that these havelis have now turned to ruins with barely any traces or remnants of the beautiful Persian architecture which was the charm of these residential structures once. Currently, they have no architectural style left and have started looking like hideous mass of glass and metal scaffoldings, proliferating all over the city and elsewhere. The research focuses on this aspect of lost heritage and what could be done to ameliorate the status of the residential precinct.

3. MATERIAL AND METHODOLOGY

3.1 Planning of Shahjahanabad

The plan of Shahjahanabad showcases both Hindu and Islamic influences. It seems to have evolved around a design from Manasara, an ancient disquisition on architecture which contains a semi-elliptical form called karmuka or bow for a site overlooking a river or a seashore. The traditional Islamic city plan is also reflected in the planning. According to it, the concept of the city lies between the two aspects-man and universe-and that assimilates the symbolic principles of both.

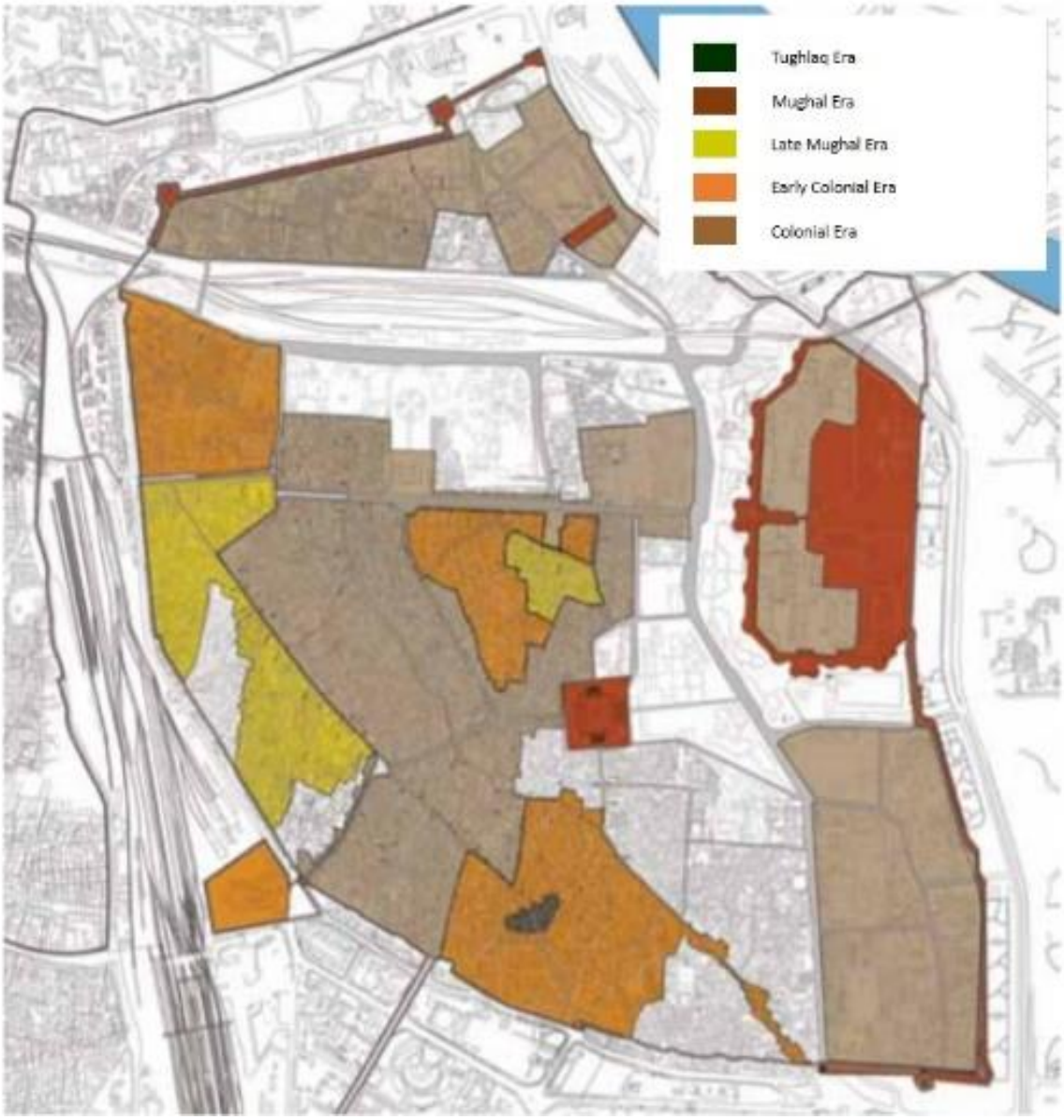

Figure 4: Architectural Eras Prominent in Shahjahanabad

Source: Delhi Urban Art Commission.

The whole of Shahjahanabad is divided into different sectors based on the architectural styles they portray. There are 5 major eras classified by various organizations based on which these places are identified. They are: 1. Tughlaq Era, 2. Mughal Era, 3. Late Mughal Era, 4. Early Colonial Era and 5. Colonial Era. The havelis of Shahjahanabad have also been categorised based on these architectural eras.

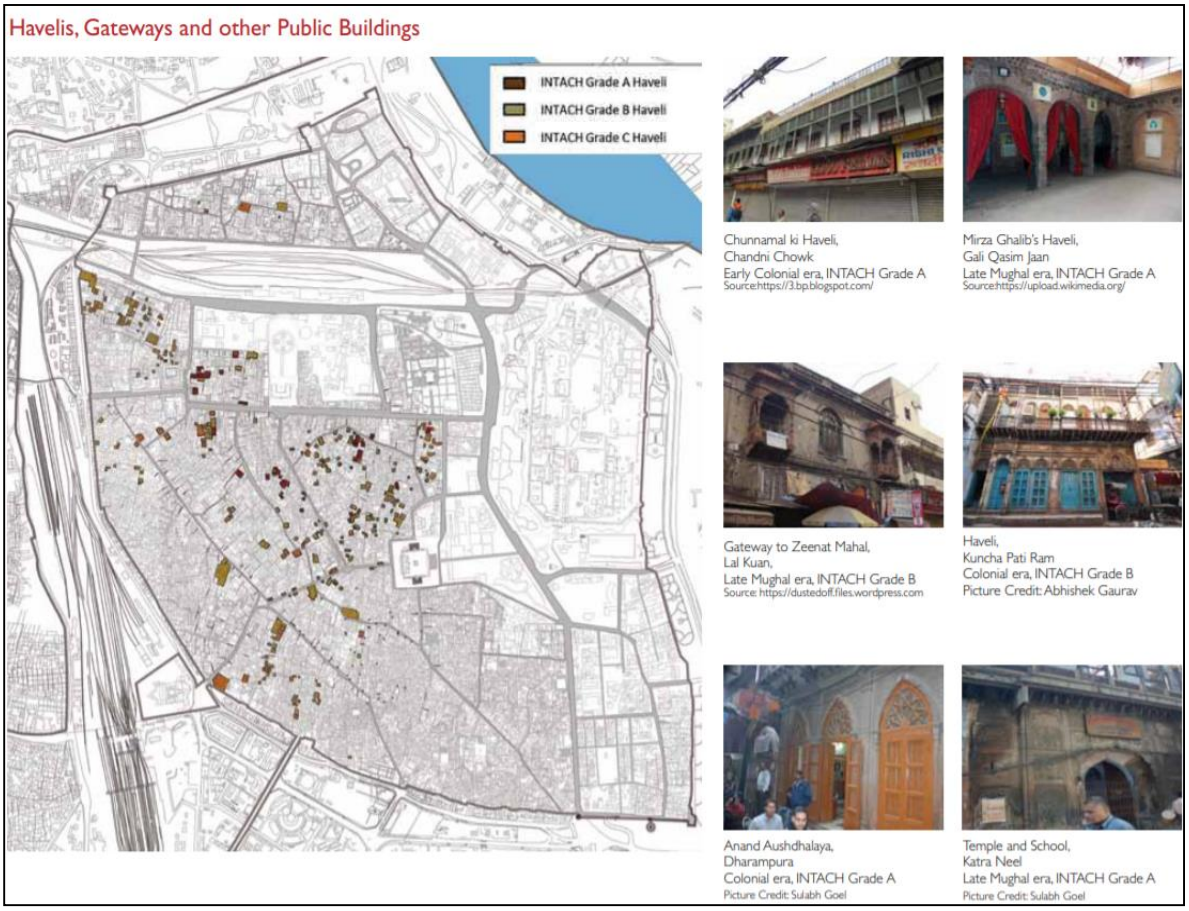

Figure 5: Map of Shahjahanabad with the Havelis Marked

Source: Delhi Urban Art Commission.

3.2 Characteristics of the Havelis

Shahjahanabad houses a number of grand and prestigious havelis of considerable architectural merit constructed along a set pattern. Built during the Colonial and late Mughal periods, the façades are intricately carved in buff and red sandstone. The front portion of the havelis are decorated with floral patterns, sculptures and fluted designs. The interior of the havelis have a central courtyard around which the rooms are planned; and is effectively known as the central courtyard plan. A small stone stairway leading to the first floor is usually placed on one side of the court. The characterizing features are the majestic old wooden doors with iron or brass and copper fittings with fine detailed designs on them and arched niches.

The wall, the rooms, the arch-vault jack roofs and arcaded verandas showcase colonial features. Mesmerizing jharokhas (windows), chattris (umbrellas), small bedecked balconies, fluted columns, well-designed chabutras (platforms), traditional baithaks (drawing rooms) and marble floors are some of the striking features of the Mughal Architectural Style prominent in the havelis. These havelis are set on a high platform above street level. Intricate and detailed fluted designs depicting different themes adorn the interiors of these havelis. Stained-glass windows which are generally associated with churches, is another remarkable feature of these grand residences.

To better understand these heritage havelis and their importance in the history of the place, three different case studies have been studied and analysed. Each of these havelis is significant in terms of the legacy it holds and the crucial events it narrates.

3.2.1 *Chunnamal Ki Haveli*

Lala Chunnamal ki Haveli is a very exquisite and 'one of its kind' haveli, surviving in a well-maintained condition within Shahjahanabad. The Haveli is beautiful and magnificentand makes the perfect dream home. The walls narrate its own story,

the paintings recite its own verse, the floor marks its own civilization, the lightning emitsits own aura and the whole haveli has its own glamour. It is one of the few havelis that has made it through, and is perhaps the only one that continues to be inhabited by the descendants of the family. While the haveli now is just a shadow of its former glorious self, parts of this sprawling residence, which is spread over an acre, still maintains itslink with the past.

For history enthusiasts, culture vultures, conservationists and other interested people, this haveli is a paradise with the potential to be an iconic structure in the streets of Shahjahanabad. The three storied building that witnessed the majestic era of royal luxuries is crumbling down to its end.Now a shadow of its former glory, the haveli that once displayed the opulence of Lala Chunnamal is lost among the ravages of time and taken over by the commercialized world of today. If immediate actions are not taken, this one well-preserved haveli will also lose its appeal and be a part of the forgotten heritage.

Figure 6: Haveli in its Former Times
(Source: www.chunnamalhaveli.com)

Figure 7: Haveli Today—A Lost Beauty
Source: www.chunnamalhaveli.com

3.2.2 *Mirza Ghalib Ki Haveli*

Mirza Ghalib ki Haveli, as the name suggests,was the residence of the 19th Century Urdu poet Mirza Ghalib and is now a heritage sitelocated in the Gali Qasim Jaan, Ballimaran, Delhi. It reflects a very important period of the Indian history, that is, the decline of the Mughal era in India.The great poet spent a total of 9 years of his life here. This includes the last stage of his life during the years of 1865 to 1869. The haveli offers insight into the lives and times of a beautiful period which now can only be visualised and experienced through the folktales but cannot be witnessed and enjoyed.

The interiors of the structure are preserved well but the same cannot be said for the exteriors. The entrance is not as grand as it should have been and the only way to identify the structure is through the plaques that are outside. The electrical cables hanging from above ruin the aesthetic of the façade. The hoardings of the shops on its either sides, interfere with the access of the structure. The fabric of the entire street looks monotonous and the Haveli gets camouflaged due to it.

Mirza Ghalib ki Haveli is not just a living memory of the poet but a standing testimonial to a bygone era. The structure has had many influential poets and writers live amidst it and the entire place holds the reminiscence of these legends.

Figure 8: The Haveli of Mirza Ghalib
Source: www.tripoto.com

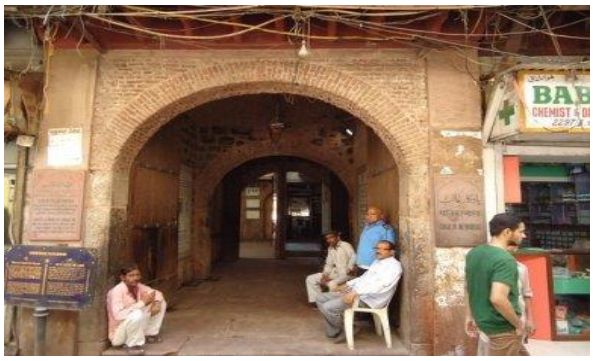

Figure 9: Arched Entrance to the Haveli
Source: www.blookenine.wordpress.com

3.2.3 *Zeenat Mahal Ki Haveli*

Few would believe that amidst the grimy and exasperating traffic of Lal Kuan Bazaar, in the Walled City of Shahjahanabad, there still exists the haveli of Begum Zeenat Mahal, Bahadur Shah Zafar's queen. The Haveli is situated in the core of Chandni Chowk and spreads over four acres of land. A glance at the haveli leaves one in epiphany. Very little history of this unprotected monument remains but still it retains its architectural charm at certain places. Today, this haveli lies in a state of total neglect and chaos survived only by an imposing gateway, a few arched corridors and the outer wall of the haveli.

Of the many mansions of Delhi, Zeenat Mahal today remains to be the ugliest for it has borne the brunt of ever-increasing commercial demands of the shopkeepers surrounding it. Right in the heart of the haveli, there is a factory grinding red chilli powder which is supplied all over India. Besides, the Lal Kuan gate has become an eve teasers' heaven. It is indeed very difficult to imagine that instead of rusted, web-infested gates, dusty floors and flimsy withered walls, there lay gilded entrances and windows and a palace fit for the royals once.

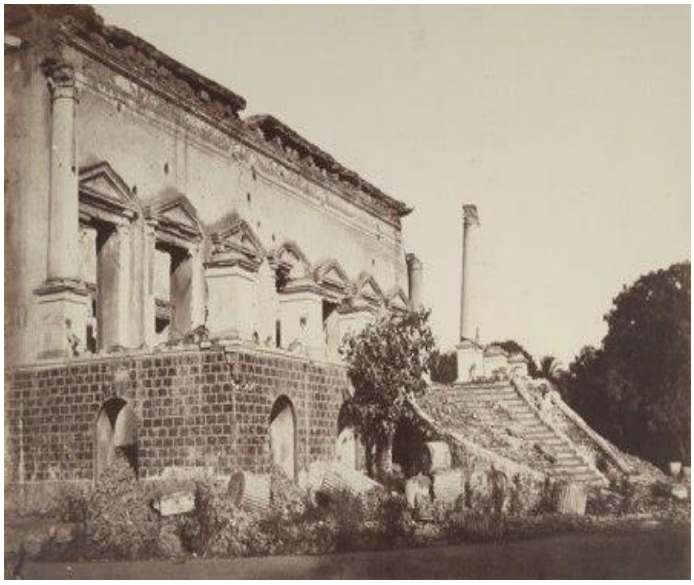

Figure 10: Old Zeenat Mahal Ki Haveli
Source: www.stsmeeraas.wordpress.com

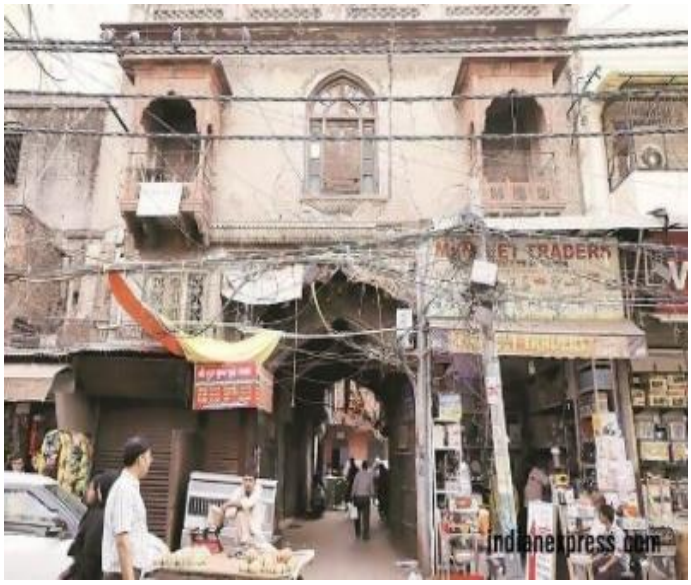

Figure 11: Encroachment and Vandalism
Source: www.indianexpress.com

4. ANALYSIS

The Havelis of Shahjahanabad are spectacular inside out. All the Havelis have many stories to tell, incidents to narrate and memories to portray. They are same in terms of their material usage, historical importance and significance and different in terms of their use, architectural style, features, their existing condition and many more. The following table provides a comparative study of the three case studies discussed earlier, on various parameters that make these structures remarkable and unique, whilst highlighting the need for conservation of these havelis.

Table 1: Comparative Analysis Chart of the 3 Case Studies

CASE STUDY / PARAMETERS	CHUNNAMAL KI HAVELI	MIRZA GHALIB KI HAVELI	ZEENAT MAHAL KI HAVELI
LOCATION	Katra Neel, Chandni Chowk, Shahjahanabad, Delhi	Gali Qasim Jaan, Ballimaran, Shahjahanabad, Delhi	Lal Kuan Bazaar, Chandni Chowk, Shahjahanabad, Delhi
BUILT IN	1848	1860	1846

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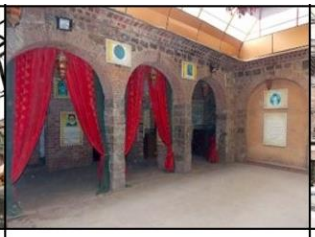
REFERENCE IMAGE			
ARCHITECTURAL STYLE	Early Colonial Era	Late Mughal Era	Late Mughal Era
HEIGHT OF THE HAVELI	G+2	Ground	G+1
HISTORICAL PERSONALITIES ASSOCIATED	Lala Chunnamal	Mirza Ghalib Hakim (who gifted the Haveli)	Zeenat Mahal Bahadur Shah Zafar Mistress of the King of Patiala
CONTEXT OF THE HAVELI	Situated on a busy street with a lot of traffic. It has many commercial shops around.	Situated in the streets of Gali Qasim Jaan, the structure has various retail shops on either sides.	Situated on a busy street of Chandni Chowk, the structure is surrounded by many shops like milk, spices, paan, etc.
CONSTRUCTION MATERIALS USED	Lakhori Bricks, lime mortar and timber.	Lakhori Bricks, lime mortar and timber.	Lakhori Bricks, lime mortar and timber.
COLOUR PALETTE	White with pop of brown from timber and green from posts	Hues of brown with a pop of colour from the red curtains on the inside.	Earthy tones with a pastel pink for the jharokhas adorning the facade
CURRENTLY USED AS	The ground floor is rented out to shop owners. The family resides in the front portion and the rest of the structure is abandoned.	Gallery / Museum housing the artefacts and poems of Mirza Ghalib. The structure is open to all.	It is an abandoned structure and the premise is used for a primary school which has become the dominating structure.
WHAT IS CONSERVED	The interior of the structure is well preserved. 	The interior of the structure is well preserved. 	Both the interiors and exteriors are not well preserved. 
WHAT NEEDS CONSERVATION	The exterior of the structure is not maintained well. Soot from the traffic, electrical cables, AC units, encroachment by the shop owners are the major areas of concern.	The exterior of the structure has been subdued due to the hoardings and the electrical cables. The walls of the entrance are vandalised by writing and scribbling	The exterior of the structure is in a very shabby condition. The windows on the façade are almost in ruins. Electrical cables, vandalism is a common threat. The interiors are also in a bad condition.
ORGANISATIONS INVOLVED IN CONSERVATION	INTACH ASI SPA	ASI	Proposals made to ASI and INTACH for conservation policies.

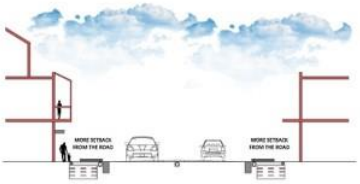
Source: Author.

5. RECOMMENDATIONS

There are many organisations and committees involved with the conservation process of Shahjahanabad and there has been a tremendous progress with various structures, but, there are many more which require added attention and care. The electrical cables hanging from the poles on the façades of the structure is matter of serious concern. Not only does it ruin the aesthetic of the façade, it also poses a major threat of fire in case of short-circuit, power failure or even lightning. Due to the vehicles passing from a very close distance to the structures, the soot emitted damages the façade of the structure and hampers its look. Exposed AC outdoor units, excessive hoardings, contrast in material of the elevation, etc. are a few issues that still need to be addressed.

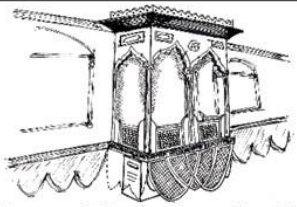
Following are some of the recommendations that could be implemented to enhance the quality of the space and make it even more vibrant and lively in terms of architecture and heritage.

Table 2: Recommendations at the Government Level

PROBLEM	SOLUTION
 Street with hanging cables	 Underground Electrical Cable Ducts
 Soot damages the façade	 Leave more setbacks from the road

Source: Author, www.so.city.com

Table 3: Recommendation at the Organisation Level

PROBLEM	SOLUTION
 Exposed AC Outdoor Units	 Conceal the units under the jharokhas
 G.I Shutters of the shops creating material variation	 Wooden folding sliding doors could be used

Source: Author, www.so.city.com

5.1 Hoardings Should be Limited

Due to the excessive number of commercial shops all around the havelis, there are many hoardings and boards put up by the shopkeepers and owners to advertise their products. This ruins the look of the façade as the hoardings have bright and flashy colours and are put up haphazardly without giving any thought to the aesthetic of the structure above. To avoid this, there should be a limit on the number of hoardings and care should be taken to arrange them in a systematic manner with the use of decent colours.

Figure 12: Problems Pertaining to the Random Misuse of Hoardings

Source: Author, Delhi Urban Art Commission

5.2 Shop Layouts Could be Made in Cohesion to the Architectural Style of the Overall Structure

Most of the shops housed under and around the structure are designed independently without taking into consideration the architectural style of the Haveli. The interiors of the commercial spaces below, if possible could be planned in a way to have elements similar to that of the havelis. This helps maintain the character and will also help promote their own businesses, as tourists love visiting places with traditional architecture and authenticity.

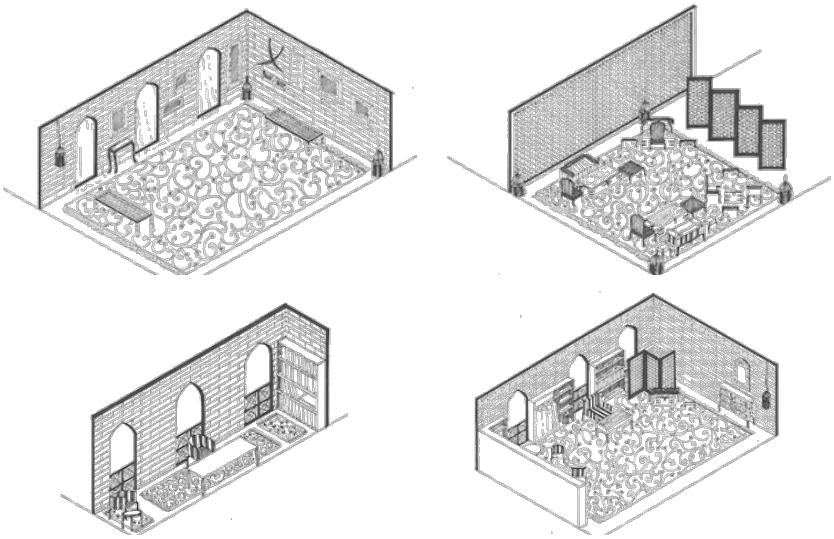


Figure 13: Different Layout Options Available for Various Commercial Places

Source: www.behance.net

5.3 Adaptive Reuse of the Havelis

In most of the cases, the owners were not able to maintain the havelis due to the lack of fund and interest. They were reluctant to invest money in a structure when they barely had enough to eat. Such owners should be made aware of the 'Adaptive Reuse' of their havelis. This will help them generate revenue not only for the structure but also for themselves. Tourists and visitors love to stay at the traditional and heritage residences. The owners will get a chance to interact with people and also earn money in the process. This will definitely ignite their interest in conservation.

5.4 Say No to Vandalism

Lastly, people should be made aware about the sensitivity of heritage and the important role it plays in our cultural life. They should be educated to refrain themselves from 'Vandalism' and should be encouraged to protect and nurture these heritage structures.

6. CONCLUSIONS

The Walled City of Shahjahanabad has a fabric laden with various architectural styles and character. Each building is different from the previous one, each space has an interesting story it wants to convey, every element has seen an era which it tries to depict and every visitor here has an experience which he never wants to forget. This is the magic of heritage structures. They get you so absorbed within them and teleport you to a time you wish existed today. By reviving and conserving these structures, we are not doing a favour to them but a favour to the mankind and the generations to come.

Heritage buildings and monuments, in a nutshell, are the representatives of the past history and culture of a nation. They together account for the architectural heritage of a precinct. But, with the fast changing times, these magnificent buildings are subjected to processes of degradation which leads to a situation in which they become incapable of fulfilling the purpose for which they were built. Therefore, heritage buildings need an important tool to protect them which is 'Conservation and Preservation'.

People are the most important factor when it comes to preserving any structure. Their meaningful intervention can keep the structure rejoiced for ages to come and their negligence can turn it into ruins forever. Thus, people need to reclaim their cultural identities and roots; hold accountability and responsibility for their heritage. This can change the cultural attitude towards the conservation and preservation of ones heritage and succour the cultural legacy of the place.

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The Sattriya Theatre: A Modern Perspective

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ABSTRACT: Performing arts have been an integral part in the history of the human culture. The relationship between the performance space and the audience seating area is important for the engagement of the audience in the performance. Theatre design plays a vital role in determining this engagement.

There are different types of stage layouts depending upon the type of the performance. In India, these were as per the guidelines given in the second chapter of the Natya Shastra. Modern theatre arrangements have evolved with different internal layouts according to the nature of the performance and position of the audience.

Sattriya, the temple dance of Assam, is the youngest of the eight recognized classical dances of India. Performed in the namghar, it is the centre of all ritualistic activities in a sattra (monastery). This research paper aims at understanding the spatial arrangements of the namghar in comparison with Natya Shastraic theatre and the modern theatres.

Keywords: *Performing Arts, Natya Shastra, Theatre Arrangements, Namghar, Sattriya, Dance Worship.*

1. INTRODUCTION

Performing arts have been a part of human culture for a long time in history. While the engagement between the performance and the audience depends on the nature of the performance, the relationship between the performance space and the seating arrangement of the audience are important for the communication and association of the audience with the performer. Theatre design plays a vital role in determining this. Throughout the history, different types of theatres have been used for various kinds of performances.

Theatre buildings evolved from the open-air amphitheatres as seen in the Greeks and Romans to the modern forms that we see today. In India, traditional performance spaces were planned as per the *Natya Shastra* written by Bharat Muni, in-between 5–2 BCE. The second chapter of the *Natya Shastra* called *Description of the Playhouse* gives a detailed study and description of different types of theatre arrangements. It mentions three sizes-small, medium and large, and three shapes used for theatres depending upon the position of the stage and the audience area- rectangular, square and triangular. Thus, the *Natya Shastra* lists down nine types of theatre arrangement [1, 2].

Theatre design is an essential part of the overall theatre performance. Throughout the history of theatre staging, there have been many different types of stage layouts and applications. The modern theatre's arrangements have evolved with different internal layouts according to the types of activity performed there. There are five types of modern theatre arrangements: found stages, proscenium stages, thrust stages, arena stages and flexible stages [3].

Traditionally, Indian performance spaces were often a part of the temple, temple complexes or the royal courts as dance and drama were often performed as a form of worship all over the country. In Assam, the namghar or temple, also known as the kirtan ghar is the centre of all ritualistic activities in a sattra (monastery) and serves as a practice space for Sattriya—the classical dance of Assam. All dance performances were traditionally offered to the deity as a daily ritual of worship within the boundaries of this namghar.

While most of the Indian theatre arrangements have been derived from the *Natya Shastra* and have been altered as per contemporary requirements, the namghar inside the Sattra complex is retained as a traditional performance and practice space for the Sattriya dance. This research paper aims at understanding the reflection of spatial arrangements of traditional and modern theatres arrangements in the performance spaces of the namghar. The objectives of the study are as follows:

1. Studying the traditional theatre arrangements as mentioned in the *Natya Shastra*.
2. Examining the modern theatre forms.
3. Analysis of the planning of the namghar.
4. To understand the movement patterns of the dancers in the performance area.

Scope and Limitations

The study concentrates upon the examination and comparison of the three categories of theatre layouts-traditional theatre of the *Natya Shastra,* modern theatres and the namghar. It focusses on the orientation of the theatre, the arrangement of the audience area with respect to the performance space and the relationship between the audience and the performer. The study does not go into the acoustical, lighting and any other technical details apart from those of the spatial analysis of the theatre.

2. LITERATURE REVIEW

The correlation between the performer and the audience is important for the success of the theatre performance. The research aims at understanding the relation between the performer and audience engendered through different arrangements.

The arrangement of traditional theatres have been studied not only in the *Natya Shastra* but also through the works of various experts like Bharata Pande, Kapila Vatsyayan and R.P. Kulkarni [4], Prachi Shah [1] and Manomohan Ghosh [2]. Commentaries on the *Natya Shastra* have been studied to derive diagrammatic layouts of the theatre arrangements. While Manomohan Ghosh has explained in detail the elements and arrangement of the theatre, Prachi Shah gives the diagrammatic representation of the *Natya Shastra* based theatre arrangement. A detailed description of different types of theatre or the *Natyamandapa* is given in the second chapter of the Natya Shastra written by Bharata Muni in-between 5 to 2 BCE. All the experts state the dimensions and layouts of the nine different types of theatres as well as the construction of walls, columns, roof and their decoration. It can be seen that this layout and arrangement depended upon the type of performance and the size of the audience and was designed to bring about an optimal viewing experience.

Modern theatres developed to ensure the engagement of audience with the performer depending upon the typology of the art, sport or any kind of performance activity that takes place within them. Currently, there are five primary types of modern theatres-found stage, proscenium stage, thrust stage, arena stage and flexible stage.

The Assamese namghar is a space for the ritualistic activities inside a sattra (monastery) complex. These rituals involve the performance of Sattriya, the classical dance of Assam. In *A Comparative Study of Kathak Dance and Sattriya Dance with Special Reference to Presentation,* Moni [5] explains how the sattras served as a practice space for the Sattriya dance. Within the sattra zone, there stands a namghar (a prayer-hall) where people assemble to pray. Inside the namghar, there is a manikut, or sanctum, where the deity is placed on a pedestal. Both Moni [5] and Goswami [6] explain the importance of the manikut, in front of which the dance and the other ritiuals take place.

The performance of the Sattriya dance within the namghar has been described in detail by several experts. During the offering of the rituals, the dancers called ‘bhakts’ progress down the central space to begin most of the performances. All performances take place within the boundaries of this namghar. The audience which comprises the sattra residents and the devotees from the surrounding villages sit on the ground or stand in the adjacent aisles. The bhakts make their way up and down the central nave while performing the dance ritual [6]. The detailed studies of the performance of the Sattriya dance within the namghar has helped this study in the analysis of the performer- audience relationship.

The relationship between body and space is widely explored in the field of dance not only for the dancer, but also for the audience. The performance space serves as a medium of interaction between the dancer and the audience. The relationship that the body and spaces share, denotes the level of involvement of the people in the performance. Creating spaces that makes one feel in connection with and providing functions one is comfortable with, crafts a space of engagement. Thus, the spaces need to be designed keeping in mind the performers, their movements through the theatre spaces and their interaction with the audience.

3. METHODOLOGY

Various methods were used to fulfil the objectives of the research. Primary and secondary studies were carried out in order to understand the spatial arrangements of several modern and traditional theatre forms. Primary case studies were conducted to understand the location of the performance space with that of the arrangement of audience seating during the dance performance in modern and traditional theatres, along with papers and books by various experts. The second chapter of the *Natya Shastra* and commentaries on these by various authors were studied in order to understand the planning of traditional performance spaces. The spatial arrangements inside a namghar have been studied by examining the sattras of Assam and the dancers’ movements within it to understand the relationship between the performer and the audience.

4. RESULTS AND DISCUSSION

A theatre, sometimes known as a playhouse, is a structure in which theatrical works or plays, as well as other acts, are performed. The performance and audience spaces are the two principal components of the theatre. The importance of theatre design is to provide the best possible environment for the audience to enjoy a performance and to assist the performer in achieving the maximum involvement of their art with the audience. The architecture of the theatre can assist the audience to be temporarily cut-off from the outside world and help them in imagining and entering an alternate reality where they are emotionally invested in the performance. The audience feels a strong bond with both the performers and one another. A theatre is more than just a place to see or listen to a performance. It is a location where artists and audience actively exchange attention and energy [2]. In order to enhance this relationship, theatre arrangements have evolved with different internal layouts according to the nature of the performance and position of the audience.

4.1 The Natya Shastraic Theatre

A detailed description of different types of theatres is given in the second chapter of the *Natya Shastra* by Bharata Muni. This includes the dimensions and layouts as well as information about the construction of walls, columns, roofs and decorations [2,2].

The theatre, as seen in Figure 1, is oriented in the east-west direction and is designed to accommodate the two main functions, the audience and the performance by dividing the space into two main parts of equal length. While the eastern division is used to seat the audience, the western part is further divided in two equal parts. One part of it is the *rangashirsh* or the green room passage and the other is the *rangapith* or the stage [2]. The wings on the stage are called the *mattavarani*. The stage is on an *adhisthana* or plinth.

The sizes and dimensions are mentioned in *hastas* where 1 *hasta* (hand) is equal to 0.45 m. The seating arrangement for the audience is step-like seating arrangement at a distance of eight *hastas* or 3.6 m from the eastern edge of the *rangapith* [4].

Theatres are mentioned to be of three types depending on their shape: rectangular, square and triangular. As seen in Table 1, each shape is further subdivided into three according to their dimensions—as large, medium and small. The large theatre is 108 *hastas* long, medium is 64 *hastas* and the small theatre is 32 *hastas* long. There are thus nine types of theatres formed.

Four doors should be provided to the rectangular theatre and three doors, each, to the square-shaped and triangular theatre. A door is provided for the entry of actors from outside to the green-room in all the theatre. Another door is provided in the eastern wall of the theatre for the people to enter the audience-hall. In case of the rectangular theatre, there are two doors in the partition wall separating the stage from the green-room. In case of the square and the triangular theatres, there should be only one door for the entry from the green-room to the stage [4].

Table 1: Sizes of Theatres as Mentioned in *Natya Shastra* [7]

***Sizes* (In hastas or cubits)**	***Jyeshth* (Large)**	***Madhyam* (Medium)**	***Kaniyas* (Small)**
Vikrsta **(Rectangle)**	108 × 64 (60 × 30 m)	64 × 32 (30 × 15 m)	32 × 16 (15 × 7.5 m)
Chaturasra **(Square)**	108 × 108 (60 × 60 m)	64 × 64 (30 × 30 m)	32 × 32 (15 × 15 m)
Tryasra **(Triangle)**	108 (60 m)	64 (30 m)	32 (15 m)

Note: 1 hasta (hand) = 1 cubit = 1 ½ feet = 0.45 m
(*Source:* Table 9.1: Variations of Bharat's theatre (Sharma, 2018, p. 294))

4.2 Modern Theatres

The relationship between the stage and the audience area is different in different types of theaters. The design of all these types is based on the relationship the space establishes between the stage and the house. Depending upon the type of performance, there are five major types of modern theatres as shown in Figure 2 [3]:

4.2.1 *Found Stage*

A found stage is one of the simplest stages available. These stages typically place audiences on risers facing the stage as seen in Figure 2(a). They do not require staging such as props, lighting or other theatrical elements.

4.2.2 *Proscenium Stage*

Proscenium stages are usually deep from front to back. The back of the stage may be raked so the stage slightly inclines as it moves away from the audience as seen in Figure 2(b). The front of the stage may also extend beyond the proscenium frame into the audience.

4.2.3 *Thrust Stage*

A thrust square is usually rectangular, but could be of varying shapes. It has audience seats on three sides of the stage as seen in Figure 2(c). The fourth side forms the back wall of the stage. The thrust stage helps to prioritize intimacy between those on stage and those in the audience. This stage is also great for other events outside of theatrical performances, including dance, worship services, motivational speaking engagements and events for children.

4.2.4 *Arena Stage*

An arena stage features audiences on all four sides as seen in Figure 2(d). These types of stages are used when no background is required and when the audience needs to engage with the performance from all sides. Although the arena theater can accommodate theatrical performances, this theater type is better suited for other types of events, such as concerts.

4.2.5 *Flexible Stage*

This adaptable theatre was created to meet a variety of requirements. As seen in Figure 2(e), flexible theatres, unlike other types of stages and theatres are not fixed. The flexible theatre enables the creative team to customize the stage and audience configuration to their liking. The stage and seating arrangements may be set up, adjusted, or removed in minutes. The flexible theatre may not involve a stage at all in some situations, instead placing the performers on the floor at the same level as the audience.

4.3 Namghar Arrangement (See Figure 3)

Architecturally, a namghar is a large open hall usually with a gabled roof having its main entrance from the western façade. The interior of a namghar has a simple nave in the middle and two aisles on the sides as seen in Figure 3. The aisles and the central nave are separated by a set of columns. The pillars are in odd numbers of a group of 5, 7 and 9 pillars or *khutas* usually, which divide the area loosely into three parts. Traditionally they were erected with wooden beams supporting an architrave over which the roof rested. However, at present, these pillars are made of concrete as well [4].

4.4 Movement of Performers with Respect to the Audience

The performers, in traditional as well as in modern times, plan their notations in accordance with the seating arrangements of the audience and/or the deity. This arrangement and movement pattern is important in order to ensure the engagement of the audience with the performer. The flow of the performers' movement commences from the green room, onto the stage, where the performance is usually directed towards the audience by facing it. At times, in order to create a planned impact, the performers may enter through or move among the audience.

As seen in Figure 1, in the traditional theatres, the dancers enter from the northern or southern ends, in case of the rectangular and square theatres and from the western end in case of the triangular theatre. The performers face the audience on the eastern side while performing and the audience faces the western end of the theatre. The movement seems formal and does not intrude much into the audience space.

As seen in Figure 2 the orientation of the performer and the audience is different for different types of modern theatres. Some types of theatre offer a formal setting by providing a stage area with backstage and wings on one side and the audience on the other. Few stage arrangements are informal in nature where the audience is seated on more than one side surrounding the stage area. This orientation and arrangement of the stage depends upon the type of performance and the level of audience involvement that is required for it.

While performing the Sattriya dance in the namghar, the performer creates circular shapes or arch shapes upon the floor as well as in space. Straight lines are rarely seen in this dance style [8]. Before the start of the ritual, the dancers get ready in their respective bahas or residences, and the make-up and mask painting activities are done in the outdoor corridor area. The dancers enter from the eastern door, the one closer to the manikut, and then take up their respective positions in the central nave as seen in Figure 3. The dancers use any of the doors to exit depending upon the dance notations for different performances. Inside the namghar, while performing the dance ritual, the guru performs in front of the manikut (place of the deity), and is the prime performer before the deity. He is followed by the senior dancers who perform behind him. The novice dancers perform in the last row. The viewers sit in the aisles on either side of the performers [4] (Goswami, 2015). At all times, the primary audience is taken to be the deity within the manikut, while the human audience at the sides is treated as secondary or incidental, and the dancers may or may not direct their movements towards the latter.

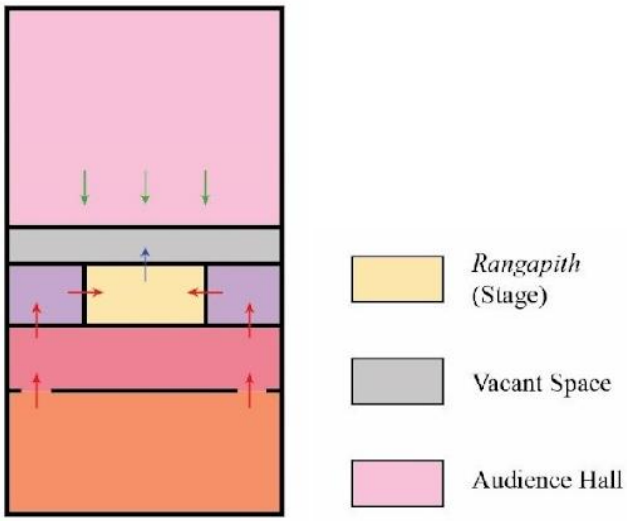
It is thus seen that different types of theatre arrangements require different orientations of the audience and the performer. This depends upon the type of performance that is taking place and the degree of interaction that is required between the performer and the audience.

5. CONCLUSION

From the above findings, it is seen that the arrangement of the stage with respect to the audience seating area is an important factor which determine the success of a theatrical performance. In traditional theatres, there are three different forms of the arrangements and three different sizes. This gives a total of nine types of theatres. According to R.P. Kulkarni [4], traditionally, the size of the theatre depended upon the type and number and the typology of audiences: the large size was meant for the gods, since they are the only ones who will be able to view and hear the performance from a long distance and also, because the performance would be on a very grand scale. The middle-sized theatres were designed for the kings and nobility where the size of the stage could be used to depict scenes of war or the royal palace, and the smaller sized theatres were meant for the common people or for smaller sized performances, which would not require an elaborate setting.

The modern theatre forms also focus on the similar concept of engaging the audience with the performer by introducing different forms of theatre arrangements depending upon the nature of the performance. These theatre forms allow different type and level of engagement of the audience with the performer.

Comparing both the traditional and modern theatre forms with the arrangement of the namghar, certain similarities and adaptations were observed. The east-west orientation of the namghar is similar to that of the *Natya Shastra* theatre. The manikut being the primary audience in the namghar is placed in the eastern end of the namghar and resembles the *Natya Shasta* theatre where the audience (gods, kings or people) are also placed on the eastern end. The arrangement of the secondary audience, the viewers, with respect to the performer in the center is similar to the arrangement seen in the modern found theatre arrangement.



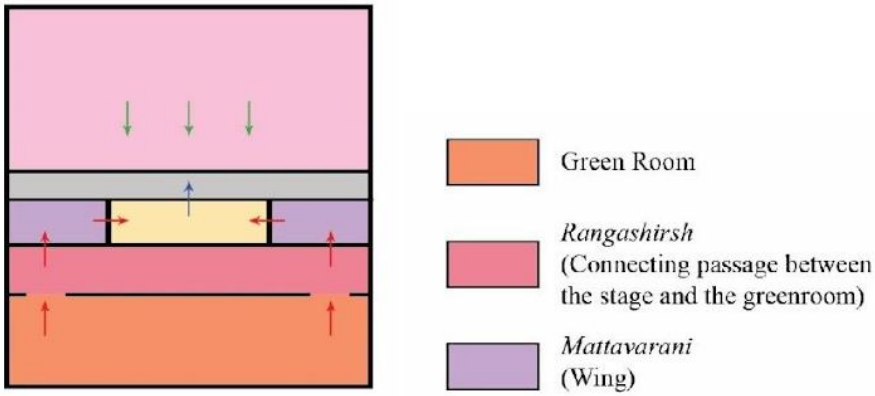
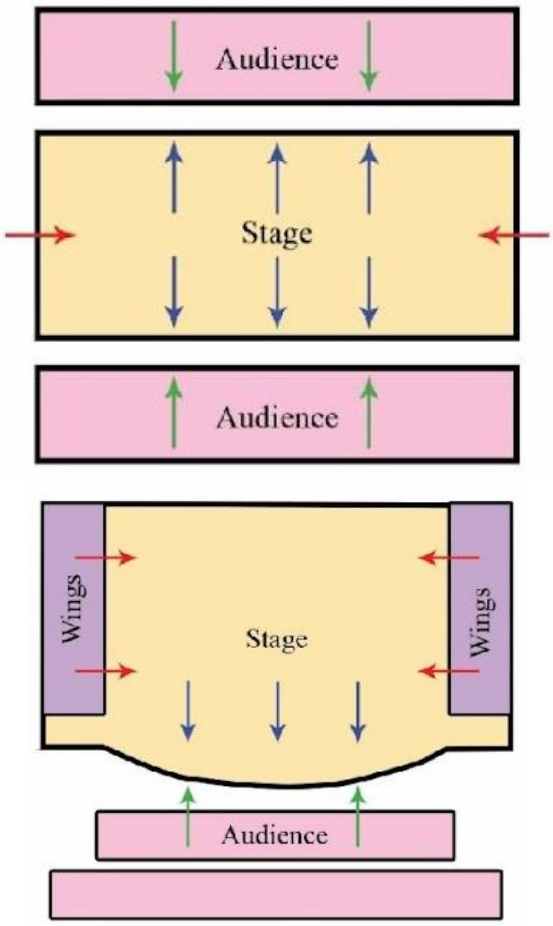


Figure 1: Types of Theatre Shapes as per Natya Shastra

Theatres have always played a vital role in all kinds of performing arts. They server as important spaces, both, for the performers and for the audience. When inside a theatre, the performance causes an experience of suspended reality for the viewer by cutting them off from the outside environment. A performer achieves this by emotionally involving the audience in the act, art or the performance. The success of any typology of theatre- traditional, modern or in case of the Assamese namghar, depends upon the degree and type of involvement that it arouses between the performer, the performance and the audience. Hence, the layout and planning of the theatre becomes a crucial factor in its architecture to ensure a strong connect between the audience and the performer and ultimately creating a rewarding performance.



(Adapted by Author from Kulkarni [5], 1994, p. 64).

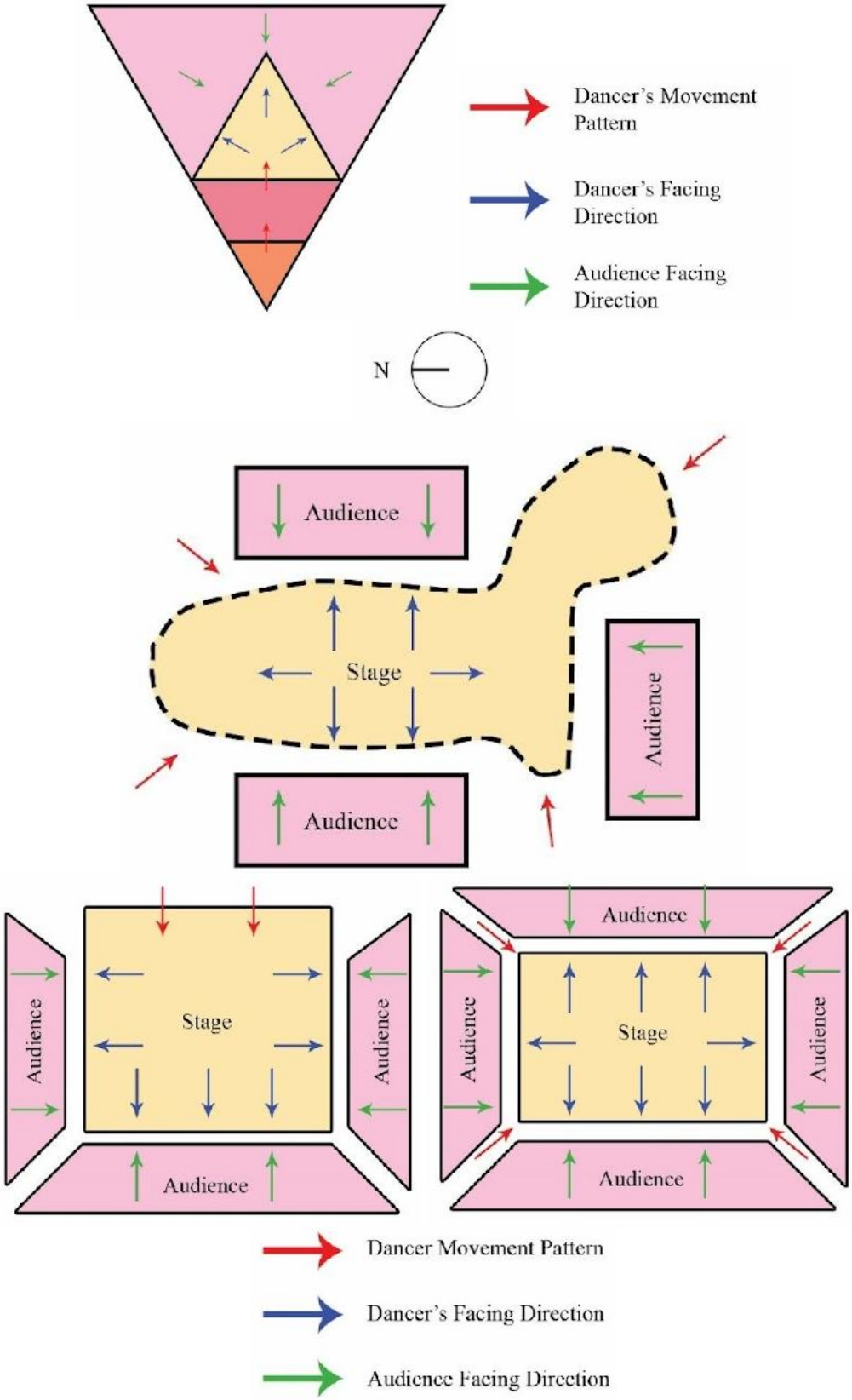


Figure 3: Plan of a Typical Namghar
(*Source:* Author)

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Reverence: Giving Dignity to Alzheimer's Patients

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ABSTRACT: In India, the impact of Alzheimer's is such that 1 out of 16 households having individuals above the age of 60, is estimated to have a person suffering from Alzheimer's disease. It is scientifically proven that well-designed spaces help in the wellbeing and faster recovery of the patients. Often, facilities in India are rented houses or flats in a building. But the existing infrastructure and interiors required for their safety and movement aren't sufficient, which aggravate the situation further. Hence, India needs more Alzheimer's Centres to cater to the emerging needs of the elderly, with emphasis on non-identical landmarks, different lighting conditions, landscaping and organizational strategies which will benefit the patients. The research paper highlights the voids in the existing facilities and seeks to create awareness about the disease, to sensitize society towards Alzheimer's patients, to provide safe and appropriate care for patients and offer counselling and support for caregivers.

Keywords: *Alzheimer's Friendly Centre, Well-Designed Spaces, Awareness.*

1. INTRODUCTION

Alzheimer's is the most cunning thief because she not only ends up taking from you, but she also takes the one thing you need to recall what was taken.

With the alarming rise in the city's elderly population, one sees the rise in the levels of Alzheimer's disease also, as age progresses. It engulfs the power to remember, thus making a person devoid of all the necessary stages in life. Even though there is a rise in the number of people diagnosed with this disease, the number of care giving facilities has not multiplied, leading to an increase in stress in the life of the family members. And India being the 3rd largest case holder, needs to aim at the wellbeing of its people.

So, is there any way out?

Yes, hence, India needs more Alzheimer's friendly centres to cater to the emerging needs of the elderly, and an architectural intervention can help in this regard.

AIM: This research focuses on the problems of memory loss associated with Alzheimer's and explores creating spaces for the same, thus making their life easier in terms of their day-to-day activities.

Architecture might not cure the disease but can try to improve the quality of life for the users.

1.1 Research Questions

1. How can we create a socially stimulating environment for elderly suffering from Alzheimer's disease?
2. How can different spaces play a part in enhancing cognitive skills of elderly with Alzheimer's disease?
3. How do factors like light, volume and ventilation affect the perception of a space for elderly citizens with Alzheimer's disease?
4. Is Institutionalization of a space important? Does this create a positive or negative impact on the Alzheimer's patients?
5. How are existing facilities in India catering to all the needs of Alzheimer's patients?

1.2 Objectives

1. Understanding different stages of Alzheimer's disease.
2. Studying about the various types of requirements of the patients (psychological, physiological).
3. Understanding the care giving community and their needs. 4. Understanding their issues with respect to the spaces built around them in terms of material, spatial organization, scale and proportion, colour schemes and try to alleviate those.

5. To spread awareness amongst the family members and the people around, about the disease and to set an example of respite facility, for the future generations that can cater to all their needs.
6. To build spaces that are user friendly to the specific group and create a relationship between the patients and their caregivers.

1.3 Scope

1. The research tries to understand the user group in India above 60 years and requirements of facilities that can delay the progression of their disease.
2. Materials available in India and can be used for specific user group while designing.
3. Research tries to understand how different age groups perceive the same space in different ways.
4. To study how different spaces affect human behaviour and their movement.
5. To study the healing process by incorporating nature with architecture.
6. To create awareness about the disease, amongst the masses at an early age.

1.4 Limitations

1. Research is limited to Alzheimer's patients only and not patients with other types of dementia.
2. In India there are a few prevalent facilities for the Alzheimer's patients, but not all of them have been designed keeping in mind the spatial configuration required for the specific user group, hence the research will depend upon the secondary source of data that is case studies from various other parts of the world.

2. LITERATURE REVIEW

2.1 Book Review

Table 1: Parameters for Literature

Parameters for Literature Review		*Type of Literature Review*
Space Making	1. Analysing Architecture 2. The image of the city	1. Book 2. Book
Biophilic Architecture	1. Healing spaces—the science of place and wellbeing	Recorded Video
Multisensory Stimulation	1. Neuroscience for Architecture: How Building Design Can Influence Behaviours and Performance	Research Article

Source: *Author.*

Space Making—Review 1 Book: Analysing Architecture

Author: Simon Unwin, Year of Publishing: 1997
(Unwin, 1997)

Architecture is a tool for controlling, coordinating, and changing our connection with the surrounding environment. It serves as a framework for every situation. A clear idea can be acquired from the book on how to analyse spaces through its planned elements and thus create an identity for each space designed. It helps to understand the union and scission between different spaces to form another. It helps to detect potential hazards and ensures that the design meets the quality criteria.

Space Making—Review 2 Book: The Image of the City

Author: Kevin Lynch, Year of Publishing: 1960
(Lynch, 1960)

Perception brings about the synergy between people and their surroundings. People who live in cities are able to identify and accept their surroundings through experiencing it. Perception is caused by the preservation of significant or appealing components, which results in a picture connected to the surrounding or the city. The book revolves around the predominant

word 'Imageability/Legibility' of space. Imageability is the property of any item or a space that makes it more likely to trigger a powerful image to any particular viewer. The author emphasizes the necessity of non-identical/unique locations throughout the book to minimize disorientation among people and to aid in way finding. Physical components of way finding might include landmarks, different light conditions, pathways, landscaping, and road markings. These aspects collaborate to define routes and highlight critical decision points, with the goal of improving and enhancing people's experiences as they travel from one location to another. Navigating through a space develops a person's independence and confidence, allowing them to continue doing so as it becomes an integral part of daily life.

Multisensory Stimulation—Review 3: **Research article: Neuroscience for architecture: How building design can influence behaviour and performance.**

Author: Andrea de Pavia, Year of Publishing: 2018
(Paiva)

"We shape our buildings; thereafter they shape us". It is frequently seen that people are impacted by things around them even when they are unaware of it. Every place, whether natural or man-made, will be perceived differently by the brain. Some aspects of the environment may be perceived as symbols of power and indicate a hierarchical status. When a person perceives an area as his own, his or her attention levels tend to be lower. Therefore, the time span to relax will be quicker, which influences the behaviour. Thus, the author highlights the idea on the relation between neurosciences and architecture, and how it can be reflected in the form of built spaces through architecture and can be enhanced by creating a passive positive impact on the users.

Biophilic Architecture—Review 4: Recorded Video: Healing Spaces—The science of place and wellbeing

Author: Ar. Esther Sternberg, Year of Publishing: 2013
(Sternberg, 2013)

Healing is frequently associated with nature, as in the case of healing gardens and hot springs, but healing may also be done in structures, which is what therapeutic architecture entails. All therapeutic settings strive to involve patients in the process of self-healing and recovery. Each space has its own aura that can be felt and this aura can be created while the careful designing process of architecture. Thus, space can help a person heal faster.

Thus, the author emphasises the contribution of different spaces in the wellbeing of their residents and, how we as architects can contribute to the wellbeing of our future generation.

2.2 Case Studies

The analysed live and online case studies are of three distinct typologies:

- International Case studies were done to understand the planning aspect.
- Local Case studies were done to understand the current situation of centres present in India.
- To study the universal design features, case study of Hazelwood School was incorporated.

2.3 Case Study 1: Online International Case Study: Hogeweyk Dementia Village

Architect: Frank van Dillen and Michael Bol

2.3.1 *Overview*

Hogeweyk is located in the Netherlands town of Weesp. It is a Low-rise building that cover 130 × 95 meters of land. (De Hogeweyk, n.d.)

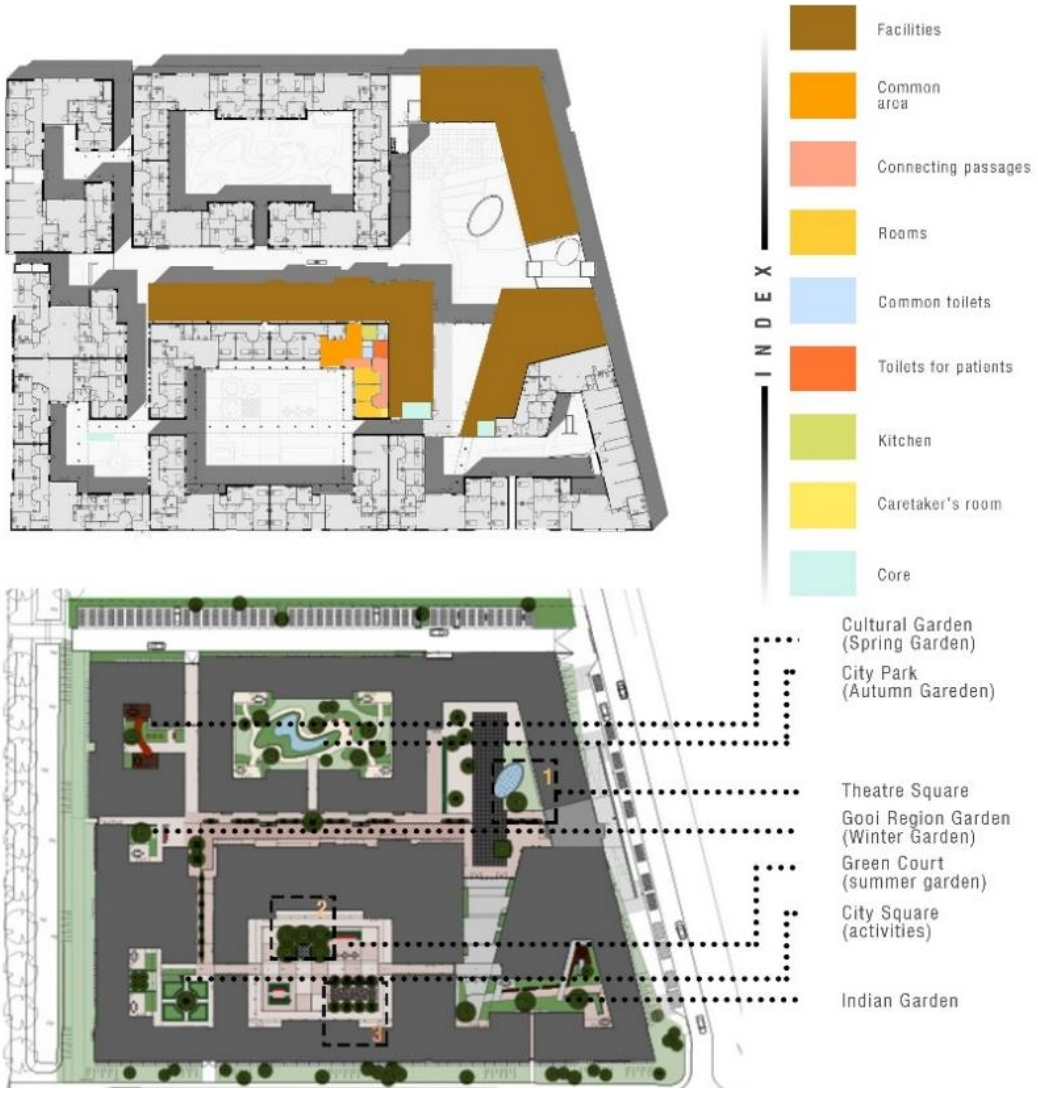


Figure 1: Plan of Hogeweyk Dementia Village

Source: Author.

2.3.2 *Analysis*

The built structures are organized in such a manner that they form a boundary between the external and the internal world, thus putting an end to the provision of isolating facilities like fences or boundary walls. All the streets are looped (interconnected) to reach different facilities, thus abandoning the confused and lost state of mind. Spaces flow into each other and are well connected with no dead ends. Hyperreality is maintained within the village to avoid the feeling of being watched over. Only one entry and exit gate respectively, thus reducing the chances of unintended escaping/being lost. Solid to void ratio of 1:1 is maintained in harmony to each other with provision of courtyards and gardens. The intermediate open spaces act as spaces for social interaction and takes care of the wanderings observed in AD Patients, as it forms a continuous looped pathway.

2.4 Case Study 2: Live Case Study: Tapas Dementia care centre, Pune

2.4.1 *Overview*

It is a private institute of 4 storey near Mumbai-Pune Highway on Balewadi road. There are 90 patients in total with staff members consisting of full-time attendants, doctors, nurses, physiotherapists and counsellors. It has a medical store and 2 hospitals near it in case of emergency.

2.4.2 Architect

Planning

There are 2 separate entries to the centre, front entry for visitors and back entrance with a ramp for patients. The stilt area has been used for various activities like waiting area, reception, visitor's areas, main office, dining area, common toilet, activity area and kitchen. Accommodation facility for single as well as double occupancy is provided. For safety purpose of patients, the flooring has anti-skid tiles and passages have railing to hold on to. The doors of the rooms for patients have different colours to avoid state of confusion and help in navigation. The staircase on each floor has a grill door for the protection of patients. There is provision of DG set and transformers towards the corner of the facility. There is enough open space for the movement of the patients.

Analysis

Highlights the importance of colours in way finding. Provision of open space around the centre promotes wandering but in a safe manner. Provision of ramp and lift to facilitate those with wheelchair helps in circulation. Linear planning to avoid confusion and aids immediate access to visual points of interest. Provision of activity area tends to keep the environment lively and stimulates their brain activities. Solid to void ratio is maintained in the structure through scooped out double height balconies.

Table 2: Inferences from Case

Name of the Facility	***Observations and Inference***
Alzheimer's Respite Centre Dublin	1. Stresses the importance of colour schemes 2. Maximise social interaction 3. Direct access to points of visual interest 4. Detailing that don't impact the patient's psychology 5. Spatial planning and arrangement: maximize orientation 6. Maximize wandering but in a secure way (LOOP)
Jagruti Rehabilitation Centre	1. No spatial planning: abandons the natural wandering activity 2. No therapies or other recreational activities that can help them heal. 3. No use of colour coding or signages seen in the spaces that can help them in way finding or distinguishing between 2 different areas 4. Also the kitchen is being used as a double occupancy room which can be dangerous for the patient's life.
Dignity Foundation (Mumbai)	1. Various activities performed -help build back their confidence and increase their cognitive and mobility skills. 2. The infrastructure lacks proper ventilation. 3. There is no green space surrounding the facility which creates a soothing effect and in turn helps to heal. 4. There is no provision of beds in the centre to take rest or have a power nap
Golden Care-Old Age Care Centre (Mumbai)	1. No use of colour coding or signages that can help in way finding or distinguishing between 2 different areas 2. The flooring used should be antiskid to avoid chances of skidding/falling. 3. A ramp and lift helped in movement of patients 4. Planning is done such that there are many openings in the facility for natural ventilation to take place
Hazelwood School	1. Maximise natural lighting, incorporated visual, sound & Tactile clues 2. Navigation had a trail system which helped students to move more independently in the school. 3. Transition between the 'street' and classrooms areas was designed to inform children of their location as well as school events.

Source: Author.

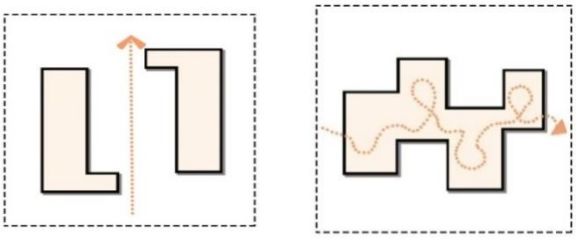
3. METHODOLOGY

The study developed out of an attempt to extensively study Alzheimer's Disease, Statistics connected to the disease, Issues and cures, and Alzheimer's care facilities found in countries as well as their built settings. Collection of all the theoretical data required for the study by interviewing the experts in the field and activity mapping of the user group was looked at as a part of Primary Data. Secondary data involved collection of data through literature study and case study and various online resources. Observations and inferences were drawn to derive design principles.

4. RESULTS AND DISCUSSION

4.1 Derived Design Principles

Line of Vision: While designing spaces, in order to avoid confusion a straight line of vision should be maintained.

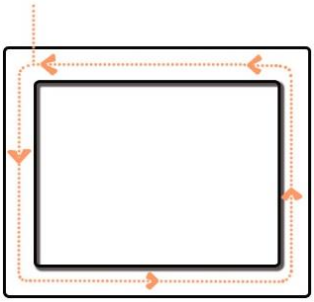


(a) Direct Line of Vision (b) Disrupted Line of Vision

Figure 2: Requirements of Line

Source: Author.

Figure 2(a) shows disrupted line of vision due to scooped out spaces that divert one's attention. Figure 2(b) direct line of vision has been maintained in order to reach a certain destination or spot.



A Looped System of Circulation: Since people suffering from Alzheimer's have been observed with persistent wandering habits, the looped kind of circulation keeps a check on this. This type of circulation brings them back to the original start point, thus avoiding a feeling of being off-track.

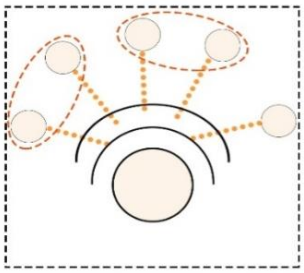


Figure 3: Looped Pathway for Circulation

Source: Author.

Cluster Formation: Small cluster of spaces when blend in together form an efficient model of space which can be then arranged in series around a specific gathering space as a point of social interaction. Each small cluster then opens up to this large gathering space, thus showing a transition of closed to semi-open to open spaces. Also, this creates a hierarchy of spaces in terms of volume. These small clusters avoid noisy and crowded behaviour of spaces, thus avoiding agitation amongst patients.

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Figure 4: Cluster Formation

Source: Author.

Sensory Spaces: Spaces should be designed in such a manner that all senses are being utilized equally, and not have the predominance of one sense (vision) over other. This helps to identify the design as a Universal Design which focuses on social sustainability.

4.2 Transition and Accessibility

Figure 5: Sociopetal Kind of Arrangement of Spaces

Source: Author.

Spaces of visual interest should have direct access to avoid disorientation in way finding. And while accessing those pts. of interest the flow from one space to another should be maintained, to avoid confusion.

4.2.1 *Sociopetal Kind of Arrangement/Arrangement or Pattern of Spaces*

The inference from case studies is such, that, it is found that spaces when arranged with small pockets of open spaces in-between, help in faster recovery of patients. The orientation of spaces provided a clear line of vision, had interspersed open spaces, looped pathways for movement and inward-looking arrangement of accommodation for patients. The major forms of clusters identified through case studies were 'L' and 'H' shaped. The 3 Typologies demonstrate the same.

4.3 Effects of Space on Brain

Our surroundings constantly influence us in our daily lives. Today's architects seek to design spaces that are more than four walls and a ceiling. Because it is our tendency to expand our sensory experience, it is one of the architect's tasks to always seek new methods to excite the built environment, both on the outside and on the inside. Architecture, when used appropriately, may prove beneficial in the treatment of people. It elicits emotions that a person may not be able to express. Architecture stimulates emotions such as rage, tranquillity, happiness, and so on. Certain architectural features can be modified to affect behavioural patterns, which are as follows:

- **Orientation and planning:** Small Landmarks or roundabouts or sculptures can add to the identity of a junction when placed aptly. Also, smooth transition between spaces while moving from one place to another is essential. In case of Alzheimer's patients' disorientation while navigating to spaces is a common issue faced, so in order to avoid that the spaces should be designed in an inward-looking manner (socio petal arrangement) to cut-off distractions from the external environment and thus prevent them from being lost.
- **Colour coding:** Use of neutral palette is generally preferred by patients over strong contrasting colours as they invoke a calm feeling within the patient's subconscious mind and even relieves stress from the family members thoughts. For patients with Alzheimer's neutral yet contrasting colours should be utilized to distinguish between the furniture and elements of room. Colours also tend to change the spatial perceptions, like white colour makes a space look bigger.
- **Light and shadow:** Spaces that have harsh and absolutely no light should be avoided. In case of Alzheimer's patients, the corridors form an integral part of the design hence they should be well lit to avoid disorientation and aid mobility

from place to place. Researchers have also demonstrated that adequate lighting in well-ventilated areas increases human productivity. Lighting can also be used to illuminate spatial boundaries.

- **Material:** The flooring material used should be anti-skid to prevent them from unwanted fall. Also, the flooring should not have any dents or bumps to facilitate the easy movement of wheelchairs throughout the facility. Plain tiles without any fancy patterns should be used to avoid state of confusion or disorientation.

5. CONCLUSION

The research collectively led to a conclusion that, the no. of Alzheimer's patients in the upcoming years will be double than those existing and the need for well-designed facilities will thus reoccur. The research unveiled the possibilities of utilizing architecture as a major tool in improving the public health on a large scale.

ACKNOWLEDGEMENT

I would sincerely like to thank my Research Guide Ar. Kirti Desai as well as our Principal ma'am Prof. Alka Tawari for their great support and guidance in carrying out my research and writing this research paper.

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Reinventing the Image of the City Through Brownfield Landscapes

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ABSTRACT: Cities today are in flux, characterised by ports, industries, infrastructure, etc. as witnesses to economic and socio-cultural transformations. Ports highlight trade and evolution. Post industrialisation, technological shifts forced some most active ports to dereliction, forming brownfields along valuable waterfronts, within city cores. Worldwide, these are revitalised to economically uplift the place.

The eastern seafront of Mumbai, a precious land parcel is likewise degraded environmentally, socially and visually, post shifting of the port to the mainland. It stands at the threshold of redevelopment, a landmark event, which can impart a new identity to the city. The study is an attempt to review how this zone can be a potential socio-cultural, environmental, ecological and economic marker in city evolution. It can establish connect of the 'Past' with the 'future', people with the land, and project the 'Imageability of the City' and the 'Place' through the new gateway, the Mumbai Trans Harbour link.

Keywords: *Brownfields, Imageability, Revitalisation, Ecological, Cultural, Inclusive.*

1. INTRODUCTION

Settlements and cities evolving along the water's edge have led to trade and numerous related activities contributing to economic growth. Ports have been distinctive instruments of city development, nodes of global networks and also gateways for exchange of cultures. Ports have become dysfunctional due to shifts of industries, technological advancements, ceased activities, landuse transformations and thereby resulted in dereliction and brownfield stretches. Port areas are disconnected from the city for security reasons.

In Mumbai, a constantly evolving city, the flourishing port shifted from the eastern edge to the mainland at Nhava Sheva. Deeper waters helped accommodated transformed maritime vessels. The shift lead to landuse redundancy and change. The valuable land in island city has a potential to form a landmark development event in city growth. It can help mitigate social disparities and open space deficit.

The presence of a redevelopment proposal for the eastern waterfront, the Mumbai Port Trust land, gives an opportunity to assess the zone as a platform for inclusive spaces, and aspire for a new social identity.

The study shall also focus on how the blighted brownfields can generate a new 'image', and also uplift economic essence of the place. It shall emphasise a cultural reconnect of the past, present and future. The role of infrastructural connection opening up the region to city is recognized. Analysis of visual, ecological, environmental, social, cultural aspects towards the objective of 'Identity' generation is carried out. The study focuses on cultural markers, entry point of the Mumbai trans-harbour link bridge, surrounding brownfields, water's edge, the hillock, the fort, mangroves and mudflats, each diverse and unique.

The study is mainly based on secondary surveys, as the region is in transformative state, and the pandemic led to non-feasibility of primary survey.

2. LITERATURE REVIEW

Ports are studied due to their significance as centres of city articulation, importance to modern world economy, gateway points to city, and influx points of cultures. They are markers of political scenarios, and hubs of global commerce. They have a strong infrastructural connectivity, and are interdependent with the city. They are also places of congestion and nodes of global network of people. Socially, they are centres of employment with large scale job opportunities. They

generate growth of residential, institutional, recreational and such allied infrastructure around. They were start or milieu points of cultures, and at times, also detrimental to indigenous occupations like fishing (Hoyle, 1997-98). Socio-culturally, ports have been witness to the productive life of industries and cities, playfields for toils of workers and signify history stopped in time.

The phenomenon of dereliction of ports takes place due to shifts of trade and port activities, based on advanced technology, deeper vessels and required bay depth, connectivity, decentralisation, management practices like privatisation, and their negative impacts. Shift of industries, port allied activities, inabilities to expand lead to disuse and desolation. Brownfields often, thus happen in pivotal locations of city, are well serviced and also have imprints of traditional communities sustaining therein. They lack security, being cut off from prime areas and need to be integrated in the city fabric. These high potential lands are thus subjected to depreciated land values. They lack spatial definition due to degraded built form. Brownfields are subjected to detrimental environmental impacts. Maritime activities cause water pollution. Land degradation by pollutants seepage, toxins, dredging etc, and air pollution due to construction activities, thermal and radioactive power plants etc., arouse a need for mitigation.

The zones are however rich in their socio-cultural past, that lends 'Meaning' to the place. Associations that are emotional, genealogical, cosmological and economic are the intangible aspects that can create a sense of rootedness to the place (Low, 1992).

Brownfields in core city zones like ports thus need to be intervened upon to reconnect the city to its land and water, also by way of exploring the fundamentals of Imageability and attributing a new identity.

2.1 Imageability of the City

The identity of a place is determined not just from visual aspects, but also socio-cultural associations that create memories and thus engage users, impart meaning and define uniqueness to the city at large. The study encompasses functional, visual, ecological, environmental, socio-cultural, historic and geographic aspects as lenses to analyse the city's imageability.

Functionally, economic aspects are an outcome of events like industrial revolution. It has led to migrations, disparities, densifications, dispersion of central business districts, reclamations, urban sprawls, each that imparts to the city imagery and identity. Utilities and activities within a space, based on cultural traditions, also dictate landuses and scale of public spaces, which may include tourism influences viz. Local art or cuisine districts, eg: Art districts like Raghurajpur for Pattachitra folk art.

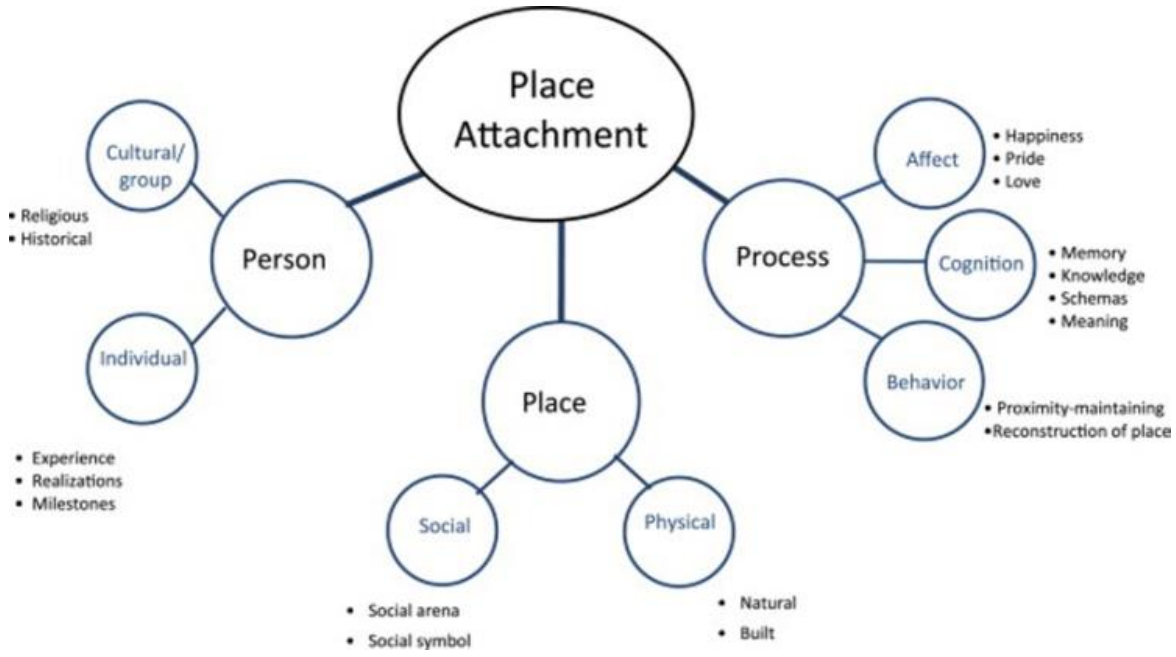

Figure 1: Tripartite Model of Place Attachment

(*Source:* Journal of Environmental psychology, Scannel and Gifford)

4 Visually, the space impact and its perception is crucial. The emotional bonding between people and places can be defined as place attachment (Low, 1992). Place attachment is a complex and multifaceted phenomenon, involving the interplay of affect and emotions, and also knowledge and beliefs, behaviours and actions in reference to a place (Kenny Chow, 2008). Space perceptions are also based on human experiences of safety and comfort. Attachments can have an ancestral, religious, cultural connect or may be due to loss or destruction of a place.

Visually, perceptions can be emphasized through volumetric and facade combinations, through picturesque approach, serial vision, concepts of enclosure and openness, variety and unity, public and private hierarchies, surprises, path lines, foci, axes, etc. (Cullen, 1961).

The cognitive aspects of the image of a city were studied through individualistic identity, structure (relationships and comparative) and meanings (emotional aspects), by way of mapping of urban space through Lynch's five elements of legibility – paths, edges, districts, nodes, and landmarks. Aspects like visibility, coherence and clarity to navigate city, were observed (Lynch, 1960).

The concept of 'phenomenology of a place' was understood with respect to human experience- situations, events, meanings, experiences of the underlying spaces. The sense of place was analysed in the globalized scenario against generic character of buildings (David Seamon, 2008).

Symbolism and meaning to objects, architecture and spaces to reflect historic, cultural influences, and impart identity to city scape was understood through examples like the Highline park or Bilbao waterfront.

A city and place identity is also strengthened by the ecological assets—the natural heritage and city's stance to recognize their value, prioritize conservation, revitalisation and protect them through management strategies including community participative approaches to induce stewardship.

Socio-cultural aspects are explored through emotional and cognitive bonds, and a sense of community. Personal connect, political backdrops, ethnic relativity, and social aspects too, lend identity to a place. Collective memories intensify attachments and lead to fixations. Memories are also imbibed in historic and archaeological remnants, built form, precincts which are 'constants' in transforming urban environments. Eg: The Victoria Terminus, Mumbai, reminiscent of colonial architecture of the Fort precinct. They become repositories of culture. Architecture that is a synthesis of lifestyles and climatic aspects, assigns a periodical identity to a place, forming physical markers of an era. It is a region specific physical symbol. Geography, natural factors, physical environment, topography, hydrology, natural features—vegetation and humans, help distinguish landscapes thus reinforcing their uniqueness to a place. Eg: Terrace garden Nishat Bagh.

Hence, understanding relationships between land and people, intangibles and physical perceptions, help ensure that people are a part of larger fabric of a public realm. The study helped evolve an understanding of a sense of rootedness and a reason to generate a sense of belonging and stewardship for future evolution of potential brownfields.

Case Studies: Port Adelaide, Australia is an example of post industrial waterfront revitalisation. An earlier thriving port faced dereliction and environmental degradation led to communities being disrupted of their livelihoods. It was transformed through mixed land uses, commercially viable spaces, and adaptively reused public spaces. The reformation included art fests, social events, indigenous food kiosks that attracted participants like locals and tourists, thus evolving a cultural centre. Adaptive reuse of existing heritage structures ensured maintenance of historic markers. Traditional activities like fishing were reintroduced for recreation.

Canary Wharf, London is a large scale economic revitalisation of the London Docklands, which had undergone a state of blight. Mixed use development was strengthened by intricate infrastructural systems, accentuating accessibility and inducing a new lease of life and creating a most coveted address in the city.

Central Park, New York is an apt example of a public realm within a dense city fabric, designed to evolve a new imageability—that of a calming respite from the confines of the streetscape. It gave a sense of freedom and break from stressful urban life. Preservation of historic village Seneca, ancient landmark entrances, reinvention of pastoral landscapes and picturesque woodlands with formal spaces, provided diversity. The rare character and scale of the park, helped create an imagery for the city.

The Exchange Square, Manchester is a reinterpretation of the historic cathedral district, into a public space that focuses on memory and emotional connect to the place. Existing heritage markers like tracks, facades, and buried waterbody are abstracted by landscape design to make sociably relevant spaces. Historic memories add meaning and allow users to adapt easily.

The studies, thus focus on aspects of waterfronts and brownfields like enhancing port tourism, open space planning, strengthening of transport linkages, enhancing commercial potential, connecting people to heritage—thereby evolving a contextual understanding of spaces that are successful public precincts.

2.2 Mumbai's Eastern Waterfront

The study has been carried out by analysing Mumbai's Eastern waterfront as a case example. The Mumbai port has been subjected to large scale evolutionary developments. The archipelago of seven islands was apt for trade due to protected waters and strategic location. Portuguese and British influxes and conflicts led to strengthening of the port and that of defence activities by building of forts. In 1686, the East India Company's shift of capital from Surat to Bombay made it a prime administrative area. It developed Mumbai into an industrial hub for cotton textiles between 1850 -1900. It was a gateway for trade with enhanced infrastructure that supported the colonial industrial city. Trade accentuated development of railways which are functional as well as historic markers today. Industrial boom strengthened the ports and also led to ancillary landuses by way of service oriented districts and residential provisions. Intensified industrialisation accentuated migrations. There was densification and urban sprawl. However, Industrial relocation policy passed in 1980, led to shifting of industries to periphery of city. Shut down of cotton mills, market changes and technological advancements in maritime industry like containerisation and larger depth vessels, led to shifting of the port to Nhava Sheva along the hinterland. This rendered the eastern waterfront derelict, with redundant port activities, illegal settlements, litigation issues and reduced social habitation.

This crucial connect with past history, for the city and its people, is a void, awaiting potential exploration.

3. METHODOLOGY

The region of study is a part of Mumbai's eastern seafront, which encompasses the Mumbai Port Trust region. It is a complex juxtaposition of natural features, productive spaces, network connections, people and communities.

3.1 Study area Description

Topographically, the Sewri hill is a part of ancient 22 hills over the seven islands. However, the port lands are a distinctly flat terrain, with rigid built edge along the waterbody, comprising wharves and jetties. Geology of the region is mainly rocky outcrops of inter-trappean basalt. The seaward mudflats cover 10 km stretch, with 3 km width, covered with domination of mangroves. These regions with clayey and silt soils, are also seasonal habitats of flamingos and other migrant avifauna. The 32 kms of water's edge is characterised with jetties, wharves, docks, natural edges and informal reclamations. Earlier industrial and service landuses have proximity of residential districts of Sewri, Cotton Green, Dadar, Mazgaon, Parel and Lalbaug. The eastern freeway is a strong connect to Mahul, Chembur, and Trombay. 46.67% of land is leased to Government bodies, semi-government and private parties, of which 70% is blocked on long lease. These dead locked lands are instrumental for the decay of property values (Institute (UDRI), 2001).

The land is interspersed with structurally unstable built forms, informal settlements and incompatible uses. It is well connected to all parts of the city through roads and railway, and waterways and monorail to an extent.

Heritage and cultural markers in the area are a distinct 17th century British fort, The Ballard estate—a commercial district, the Ballard pier—earlier water transport terminal, Cotton exchange building, Ghadyal Godi—a 100 year old clock tower, Dock wharves, Gateway of India, Sassoon dock, Ferry wharf jetties, Port railway lines, Sandhurst road railway station, Maritime studies institute, the mangroves and flamingo watch points and the hillock of Sewri.

3.2 Stakeholders and Users

Primary existing stakeholders are the industry and port related workers, porters, service oriented personnel, transport workers, administrative and commercial office staff, trainees, residents, tourists and environmental enthusiasts, commuters who transit through and immigrants to docks. Potential users, based on redevelopment schemes are administrative staff and tourists, as well as city residents at large.

The study area is chosen at the entry point of the Mumbai trans-Harbour link bridge, near the Sewri Fort precinct. It is an existing brownfield, currently used as a casting yard for the under construction bridge, and planned as a government offices

zone in proposed development, thus is a potential space for projecting the image of the city, at entry from mainland. The area is considered central to influx of population.

Table 1: Need for Open Spaces

Planning Sector E 1.04 + FS1.04 + FN1.05			
User type	***Population***	***Area***	***Density***
Existing:			
Residential	61271	587.46 Ha	104.29 ppH
Floating	172552	215.69 Ha	800 ppH
Projected:			
Residential	270000	587.46 Ha	460 ppH
Floating	490000	215.69 Ha	2271 ppH
Projected population influencing study area			
	Density	***Study area***	***Population***
Residential	460 ppH	200 Ha radius (10%)	10000
Floating	2271 ppH	82.16 Ha	187584
Total population influencing site (proj.)			197584
Open space in Mumbai: Less than 1.24 sqm/person			
Open space requirements as per standards:			
UDPFI	At 10 sqm/person		197.58 Ha
DDA	At 4.2 sqm/person		82.98 Ha

(*Source:* Draft Report on Planning Proposal, MbPT, adapted by Author)

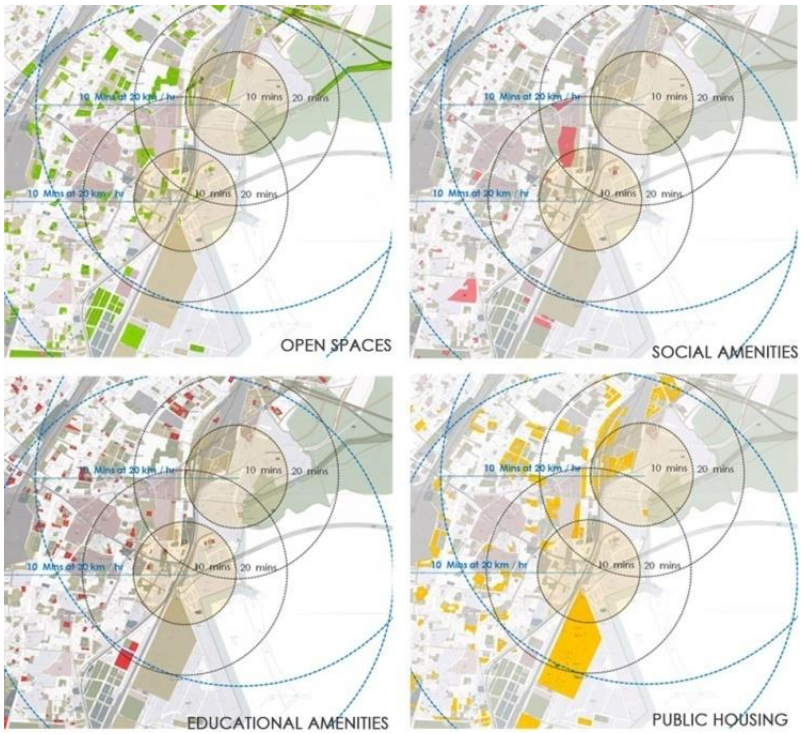

Figure 2: Maps of Site Surrounds Indicating Existing Amenities in Site Proximity

(*Source:* DP 2034, adapted by Author)

3.3 Analysis to Identify Needs of Study Area

Existing Landuse comprises port related and allied activities, and manufacturing industrial zone. It includes the presence of oil installations, silos, godowns, commercial shops and large tracts of vacant and unused sheds and lands. Natural areas and open spaces (13.88%) and vacant spaces (9.28%) form a large chunk of the seafront zone (Special Planning Authority, 2018). Numerous proposals have been evolved over time, including policy suggestions in the Rani Jadhav Committee Report, JICA report, Kirloskar report, UDRI report, and design schemes like Surbana and that by HCP consultants. The later focuses on open spaces, connections and green design concepts. Numerous guidelines like the Coastal Regulation Zone, the Development Control Regulations and the Maharashtra Ancient Monuments and Archeological Sites and Remains Act, 1960, regulate the redevelopment. However, it fails to address the provision of open space deficit for the surrounding city. It assumes site as a virgin land devoid of palimpsests, ignores heritage markers, disconnects to the existing port activities, sidelines existing fishing communities, advocates large scale reclamation ignoring the mangroves and has fewer linkages with island city. It also does not respect the setting and presence of the historic Sewri fort.

The site was analysed through primary surveys for inherent features like ecological, socio-economic, cultural, visual, and heritage aspects. These findings were overlaid, to recognize their relationships.

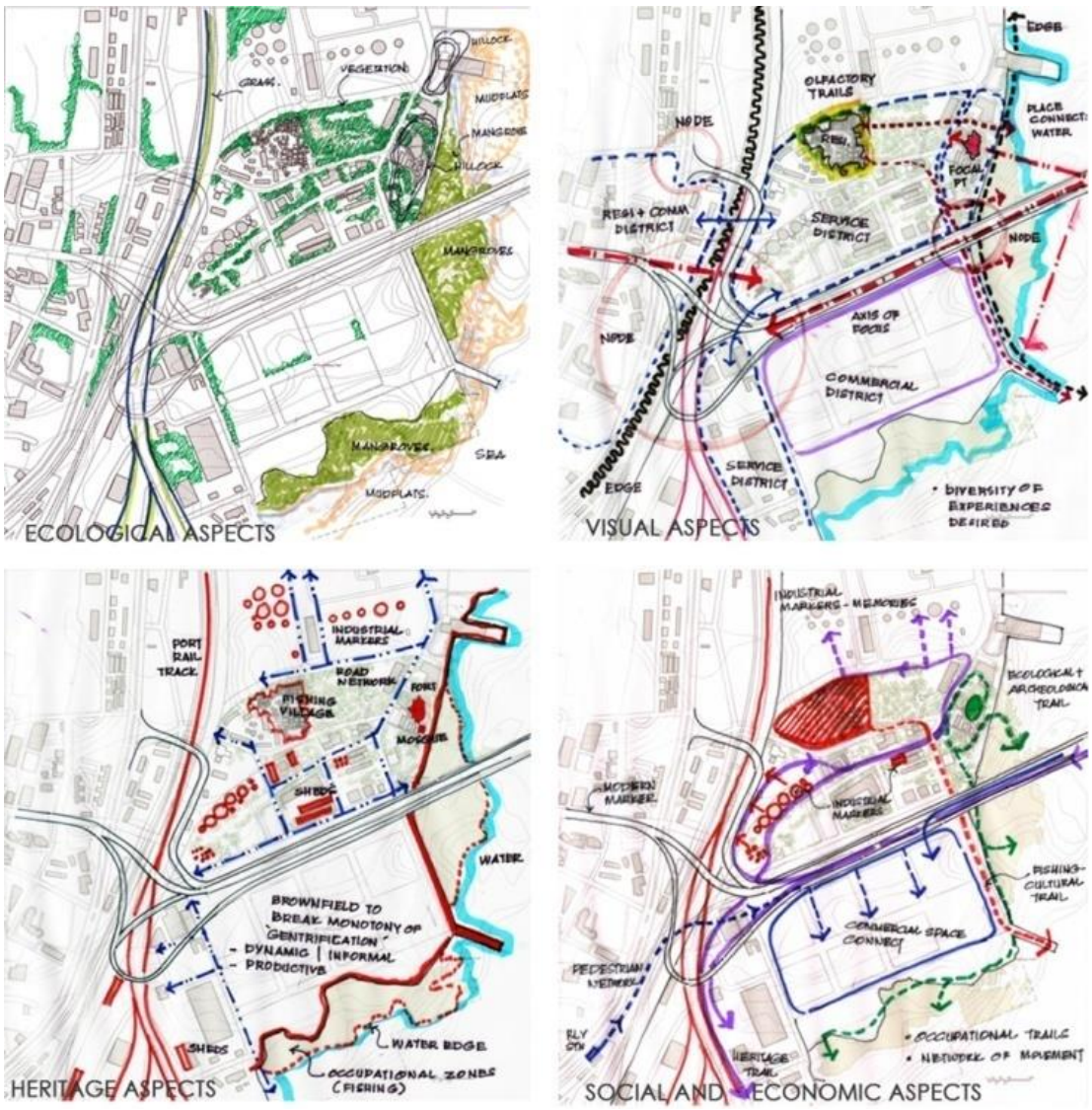

Figure 3: Schematic Study of Various Aspects in and Around Study Area
(*Source:* Author)

4. FINDINGS AND DISCUSSION

SWOT analysis was done on the basis of primary observations and survey of the area.

4.1 Strengths

Low density, large land parcels, redundant landuses, sea connect and strategic location for city, ancient hillock as a distinct feature, cultural and heritage markers, ecological markers like mudflats housing migrant birds, new viewpoint through the link bridge, backyard of city transforming to front yard, and existing strong infrastructure are prevalent.

4.2 Weakness

Brownfields lack land vitality. There is lack of easy connectivity, no mixed land uses, single ownership, tenancy and lease issues, informal uses settling in, pollution, fishing occupation loss, reduced safety and migrant population which is non-rooted to the land.

4.3 Opportunities

The region is promising to evolve a new face for the city, for socio-economic upgradation, for revitalisation of historic essence, large footfall is projected due to enhanced networks, sea connect can be reinstated, and adaptive reuse solutions can be adopted.

4.4 Threats

Extensive proposed built development, high end commercialisation, likely social disparities, cultural connect forgotten, land considered devoid of memories and palimpsests, gentrification, defence threats, safety threats, environmental and ecological threats.

The area needs to generate public open spaces to improve and enhance environmental conditions in the proposed development. These need to focus on the imagery for the city, distinct from that existing. The site context-heritage and intangible aspects need explorations through time and space.

5. CONCLUSION

The study has led to evolving schematic guidelines for Brownfield and Urban Waterfront Revival processes that are proposed to be adopted.

1. **Image of the city**: The identity of the place, and the city in flux, being the Gateway in the renewed sense by way of spatial design aspects needs to be highlighted.
2. **Cultural focus** with diverse uses—The city is the hub of culture in terms of historic evolution, institutions, socio-economic-political scenarios, architectural and occupational heritage, and diverse migrated cultures. Indigenous communities like fisher folk also need to be prioritised to generate inclusive and authentic experiences of the place.
3. **Connect to water**: to be re-established for the city at large to connect to the place, and for the place to contribute to the city.
4. **Connectivity** to be enhanced to reflect the historic trade routes, port and it shaping the city, cohesive work patterns etc. Creating physical and biological links like corridors, linkages with surrounding region, migrations of people and animals focussed upon, and improvement of urban mobility and accessibility.
5. **Accessibility** aiming at absorbing the port into city fabric, through permeability, thus increasing footfall to sustain the space.
6. **Social connections**: The space to be reinvented into a public realm, and an arena for expression and democracy. Also to generate a platform to mitigate disparities, enhancing diversity, integration, interactions, equity, sufficing open space needs, job generation, addressing health concerns, quality of life, safety and security.
7. **Natural resource conservation** for biodiversity conservation, uniqueness and as a buffer.
8. **Ecological revitalisation** for improved quality of life, land remediation and for micro-climate control.
9. **Economic revitalisation** for feasibility and mixed use developments—to enhance activities and vitality. To increase productivity, sustenance, and recognise land value potential.

10. **Environmental revitalisation:** To alleviate quality of life through reduced air, land, water pollution, sustaining biodiversity, enriching urban ecology, increasing greening of city environments etc. Evolving biophilic architectural schemes. Mitigation of the open space deficit for improved quality of life and mental health concerns.
11. **Sustainability**: Evolving solutions that reduce energy consumption, reuse of existing structure, reuse of land with prevalent infrastructure, reduce waste and improve food security.
12. **Intangible values**: Focus on restoration and integration with existing features, which can induce collective memory and also enable community engagement, thus ensuring stewardship. The fort, port railway line, industrial sheds, distinctive silos, hillock, jetties, industrial installations, etc. can be explored for aesthetic and meaningful experiences.

The thread of cultural relevance can help connect markers of the place to the people, thus evoking a relationship of the past, present and future. Brownfields can thus form a platform for aspects that are critical in weaving it together into the city fabric.

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Disaster Resilient Environment, Economy and Livelihood in the State of Odisha

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ABSTRACT: Tropical Cyclones result in massive human casualties, loss of infrastructure, and disrupting livelihood. The impact of these disasters can not be completely eliminated though they can be reduced by making strong response strategies. One of the strategies is to provide houses to the most vulnerable people. This will reduce cyclone impact on the lives during future events and will decrease the economic liability on the Government.

The research is based on the construction of houses for economically weaker sections having Kucha houses in coastal villages in the state of Odisha. As the frequency of cyclones is surging every year in the state, effective resource distribution and utilization framework, enabling a better process for completion of houses within a stipulated time are needed. In the initial stage of research, current and alternate resource provisions are examined and the paper is concluded by listing major aspects for resource distribution and utilization for the reconstruction process.

Keywords: *Odisha housing, Disaster, Resource, Resilience, Approach, Reconstruction.*

1. INTRODUCTION

The state of Odisha has been experiencing frequent onslaughts of tropical cyclones. The Government of Odisha has showcased robust preparedness and mitigation strategies at places such as rescue and relief measures to counteract the impact of the disaster. However, the mechanism of disaster resilience is incomplete without having an effective reconstruction process. Reconstruction of damaged houses is an integral part of the rehabilitation process which safeguards people from future calamities and it also reduces the number of resources required to be spent on the relief and readiness programs in case of future incidents, helping in building resilience in the economy of the state. The timeline of reconstruction work also plays a key role in the project's effectiveness, where the onset of the cyclonic storm is getting frequent year after year.

The owner-driven Approach has been followed for the reconstruction of houses for people in coastal villages, which is funded through Pradhan Mantri Awas Yojna-Gramin (PMAY-G). Lack of transparency in fund distribution and its unsystematic utilization led to delays in the construction work. The reconstruction project outcome depends on the effective distribution and utilization of resources such as money, manpower, material along with scheduling and monitoring of the work.

Therefore the research paper aims to list out major aspects for effective resources distribution and utilization process for the reconstruction of houses for cyclone-affected people in the state of Odisha.

The objective is to identify the gaps in the current practices of resource provisions in the state. The research paper also explores the other state government practices for the reconstruction of houses under the disaster response process.

The scope of the research paper is only focused on the disaster caused by the cyclonic storm in Odisha. The study area is limited to the villages in Jagatsinghpur, a highly affected coastal district of Odisha.

2. LITERATURE REVIEW

2.1 Risk Reduction

The village houses of Odisha are generally barbed fenced earthen walls, covered with thatched roof thus making the rural community most vulnerable to cyclone hits. The affected people and the government face major challenges to restore, rehabilitate and relocate the people in the rural area as they experience maximum risk. Therefore providing the most vulnerable mass, a permanent house, can reduce the impact of the disaster on the rural inhabitants and the state Government.

2.2 Current Provisions in Odisha

The housing need of rural India is addressed by funding through various policies. Pradhan Mantri Awas Yojna-Gramin aims at providing the pucca house with basic amenities, to all homeless households and those living in kutcha and dilapidated houses by 2022. The stage-wise financial assistance of 1.20 Lakhs is sanctioned to enlisted beneficiaries under the e-Governance model, using Awaas soft and Awaas App, right from identifying the beneficiaries till the last stage of fund disbursement. The villagers in coastal areas of Odisha affected by the cyclonic storm, are identified by government officials and can avail the financial assistance for building 25 Sqm of pukka house. The central government sanctions this fund on 60:40 sharing with State Government. An additional amount of Rs. 12,000/- is sanctioned for the construction of the toilet facility under Swachch Bharat Abhiyan which is disbursed jointly with the PMAY-G fund. Under this policy, an owner-driven approach is followed for constructing the house, where the owner has to devise the resources for construction work.

2.3 Other State Government Reconstruction Approaches after Natural Disasters

Gujarat

After the severe earthquake struck Gujarat in 2001, many initiatives were taken to normalize the life of affected people. Providing houses was the main focus. Different approaches and models were examined and found effective for the reconstruction process. The Gujarat state disaster management authority announced a rehabilitation policy proposing the relocation of most affected villages and assistance in less damaged areas for repairing and in situ reconstruction. There was stiff public resistance to the contractor-driven approach and relocation plan. So owner-driven approach was adopted where the government offered financial and technical assistance to all those who preferred to reconstruct on their own and did not want relocation and full-scale adoption by an external agency. The five approaches for housing reconstruction were as follows:

2.3.1 *Owners-Driven Approach (ODA)*

Under this approach, government provided financial compensation ranging from a minimum of Rs. 40,000 to a maximum of Rs. 90,000 in three installments. Technical assistance was provided by an engineer placed in each village for supervision of work and sanctioning the disbursements. The material and laborers are arranged by the beneficiary. The beneficiary was free to choose his house design and material as long as it adheres to the building codes of seismic safe construction recommended by the Government.

2.3.2 *Subsidiary Housing Approach (SHA)*

Under this approach, NGOs assisted citizens to get their entitlements and complemented the Government with materials and technical assistance. From NGOs, they got Rs. 25000 extra as material provisions on top of government compensations.

2.3.3 *Participatory Housing Approach (PHA)*

Under this approach, NGOs did an assessment of damages and identified villages for building 3000 houses. With the use of traditional construction materials, they adopted the incremental housing program for people who could not avail the government provisions. They trained and employed local laborers and the owners also participated in the construction process. The NGO offered a core house unit of 20 Sqm at Rs. 47000/- with additional sanitary facilities.

2.3.4 *Contractor-Driven Reconstruction in Situ (CODIS)*

This approach was pursued by large NGOs, where contractors were engaged for the full reconstruction of villages. Employing skilled and unskilled laborers from outside, RCC units were built costing Rs. 85000/-.Participation in finalizing the house design was encouraged to some extent.

2.3.5 *Contractor-Driven Reconstruction Ex-Nihilo (CODEN)*

This was the contractor-driven approach where RCC houses were built costing up to Rs. 124,000/-. This approach did not encourage any house-level participation. The relocation is done and the houses are allotted randomly to people. So this process was not accepted by the people and caused huge dissatisfaction

The table below shows the satisfaction level of people regarding the particular approach. The satisfaction level was measured on basis of parameters like location and size of the house, quality of materials, and construction quality.

Table 1

	ODA	SHA	PHA	CODIS	CODEN
Financial support per housing unit (in Rs)	40,000-90,000	40,000+ 25,000	47,000	85,000	124,000 (average)
Overall satisfaction with quality of housing	93.3	100	90.8	71.6	22.8
Satisfaction with…					
House location	99	95	96	95	64.5
House Size	90	95	85	89	51
Quality of materials	94	95	93	64	38.5
Construction quality	95	95	93	69	3.5
Average	94.50	95.00	91.75	79.25	39.37

Source: Household survey, December 2004-February 2005

Source: [4] Jennifer, D.B. (2008). From Gujarat to TamilNadu: Owner-driven vs. Contractor-driven reconstruction in India. https://www.irbnet.de/daten/iconda/CIB11511.pdf Ref: (iv).

The owner-driven approach was found to be most economic and effective. However, the highest level of satisfaction was achieved with the Subsidiary housing approach where the NGO participated in providing the materials, technical supervision, and the financial part was taken care of by the Government. The approach highlights the role of the monitoring agency to induce a sense of accountability within the participants, ensuring satisfactory completion of the project.

Reconstruction process in Maharashtra after the earthquake, and in Tamilnadu after Tsunami.

The reconstruction process requires various considerations of local and sociocultural concerns of affected people. Therefore the participation of end-users is always crucial. Contractor-driven approaches were not accepted by people which led to wastage of resources. The communities were severely strained by the relocation strategy in both the cases of Maharashtra and Tamilnadu.

Planning of reconstruction rose many problems at the community level. However, besides the Government, the NGO and other voluntary organizations played an effective role in coordinating the project. The building technologies adopted for the reconstruction work were not appealing to the occupants as the scope of expansion and future maintenance was difficult for them. The housing structures were lacking in retaining the vernacularism of village houses in planning and aesthetics. Therefore the contractor-built concrete boxes could not bring in the sense of inclusiveness to the occupants.

2.4 Resource Allocation

Resource planning and allocation have an important role in managing construction projects. As the construction process faces resource constraints like shortage of resources, delayed supply, competing demands, material procurement, etc. So the scheduling concepts have to be adopted to make the project time efficient. If the resources are not available, then it prolongs the project which affects the cost of the project.

Optimization and leveling of resources are very essential if they are supplied as per the stage-wise progress of the project. The restricted part of the fund is disbursed after the phase-wise completion of the project. So the fund should be utilized wisely in resources that are necessary to finish the particular phase of the project. The uneven resource assignment may lead to the resource wastage of excess procurement and scarcity of other resources for the phase, causing the delay which often results in termination of the project.

3. RESEARCH METHODOLOGY

In step 1, the research was directed towards examining the resource provisions of the State and Central government, for the reconstruction of houses for cyclone-affected people in the Jagatsinghpur district. A comprehensive study of Government policies was done to understand the resource distribution and utilization process and line out the resources provided to the

villagers. Along with the resources, the study identified the approaches adopted. Without an appropriate and acceptable approach, the process would not have been accepted by the mass, challenging the process's effectiveness. The semi-structured interview with the villagers in the group of 20 people, has been conducted in three districts i.e. Erasama, Jagatsinghpur, Balikuda to understand the resource distribution and utilization process for reconstruction work.

The semi-structured interview was done focusing on:

- The fund allocation process for the beneficiary.
- The phases of fund flow.
- Material Procurement process.
- Fund usage by the beneficiaries.
- Material usage.
- Labour availability.
- Monitoring process.
- The approach adapted in the process.

Their understanding of the process was analyzed. This step helped in identifying the gaps in the process.

In step 2, to understand the alternate approach and resource provisions, through literature review, the Gujarat state government initiatives for the reconstruction of houses for 2001 earthquake-affected people were analyzed. The paper cited the comparative analysis with 5 different types of approaches that were adopted in different regions of Gujarat. The most suitable and appropriate framework was adapted for listing out the major aspects for framing a resource distribution and utilization process for reconstruction work in cyclone-affected people in Jagatsinghpur, Odisha.

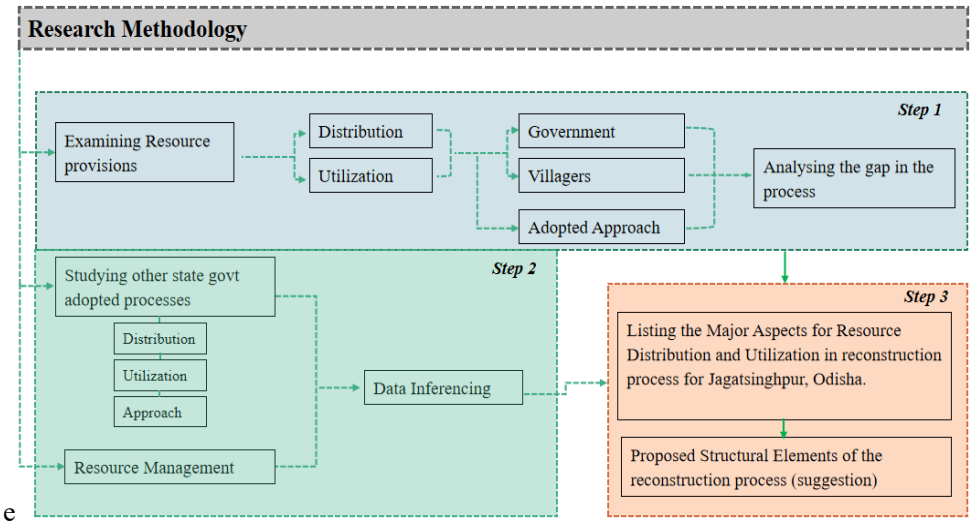

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Figure 1: Methodology

4. FINDINGS & DISCUSSIONS

4.1 Identifying Gaps

In Odisha, the resources for reconstruction work is entirely handled by the villager though the funding is supported by the Government. Though the fund for the reconstruction work is provisioned well, the phase-wise disbursement halts due to the mismanagement at the various juncture of the process.

The identification of beneficiaries is done based on certain criteria led by the government however they are tweaked from time to time, as needed by the participants in the process. Some villagers have managed to get multiple disbursements for the same stage of work. The process also lacks any technical assistance leading to the non-utilization of resources in a scheduled way for the particular phase causing delays. If at all the project drives through, the house lacks in quality.

There is no accountability for the lapses and delays as there is no monitoring agent involved in the process.

4.2 Various Aspects of the Reconstruction Process

4.2.1 *Approach*

The reconstruction paves the way to longstanding rehabilitation. The adopted approach should aim to fulfill the needs of the communities in question. So the holistic way is to have an approach that will give a sense of inclusiveness to the villagers. The self-built or Owner's driven approach will provide a possibility to choose the habitat they like to live in. The acceptance is assured at the end resulting in the full utilization of resources provided and utilized in the process.

4.2.2 *Participation*

Participation from an external agency like active NGOs is necessary to bring on transparency in the process from the initial stage. The mechanism of monitoring the work progress and overlooking the various reasons for delays due to funding release, materials supply, and labourer issues can be imparted by NGOs.

4.2.3 *Accountability*

Inducing certain obligations in the performance can bring transparency in the process. The activities in the resource distribution and utilization will have well-defined roles to be performed following specific timelines. The participants will be accountable for their non-performance in the process.

4.2.4 *Construction Method*

The use of local construction knowledge, skills, and materials is desirable in the process. It allows better maintenance, hence allowing incremental up-gradation by the villagers. The use of traditional materials and techniques allows the involvement of villagers, local laborers and can maximize the local economic value of the reconstruction project. The building with existing skills will allow the beneficiary to stabilize faster in the post-disaster phase.

4.2.5 *Scheduling & Monitoring*

The scheduling of the project provides timely completion of the house, making the beneficiary less vulnerable during the next disaster. Following the timeline of the projects makes it more economic. Monitoring of resources is important to ensure their planned utilization for the purpose. Balancing the resources for construction work is vital when the project is scheduled phase-wise with limited funding. Any obstruction in the phase completion, standstills the project.

Proposed Structural elements and their roles in the process

The structure of the process should be multifaceted.

In the structure, the co-ordinations between the participants are the aspect that will make the process effective. The resource distribution and utilization can be predicated on the active participation of four participants i.e Government, Beneficiaries, Technical agency, and NGOs. The roles of the participants should be well defined. In the process, the villagers are the beneficiaries who are aided by the government fund to get a house constructed by themselves devising other resources with the technical support and the entire work to be monitored and coordinated by the NGOs. The Technical expert will be the connector between the Government and the beneficiary, updating the progress of the work. The role of NGOs is also vital as they will relay transparency in the process.

The proposed framework will manifest many positive outcomes compared to the current practice. The resources will be least wasted in the process, The technical assistance will help out achieving an appropriate quality in construction. With proper coordination and channelized flow of resources, the project will be accomplished fulfilling the basic need of the cyclone-affected villagers.

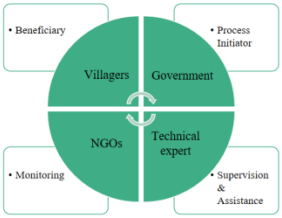

Figure 2: Structural Elements of Reconstruction Process

Comparison

Table 2: Comparision Chart

Factors	Current scenario	Proposal
Approach	Owner's Driven Approach	Owner's Driven Approach
Participation	Villagers & Government	Villagers, NGOs, Technical expert , Government
Source of Fund	Government	Government
Accountability	No	Yes
Sources of material & Labour	Owner	Owner
Monitoring of resource supply	No	Yes
Monitoring of resource Distribution	No	Yes
Technical assisstance	No	Yes
Technical supervision	No	Yes
Project timeline	No	Yes
Quality Control	No	Yes

The comparison chart above, illustrates the 11 factors that outlines the framework for resource distribution and utilization for the reconstruction process practiced in Jagatsinghpur District of Odisha with the proposed process. The outcome of the current practice are:

- Lack of transparency in the funding.
- Incomplete work leading to resource wastage.
- Project delay due to no accountability in the process.
- Dis-satisfaction among the villagers as they are not getting the benefit of the resources provided.

The outcome of the revived process can be:

- Minimal resource wastage as the project will be completed.
- Quality output due to technical assistance and supervision.
- Project Accomplishment.

5. CONCLUSION

The study of current practices for resource distribution and utilization for reconstructing houses for the affected villagers needs certain alterations and few inclusions that can make it fruitful for the Government as well as the villagers. House reconstruction is pivotal for the social and economic recovery of disaster-affected communities.

The success of the reconstruction project will be benefiting the cyclone-affected people with a house, which is likely to reduce the risk in the next cyclonic storm providing resiliency in their environment. This will strengthen their capabilities to cope in their environment leading to less consumption of resources for future readiness and rescue programs by the Government, creating resiliency in the State economy as well.

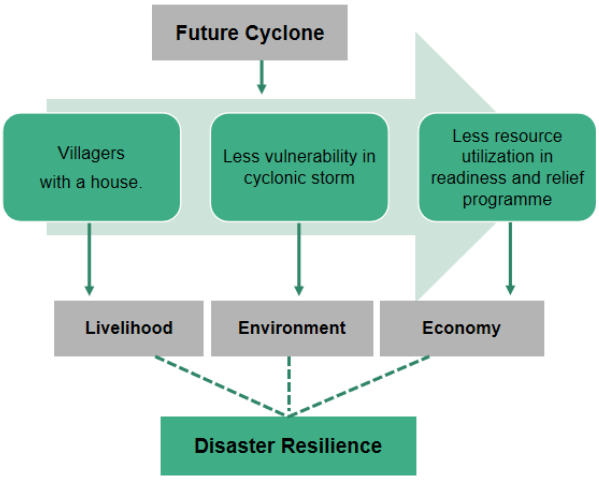

Figure 3: The Effect of Providing Houses to the Cyclone-Affected People in Odisha

Therefore a detailed framework of the resource distribution and utilization process should be lined out in further research on this topic providing an in-depth analysis of the reconstruction process accommodating all the aspects and being fair and sensitive to the end-users of the houses.

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Urban Wilderness and the City Dwellers— Case Study of Eco Restoration Chakkarpur Bundh

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ABSTRACT: We often see nature claiming its territory in urban wastelands, these places develop an ecology of their own harboring different species of plants, insects, birds, etc. These places sometimes offer a perfect refuge to nefarious activities and urban waste. This paper is an attempt to understand, can these wastelands be integrated into urban neighborhoods through design interventions, making them safe and usable for city dwellers and also providing them access to natural processes. The study will also focus on understanding the value that such wilderness spaces bring to city people and questioning whether their relationship with nature is important for the conservation of nature itself. Various studies done by researchers from different disciplines will be accessed to understand the benefits of nature on the physical and mental health of people. The same will be studied through a case study of Eco Restoration Chakkarpur Bundh which was once a derelict land.

Keywords: *Urban Wilderness, Urban Wastelands, Urban Planning, City Dwellers, Eco-Restoration Chakkarpur Bundh.*

RESEARCH QUESTION

What is the importance of exposure to natural surroundings for city dwellers and is it limited to only physical and mental health benefits? Does exposure to nature make us prefer natural surroundings and help conserve nature itself? Should urban wastelands be upgraded into usable urban wilderness spaces through careful design interventions and included in city planning as a neighborhood plan element under the category of green spaces?

Aim

To Examine the importance of urban wilderness to city dwellers and understand how urban wilderness has a different role in the lives of city dwellers than neighborhood or city parks from a health and social perspective and highlight the importance of having them as a separate neighborhood plan element under the category of green spaces in city planning.

Objectives

- Understanding the importance of Urban Wilderness.
- Collecting data on the effects of exposure to the wilderness on the physical and mental health of people.
- Understanding how childhood experiences create an affinity for natural surroundings.
- Listing the landscape measures taken to integrate urban wasteland into usable urban wilderness spaces.

Scope

The paper attempts to understand the importance of urban wilderness for city dwellers through studying various parameters which include the physical and mental health benefits, understanding what shapes our preference for natural surroundings, and evaluating how the visual appeal and design of a place also has a role in it. Another parameter that the study will also look at is the relevance of Urban wilderness at its particular locality by understanding the location, neighborhood, social aspects, connectivity, and demography.

Limitations of the Study

Though the study topic is very vast and requires many surveys of different localities to arrive at some valid answers, due to a limited period of time the paper only covers one such study area of Urban Wilderness that is the Eco Restoration Chakkarpur Bundh in Gurgaon, Haryana.

1. INTRODUCTION

An urban wilderness refers to the inclusion of biodiversity in urban neighborhoods as a part of the New Urbanism movement. The term seems to be paradoxical as natural and urban have always been viewed as opposite things (Kowarik, Ingo. 2018). Research work in the field of urban ecology says that urban wilderness crops up in derelict lands of cities and should be managed in a new manner with the possibility of conserving it by making it central and making it available to the city dwellers. Its status should be transformed from urban wastelands and accepted as the true nature of urban areas (Rink, D. 2009).

In this paper we will be understanding the importance of urban wilderness for city dwellers with the help of a case study of Eco Restoration Chakkarpur Bundh in Gurgaon, India, which is a forest trail and was a wasteland earlier.

As per the FSI 2019, the forest cover of Gurgaon has been recorded at 9.2% of its geographical area. While there is a slow increase in the forest cover of Haryana in the last ten years, Gurgaon has witnessed a sharp decline with a 1% decrease in the last two years itself. With increasing real estate, Gurgaon today is a concrete jungle where nature is far away from its residents (Roy, Uttam. 2019). In this scenario, the making of The Eco Restoration forest trail has not only revived the dead Chakkarpur bundh but has also provided Urban Wilderness to its neighborhood

2. LITERATURE REVIEW

Urban development is based on human values, therefore there is a need to make city people aware of the importance of exposure to the natural environment and the role biodiversity plays in socio-economical as well as ecological well being (Andersson, E. 2006). People who spend more time in nature or belong to places rich in biodiversity have more acceptance of biodiversity and wildlife in cities (Hosaka, T., Sugimoto, K. & Numata, S. 2017). In order to understand why urban wilderness is preferred over parks, many surveys and studies need to be done. Kaplan and Kaplan preference matrix is one such way to evaluate a place. One such study took place in Great Smoky Mountains National Park, located in North Carolina and Tennessee. The park's trail was evaluated on various parameters through surveys done by asking the people who were regular hikers there. They were asked to jot down nature-oriented details, take pictures of what they liked and did not like. Positive and negative impacts of scenic value, how the management influenced the overall experience and the presence of other people. These findings were then analyzed to understand what makes people's preferences and influences them.

Theories like 'biophilia hypothesis' and 'biodiversity hypothesis', establish a deeper connection of humans with nature which goes beyond visual perception of the environment (Aerts, R., Honnay, O., & van Nieuwenhuyse, A. 2018). They also show the good impact of biodiversity on physical as well as mental health. The Attention Restoration Theory (Kaplan, R., & Kaplan, S. 1989) suggests that mental fatigue and concentration can be improved by time spent in, or looking at nature. The capacity of the brain to focus on a specific task is limited and results in mental fatigue. Exposure to nature provides not only the adults but also children to develop an environmental ethic through regular contact with nature, natural environments offer children many additional benefits. Children who are exposed to naturalized play environments develop interest and knowledge in nature. In a study of naturalized playgrounds, it was found that playing in naturalized playgrounds has a positive impact on children's development of environmental stewardship values, and the greater the diversity of the natural landscapes, the greater children's appreciation of nature and experiences in it). Many physical and psychological problems like attention deficit hyperactivity disorder (ADHD) in children are reduced and better ability to concentrate are developed after contact with nature (White, R. 2004).

Many studies and research are done on the general physical and mental health of people; however, a space becomes truly inclusive if all the users are taken into account. People with disabilities constitute a large proportion of users of natural environments. Individuals with physical impairments generally face greater mental and physical health challenges compared to the general population. Exposure to natural environments provides some unique health benefits such as building self-confidence, self-esteem, and the realization of their capacity.

Studies provide us with evidence for a positive relationship between species diversity and well-being (physical and psychological) and between ecosystem diversity and immune system regulation. We know that the city area rich in Biodiversity supports ecosystem services by regulating heat, noise, and air pollution, which all mediate the positive health effects of green spaces, but we know little about direct and long-term health outcomes of species diversity (Aerts, R., Honnay, O., & van Nieuwenhuyse, A. 2018).

Apart from the various health benefits, studies have also shown that native biodiversity can help people establish a sense of place and belonging, therefore, highlighting the fact that loss of biodiversity may impact both well-being and community identity.

The idea that exposure to open space, vegetation, and wilderness areas reduces stress, improves psychological well-being, and promotes physical health has been advocated for over a century. To establish the findings of all these research works, a case study of the Eco restoration Chakkarpur Bundh has been taken up as it is a perfect example of Urban Wilderness. Keeping in mind various parameters that other bodies of research will provide, a survey questionnaire has been prepared which will help us evaluate its impact on all the users and the neighborhood. This will help us provide evidence to planners and policymakers on how this ecological trail forms an important part of the neighborhood it caters to and adds value to the lives of city dwellers.

3. SECONDARY DATA

3.1 Physical Health Impact

It has been well established that recreation spaces of all kinds play a role in providing space to the city dwellers for physical activities thus helping them maintain physical fitness. However, studies also show that physical activities done in the natural environment have greater health benefits due to the psychological restorative effects of green spaces (Tonnćević-Dubljević, J., Živojinović, I., & Tijanić, A. 2017).

In 1980s an old Japanese concept of “Shirin yoku” surfaced as an important preventive health care and healing technique. Shirin yoku popularly known as Forest Bathing means immersing oneself in nature by mindfully using all the five senses. Research conducted to understand Shirin Yoku brings to light a plethora of positive health effects. Time spent in the wilderness improves immunity, improves cardiovascular problems like blood pressure, is beneficial in depression and anxiety disorders, reduces blood sugar levels, and decreases stress hormones. The results are also supported by Kaplan’s Attention Restorative theory, Ulrich’s Stress Reduction Hypothesis (Hansen, M. M., Jones, R. & Tocchini, K. 2017).

As per the “biodiversity hypothesis”, places rich in biodiversity like urban wilderness spaces, are habitats for microorganisms. These microorganisms form the microbiota of that particular space which help improve immunity, helps us fight acute effects of air pollution like asthma, allergies, cardiovascular diseases and premature death (Aerts, R., Honnay, O. & van Nieuwenhuyse, A. 2018).

3.2 Mental Impacts

Since Urban areas limit city dwellers’ access to natural settings, the city dwellers become most susceptible to mental health challenges. Studies in the field of environmental psychology and eco therapy demonstrate that exposure to natural settings has restorative mental health benefits (Jennings, Viniece, Lincoln Larson, and Jessica Yun. 2016). Kaplan and Kaplan in their book ‘The Experience of Nature’ have described in detail the importance of wilderness on the mental health of people. They associated mental fatigue with irritability, difficulty in focusing, aggression, less tolerance, and less sensitivity to social cues. These are common problems of any city dweller and can lead to human error (Kaplan, R., & Kaplan, S. 1989).

According to the ‘biophilia hypothesis’ theory humans have a natural affinity to nature and other species as humans are evolved out of nature (Aerts, R., Honnay, O. & van Nieuwenhuyse, A. 2018).

3.3 Childhood Experience in Nature

Until the twentieth century, most children’s playgrounds were farms, fields, jungles, bushy areas, or trees in their yards or a stream or pond nearby. Children in urban areas now have little or no access to natural surroundings and many urban problems like safety also limit their boundaries. Lack of exposure to biodiversity-rich environments during formative years

in childhood leads to disconnection with nature and has been termed as 'nature deficit disorder' NDD. A lot of emotional and cognitive difficulties in children have been associated with growing up in urban environments with little or no exposure to nature (Aerts, R., Honnay, O., & van Nieuwenhuyse, A. 2018).

Exposure to microbiota present in biodiversity-rich places during childhood develops strong immunity systems and has profound effects on chronic inflammatory diseases. It was also found that playing or spending time in nature has a positive impact on children's development of environmental stewardship values, and the greater the diversity of the natural landscapes, the greater children's appreciation of nature is (White, R. 2004).

3.4 Understanding the Eco Restoration Forest Trail

The Eco Restoration Bundh is a forest trail that connects many neighborhoods in Gurgaon. It starts near Phase V Rapid Metro Station and connects Chakkarpur Village in sector 28, sector 27, Dlf Phase-IV, many residential societies of Sushant Lok phase-1, Harizan Colony, sector 53, 52A, and Sai Ka Aangan before ending at Sector 56, near Banjara Market. This trail is not only used by the neighborhoods it runs through but also the nearby residential societies like Jal Vayu Vihar, Rail Vihar, Devender Vihar, and the village of Wazirabad because of their close proximity to the trail. The neighborhood it runs through consists of mixed economic strata of society with some societies like DLF Garden Villas belong to the high-income group and some very low-income urban villages like Sai Baba Ka Aangan.

The Eco Restoration Bundh belongs to the 118 colonial-era bundhs which were used for checking the runoff coming from the Aravallis in Gurgaon, Haryana. These check dams were strategically located and not only did they intercept the runoff but were also water recharging areas, says M D Sinha, Indian Forest Services officer. These bundhs were slowly lost to the growing urbanization of Gurgaon. However, one of these bundhs at Chakkarpur was identified and was revived through privately funded ecological restoration efforts that were first conceived in 2015 by city-based NGO IAmGurgaon in collaboration with the state forest department, Haryana Shahri Vikas Pradhikaran (HSVP), and the Municipal Corporation of Gurugram (MCG). MD Sinha, previously of the forest department, and a private architecture firm VSPB Associates, was hired to design the landscape jointly.

The Eco-Restoration Chakkarpur Bundh now is a lush green forest trail that not only contains water and harnesses it but also provides a much-needed walking and cycling trail to the neighborhood it runs through. Along the track, there is a drain that runs from Chakkarpur bundh to Wazirabad which was filled with debris and garbage. The drain was de-clogged for the smooth running of water. In order to conserve natural resources and reduce project costs, divergent ways of recycling materials were carried out. 35000 cubic meters of construction debris, from landfills & construction sites in Gurugram, have been utilized for earth-fill operations and in preparation of base layers of the paving of the 5.2 km long stretch of the bundh site, facilitating the utilization of waste from roadside landfills (VSPB Associates)

A proper collection and discharge of rainwater was carefully planned along the bundh. The rainwater is collected and channeled into the nullah with the help of recharge chambers, trenches, pits, and laying of perforated pipes, ensuring that the rainwater flows in the right direction and recharges the groundwater table as well as the nullah.

A sustainable and eco-friendly approach has been taken to rejuvenate the place. A lot of invasive thorny vegetation of vilayati kikar (Prosopis juliflora), which covered a major portion of the area, was cleared. All the shrubs and trees now planted are native therefore the dependency on external irrigation was only at the planting stage. This also ensured restoring the biodiversity of the area as the native cover attracts butterflies, bees, birds, and other fauna. Charvi Singh in the article "Avian Oasis in a Concrete Jungle: Chakkarpur-Wazirabad Bundh" Saevus magazine says "last year, we spotted 65+ avian species in this area alone! Not to mention Indian Palm Squirrels, the Indian Grey Mongoose, and a host of butterflies. I couldn't be more grateful to iamgurgaon for creating this biodiverse haven in the middle of our concrete jungle."

The key parameters of the plan proposition were mobility and universal accessibility for achieving a barrier-free movement for people on foot, cyclists as well as the physically challenged; and providing a natural setting for recreation to the adjoining residential areas. The project utilizes the tools of 'landscape urbanism' and 'socially responsive design approach' to reimagine an old, historic infrastructure to create a Public Space for the city of Gurugram (VSPB Associates).

Many elements of design are integrated into the entire walkway making the place inclusive and accessible to all. Tactile tiles for the visually disabled, provision of universally accessible ramps, low height walls along the sides of the track offering a place for people to sit, seating plazas are designed at the various entrances and along the track in shaded areas to provide pause points, specially designed gates for cyclists and wheelchair users to enable unmanned entry and strategic placement of solar lights and dustbins.

It has given the vulnerable user groups a much-required sense of dignity of movement and feeling of social equality (VSPB Associates) community participation played a significant role in the making of the project. The local communities and the funding bodies (corporate sponsors) were invited to participate in various activities such as cleaning of the site, planting drives, workshops on waste management, and composting programs to raise awareness about 'saving the environment' amongst school children.

The Eco Restoration Chakkarpur Bundh serves as a model for the design of non-motorized mobility corridors in urban areas. It has been awarded by HUDCO in the Landscape and Planning Category, 2021.

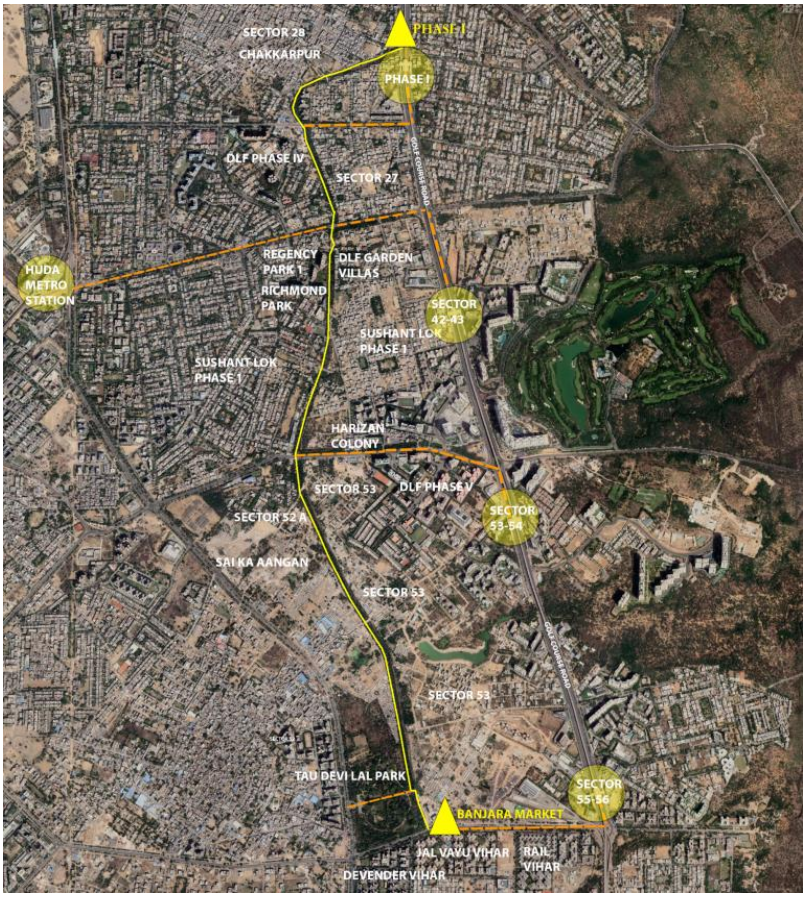

Figure 2

Source: Google Earth

Before Project Execution (Report_HUDCO Design Awards 2020–21)

After Project Execution (Report_HUDCO Design Awards 2020–21)

4. ANALYSIS

4.1 Purpose of Using the Trail

People from all the neighborhoods connected by the trail use it differently. Since the trail runs through different economic strata of people, the usage of the trail for people of low economic strata is different than those coming from a medium to high-income group. The data collected shows that for 46.5% of people of low-income strata coming from Sai Ka Aangan and Chakkarpur Village, the trail forms a route through which they can commute to their workplaces while the rest 53.5% people coming from other residential societies come here for walking or jogging in the mornings and evenings (Figure 3). 16.6% of people said that they like to sit and socialize. 2.3% of people also come here for birdwatching. While doing the survey, people were also observed sitting on the sidewall and meditating, some were also using the wider plaza space for exercising. (Figure 3)

Sathya who is a space planner is a resident of Richmond Park and an avid birdwatcher, she says " it is delightful to visit the trail especially during winters as many migratory birds can be spotted here" she also says "the number of birds visiting the residential complex of Richmond park has increased slowly since the forest trail has been made". Hanib Sheikh of Sai Ka Aangan (urban squatter) says "since there is no open space in the "basti" area, we come and gather together here to chit chat. This feels like our backyard garden".

Meditation on sidewall

Commuting to work on a cycle through the ramp

4.2 Positive and Negative Experience

When asked about the dislikes, the major concern of the women was safety. 51.6% of people said they feel unsafe during evenings, out of which 62.5% were women (Figure 6). The data also show that all the work women always walk in a group while coming back from work in the evening. Interviews taken from women coming from Sai Ka Aangan indicate that certain areas in the trail give refuge to nefarious activities like drugs. Below are the excerpts from interviews taken from Golenu, Abhika Begum, and Nashima of Sai Ka Aangan:

- *Interviewer:* What do you like and dislike about the trail.
- *Golenu:* We feel very unsafe while coming back from work in the evening.
- *Abhika Begum:* There are guys sitting behind the bushes, we have seen them taking injections.
- *Interviewer:* Did they ever harm you.
- *Golenu:* They snatched the purse of a woman the other day.
- *Nashima:* Some drunk people also pulled out the bamboo fence at night, we saw it in the morning while going to work.
- *Interviewer:* Where do these people come from.
- *Abhika Begum:* We have no idea, please ask the authorities to put two people on guard because one guard may not be able to handle the situation alone.
- *Golenu:* Also some of the lights are not working which makes it even scarier.

This interview indicates that there are certain parts of the trail that are hidden by bushes and form a perfect spot for unwanted activities.

19.4% of the people who reported the problem of bad odor from the water channel are all using the same stretch of the trail starting from Banjara market to Sushant Lok E Block (Figure 4).

Mr. N.M. Patil, resident of Jal Vayu Colony, comes here almost every day for evening walks. He says “though we have a park in our society premises I prefer coming here as it’s less crowded here and everyone is on the move minding their own business. The only thing that I dislike is that there is a bad stench that comes from the nullah near Tau Devi Lal Park. It is not there on all days but sometimes it’s really bad. The overall experience is very good though. I love to bring my kids here during weekends”.

29% of the people who reported negative experiences because of dog litter are using the stretch of trail starting from Regency Park to Paras Hospital.

The data collected indicates that the experience of the trail is not constant throughout and every stretch offers a unique problem. However, when asked about the positive things about the trail there were many similar responses. For all the people from Chakkarpur village and Sai ka Aangan, the trail provides them a shortcut to work free of vehicles. As per the collected data from 44 people more than 40 people find the path comfortable, 35 to 40 people find the place beautiful, 30 to 35 people like that the place is not crowded. 30–35 people like the natural setting of the place. 35–40 people said that there is no noise of traffic, 20 to 25 people like that the place is clean and 5 people even said that they like the sound of birds chirping (Figure 3).

Richam Tammy from Chakkarpur Village is a street vendor who sells momos, after work he comes to the trail every day. He says “I am a momo vendor and a rapper too. I come here to hear the chirping of the birds which inspire me to write content for rapping after going home.” He also says that the trail reminds him of the constant chirping of birds back home in Darjeeling.

When further asked about the "beautiful" aspect of the trail, 54.4% of people related it to the trees, 7.6% people related it to the gravel path, 19% also said that they like the informal setting of the space and 19% talked about cleanliness (Figure 7). These observations indicate that the visual impact of a place also makes people prefer "the trail".

When asked, what makes the trail comfortable for them all 44 people said the trail is smooth and its comfortable to walk, 20–25 people who cycle said that the trail is comfortable for cycling as there is no undulation in the path and no traffic, 30–35 people said that they could walk here anytime of the day even during peak summers as the path is well shaded with trees, 10–15 people said that they could sit anytime as there is a running toe wall which provides seating throughout the trail. 10–15 people said that the entrance plaza and other small plazas along the trail provide them a perfect spot to sit together and talk (Figure 8). It was found that though people had negative experiences while using the trail, the overall experience was not impacted by it.

4.3 Preference of the Trail over Residential Parks

To understand the preference of trail over residential parks the questions were asked to people coming from residential societies and not the people coming from urban squatters. 65.5% of people said that they prefer the trail more than the parks. 13.8% said they like parks as they can socialize too and 20.7% said that they feel both have different purposes (Figure 10). When further asked about the reason for liking the trail, 16.3% of people said that they like coming to the trail because it's not crowded and people minded their own business, unlike parks where people from the same residential areas come to socialize and tend to talk to one another. 34.9% of people said that the trail is a continuous space and one doesn't feel confined here unlike in parks. 25.6% of people said that this trail has a natural setting unlike the formal setting of the parks which they prefer more. 23.3% of people said that they like that there is no disturbance here and 46.3% of people said that the trail has more trees and it's shaded everywhere (Figure 11).

5. METHODOLOGY

This paper aims at understanding the importance of urban wilderness for city dwellers by both qualitative and quantitative analysis. The studied literature helped in the qualitative analysis and also brought forward quantifiable aspects which are required to evaluate the importance of urban wilderness.

In order to gather information about the parameters listed in the methodology table (Table 1-Methodology Table), a questionnaire was developed. The questions were general and put under simplified categories so that people could answer them easily. These categories helped us evaluate the broader parameters further (Figure 1).

Table 1: Methodology Table

Parameter	***Method***
Metal Health Benefits of Exposure to Wilderness	● Research Papers ● Books ● Journals ● Survey ● Interviews
Physical Health Benefits of Exposure to Wilderness	● Research Papers ● Books ● Survey ● Journals ● Interviews
Childhood Experience in Nature	● Research Papers ● Books ● Survey ● Journals ● Interviews
Understanding the Eco Restoration Bundh	● Survey ● Web Search ● Interviews ● Maps

These were:

- The purpose of using the trail
- Positive and negative experience
- Preference of the trail over public or society parks
- Childhood experience in Nature

This information was then put in a tabular format and various percentages were calculated empirically. A comparative analysis was done after the data was collected which was then supplemented by interviews taken. The data collected helped us evaluate the broader parameters listed in the methodology table (Table 1).

6. RESULTS AND DISCUSSION

6.1 Mental and Physical Health Impacts

The results indicate that the trail is used in many ways; however, most of the population uses it for walking and commuting to work. Both walking or cycling as a daily fitness regimen or for commuting to work can be factored as physical and mental health impact indicators. Similarly meditating and exercising also leads to mental and physical fitness. The literature study shows many health benefits of all these purposes, clearly indicating that "the trail" provides a healthy lifestyle for people.

6.2 Childhood Experience in Nature

37 out of 44 people said that they grew up playing in the wilderness. The other 7 grew up in cities playing in formal parks with very little greenery around. When asked about the importance of wilderness in their lives we found that 58.1% of people showed moderate affinity to nature and 41.9% showed high affinity (Figure 12). However, there was no one with a low affinity for nature.

When compared to the childhood experience data we found that people who had little experience of nature while growing up have a moderate affinity to nature however the survey done does not provide substantial data for developing a direct relationship between childhood experience in nature and affinity for nature.

6.3 Importance of Design

The data collected about the positive and negative experiences of the users helped us evaluate the preferences of people. The negative experiences indicate that people, especially women, prefer coming for walks in the morning or coming back from work in groups of two to three in the evening as it is safer.

The positive experiences show that people prefer coming to the trail because it has trees, it is traffic and noise-free, it is not crowded, it's shaded all the time of the day and it's clean.

As per the data, many elements of design also help shape user preferences. The table below is a listing of such elements.

Table 2: Design Elements

Elements from Positive Experiences	*Elements from Negative Experiences*
• Natural environment	• Insufficient lighting
• Smooth track	• Negative spaces
• Transitional ramps	• Plant Islands
• Gravel path	
• Sidewall for sitting	
• Plaza areas	
• Native trees	
• Informal setting	

7. CONCLUSION

In urban areas where we have limited access to nature the city dwellers become detached to nature. The literature study shows that it can lead to nature deficit disorder (Aerts, R., Honnay, O., & van Nieuwenhuyse, A. 2018). At the same time exposure to places rich in biodiversity have manifold mental and physical health benefits (Hansen, M.M., Jones, R., & Tocchini, K. 2017) and more so in children (White, R. 2004). The secondary data also shows that exposure to the natural environment inculcates environmental ethics in humans which imbibes environmental stewardship in us, making us conserve nature (White, R. 2004).

The study and the collected primary data highlights the fact that Eco Restoration Bundh is a successful Urban Wilderness model that not only helps mitigate urban issues like flooding, air, and noise pollution, and urban heat but also connects many neighborhoods of different economic strata and provides space to its immediate neighborhood to walk and commute to work. The careful design intervention has converted an urban wasteland into a city forest trail. The design also respects all its users, making the trail equitable and inclusive. The Eco restoration Chakkarpur bundh is rich in biodiversity and therefore gives multiple health benefits to its users. The analysis of the collected data shows how the city dwellers are benefitting from the trail.

The collected data is only from one case study of Urban wilderness space therefore it's difficult to conclude that Urban wilderness should be a part of city planning, however, the literature provides us with enough established benefits of urban wilderness not only to city dwellers and the city but to nature itself, therefore, it would be safe to say that urban wilderness has a big role to play in a city and every city dweller should have access to it.

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ANNEXURE

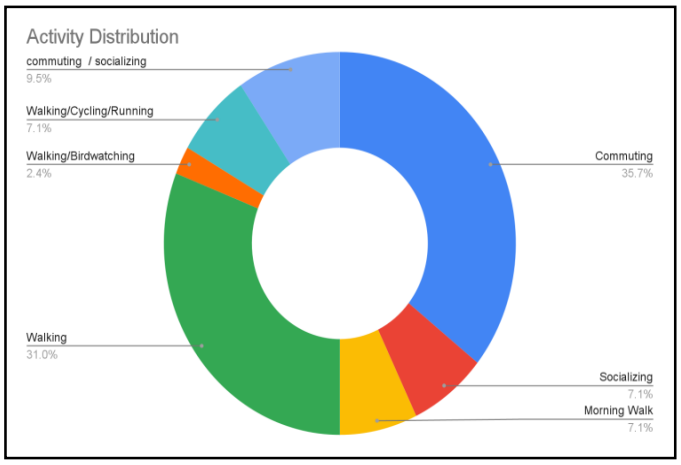

Figure 3

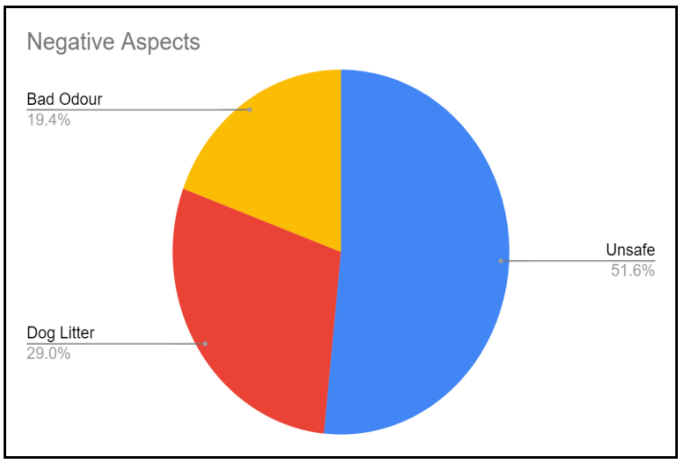

Figure 4

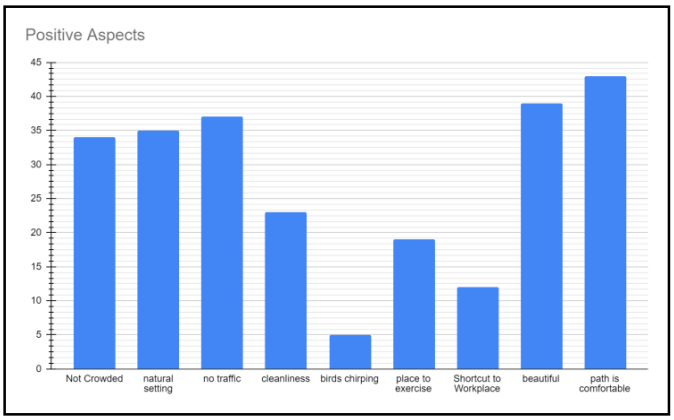

Figure 5

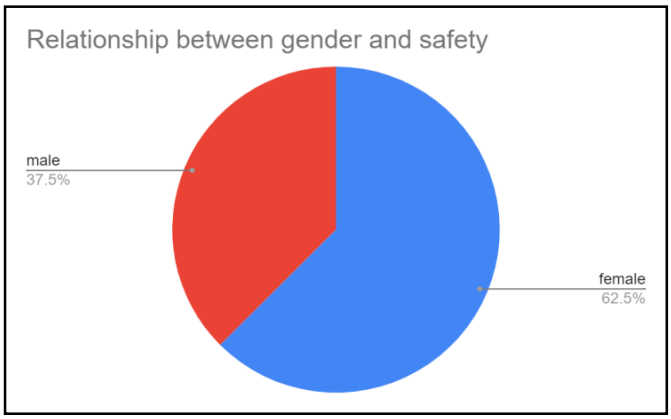

Figure 6

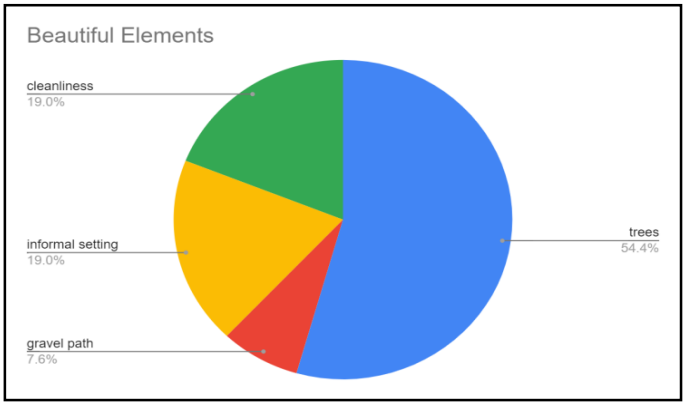

Figure 7

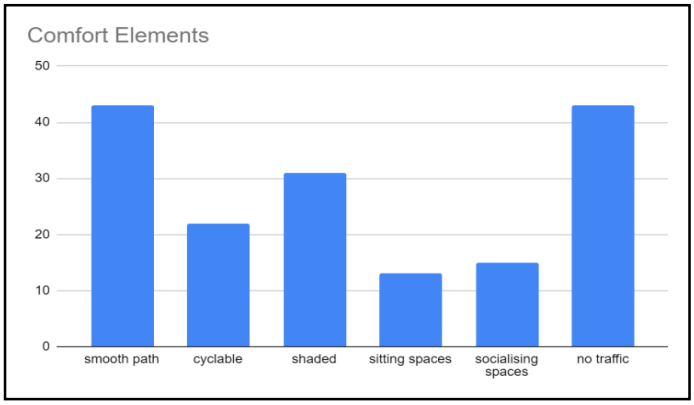

Figure 8

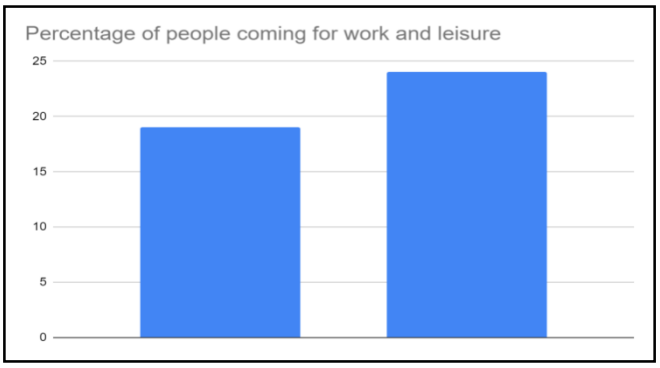

Figure 9

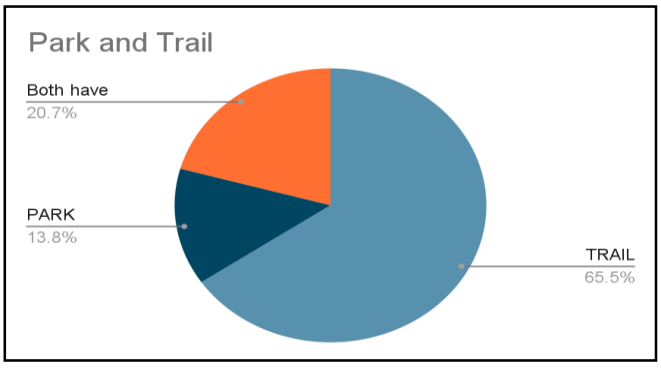

Figure 10

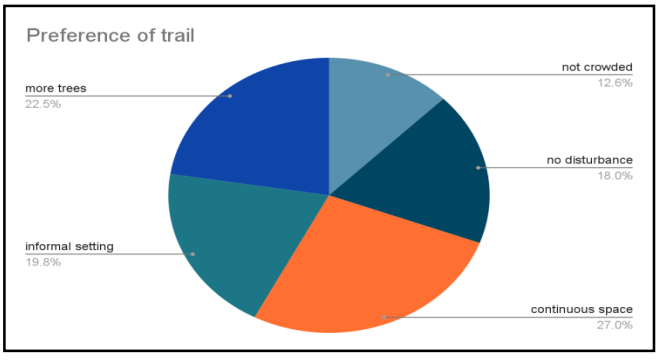

Figure 11

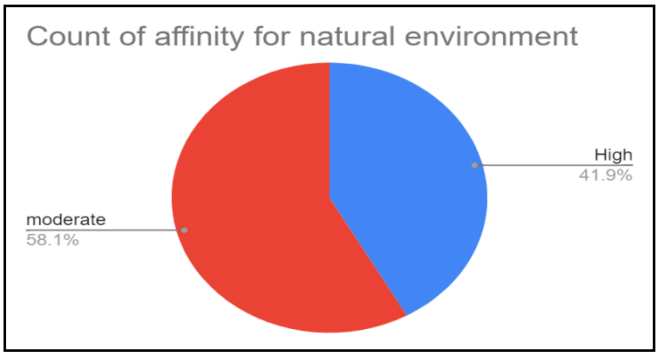

Figure 12

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Mapping the Change in Habitable Spaces in Rural Haryana

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ABSTRACT: Historic residential buildings across the Haryana are known to have demonstrated a thorough response to the climate, local technology and socio-cultural factors in which they evolved. The origin of these traditional building body associates with the availability of local materials to the local builders as well as religious beliefs, culture and taboos. But over the period of time there is change in culture, beliefs, customs and technology and that become the major reason in the evolution of residences in Haryana. The pattern of residences is changed over the period of time.

Though the study of residences built at different points on the timeline in a span of 80 years. The architectural change is mapped with an overlay of evolving a new cultural ethos. The village of Haryana is looked at a view to understand its origins and broad physical and historic characteristics. The three residences of the same village from different time period are taken up for investigation. For this paper both primary and secondary research methodology is employed in this research besides literature study. The author dells back her own personal experiences and bringing for intimate perspective of lived cultural experientiality as part of the study. This paper brings on ground real time data to collaborate the hypothesis. The community living in the village is now losing the cultural value and that has an huge impact on the changing architecture of the village.

Keywords: *Village, Haryana, Culture, Traditions, Festivals, Residences, Modern, Human behaviour.*

1. INTRODUCTION

Historic residential buildings across the Haryana are known to have demonstrated a thorough response to the climate, local technology and socio-cultural factors in which they evolved. The origin of these traditional building body associates with the availability of local materials to the local builders as well as religious beliefs, culture and taboos. But over the period of time there is change in culture, beliefs, customs and technology and that become the major reason in the evolution of residences in Haryana. The pattern of residences has been changed.

"The built environment carry with it important meaning from one generation to the next, and serves as a repository of cultural meaning" (Sutherland, 2007). These meaning are embedded in the research that there are imprints of architectural elements on the future buildings.

2. OBJECTIVES

- To identify the culture of that village (Haryana).
- Mapping the cultural evolution over the period of time.
- Identifying the cultural influence on the scale, material & architectural elements.
- Identifying the relationship of spaces interaction.
- To Identify the change in pattern of different houses.

3. METHEDOLOGY

The study starts off with the explanation of the main premises from which the idea in the research is based and explored.

It leads on the discussion of the main concept of culture of Haryana on the basis of literature review and trying to explain on the further research that it has an impact on the architecture.

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The research started with the discussion of the main concepts of culture on the basis of literature review (past research) and on the basis of my own personal experience. An attempt is made to at the literature which relates the change of the village and the evolution of the houses at various timelines.

The village of Haryana is looked at a view to understand its origins and broad physical and historic characteristics.

A preliminary survey is done in order to understand the composition of planning patterns and architectural elements of the residence.

Secondary sources of literature which talks about the culture, locality and area and trying to examine the socio-cultural factors.

There is a component of socio-cultural influence drawn in the research. It is drawn on the basis of secondary data like—literature review, informal interviews with the residents or villagers and my personal past experience.

The three residences of the same village from different time period is taken up for investigation. There is a period around before Independence that was an era which is completely different from the post liberalization and one era between these two hence. The author picked up these three era for investigation of the research. The village has grown in that manner also. There were 3 typology of residences are there in the village.

Haveli from 1940 (*Source: Author*)

Residence from 1970 (*Source: Author*)

Residence from 2019–20 (*Source: Author*)

4. CONCEPTUAL FRAMEWORK

4.1 Socio-Cultural Factors

In the village, there is little interaction between husband and wife. Rooms are not specifically designated for any function except the kitchen. The courtyard in the centre of the house is surrounded on all sides by rooms, where women sit and gossip and work. An elderly matriarch sitting on a cot in the centre of the courtyard wielding a hookah is not unusual. Only the highest-status women may sit on a cot. Others sit on the ground or low stools, and the youngest remain standing. You rarely see men around the house, except for very old ones who need to be cared for by women. (Channa, 2015)

4.2 Girl Education

Education seems to be the key factor in females empowerment. However, the access to education is differently perceived for male and female students. (Tauffiqu Ahamad, 2015)

A changing society and developing economy cannot progress if the education system that is responsible for creating moral and cultural norms remain controlled by traditionalists who see the world as a fragmented entry. The differences between the position of men and women in society will not disappear the education levels of men and women. Inadequate education or no education is the most important factor contributing to the backwardness of our masses, especially women. (Tauffiqu Ahamad, 2015)

Education changes the thinking of people and decreases the differences between men and women. So it has an impact on the planning of the residences that there is no more segregation of spaces in a residence in rural areas of Haryana.

4.3 Infrastructure & Technology Adaptation

Road: Village is connect by road to Delhi, Gurgaon, Rohtak, Rewari, Mohindergarh and other towns in Haryana and nearby towns Jhunjhune, Behror, Jaipur etc. of Rajasthan. Buses depart from the main bus interchange junction in Narnaul to these and other town of Haryana & Rajasthan. There is major road routes developed during 1990's. This road connectivity has decreased the distances from metro-cities and other towns so that also has an impact in the development of the village.

4.4 Change in Economy

Earlier the major occupation of the villagers was cultivation. People were not aware of having jobs as they were not educated.

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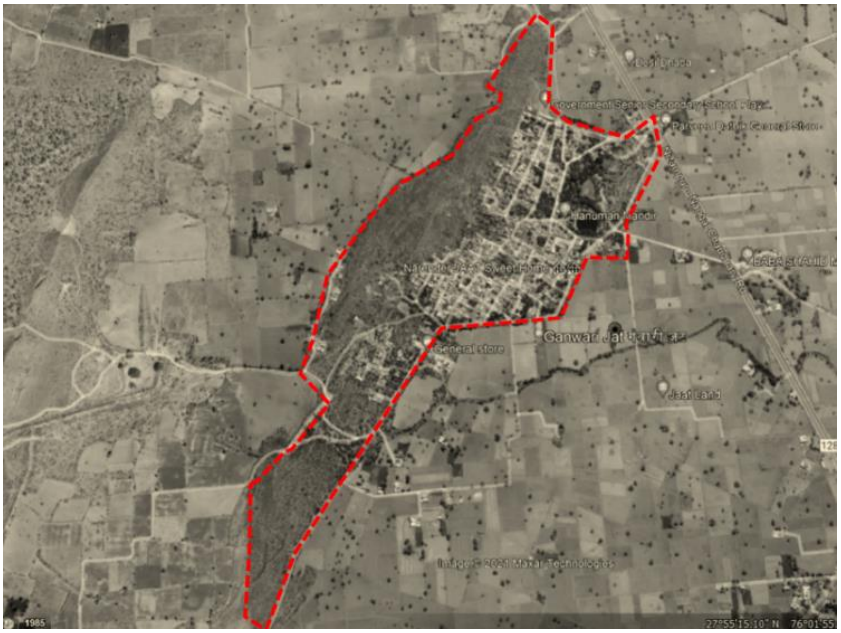
5. THE CASE STUDY—GANWARI VILLAGE (HARYANA)

5.1 Village Brief

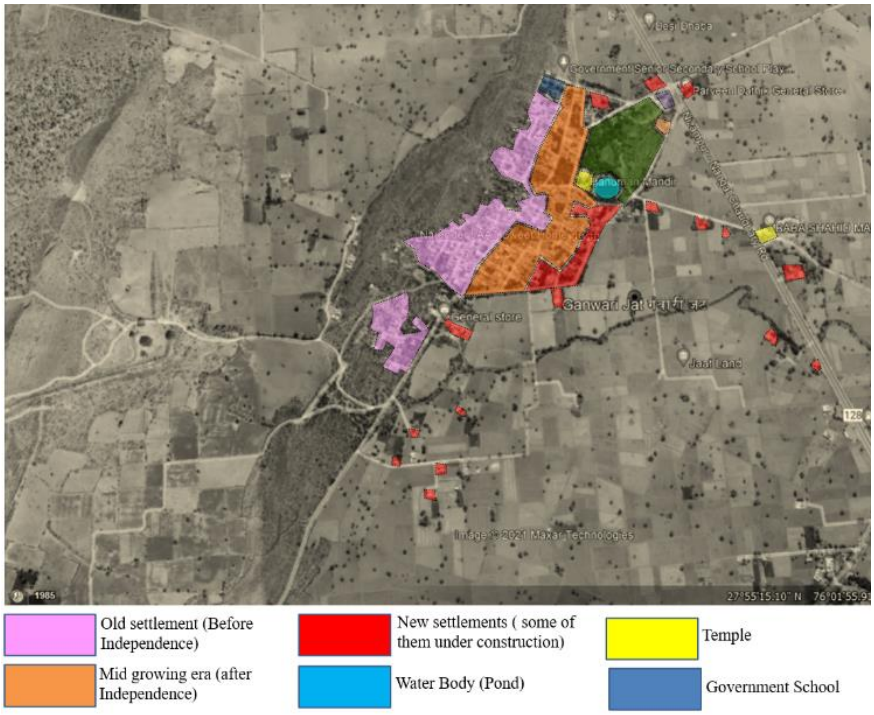
Ganwari Jat village is located in Narnaul Tehsil of Mahendragarh district in Haryana, India. It is situated 16 km away from sub-district headquarter Narnaul and 16 km away from district headquarter Mahendragarh. As per 2009 stats, Ganwari Jat village is also a gram panchayat. It is 150 km away form Gurugram.



Village Boundary

(*Source:* Wikipedia)

HILL



(*Source:* Wikipedia)

This village is situated along the hill side. Earlier time people used to settle down along the hill side for the purpose of safety and security from wild animals.

Evolution of Village

This village has grown gradually over the period of time. In the following image pink colour dedicate the older settlements before Independence. In this typology majory haveli's are there. In orange colour the settlements after independence or growing settlements are there. People used to shift outskirts of the village when the families started extended**.**

5.1 Case Study-1: Haveli from 1940

- History
- Site Surrounding
- Base Drawings
- Understanding
- Spatial Planning

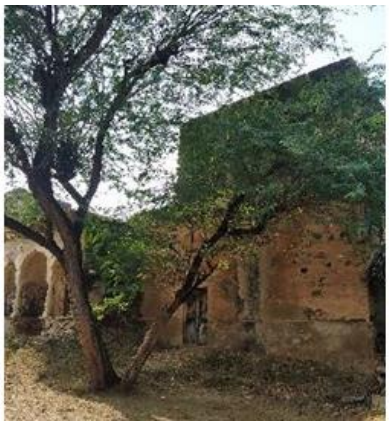
5.1.1 *History*

The house is owned by the Dathik family. The age of this house is over 80 years. The house is located at the adjacent of the hills of the village as this village has grown along the hills. There are multiple owners of this house right now because this haveli belongs to five brothers. Five families used to live together here. Dathik family used to residing in this house for almost around 40 -50 years and then one by one they started shifting to their own personal residences at the outskirts of the village.

One or two families occasionally visit here and use this haveli for storage purpose.

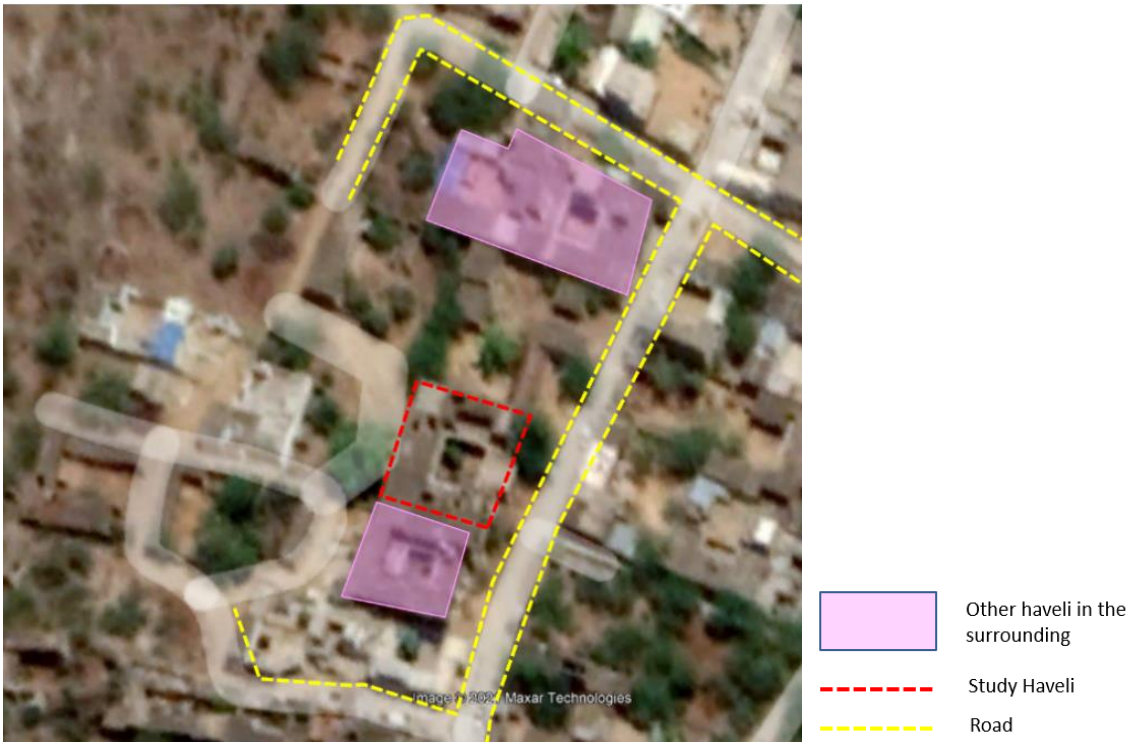
However the state of this haveli is atrocious. No maintenance has been done from last 40 years.

5.1.2 *Site Surroundings*



Open Space on the Right Side
(*Source: Author*)

Front Road
(*Source: Author*)

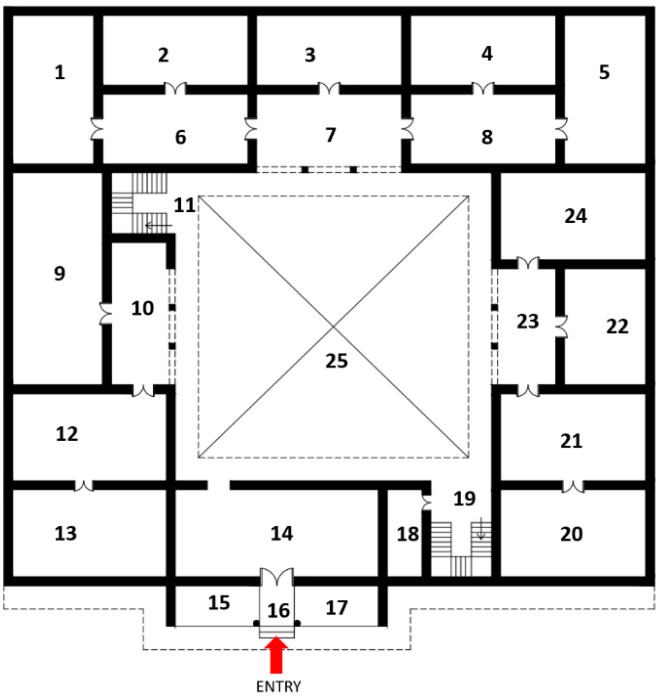


(*Source: Author*)

5.1.3 *Base Drawings*

The following plan shows the original layout of the haveli. The haveli follows the courtyard typology. There is an open to sky enclosed space in the centre of the house which is used for multiple purpose.

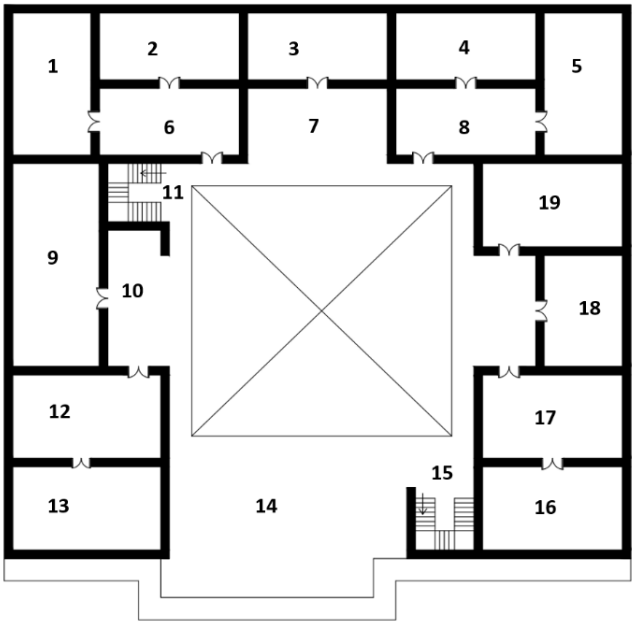
The planning of the house is in such a way that the core of the house is hidden. There is multiple rooms inside a room. The basic planning of the house is simple, main entry of the house is from East direction.



Ground Floor Plan

Legends

1, 5, 13, 20 – Store room
2, 3, 4, 9, 12, 24, 22, 21 – Bed room
6, 8, – Lobby
7, 10, 23, 15, 17 – Verandah
16 – Entry
14 – Entry Foyer
25 – Courtyard
11, 19 – Staircase



First Floor Plan

Legends

1, 5, 13, 16 – Store room
2, 3, 4, 9, 12, 17, 18, 19 – Bed room
7, 10, 14 – open terrace
11, 15 – Staircase

Proper services were not there. Electricity facility was not there, so the walls of the house was designed in such a way so that the house will remain warm in winters and cooler in summers.

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All the planning factors played a major role in determining the nature of the society, culture, depicts the customs and taboos.

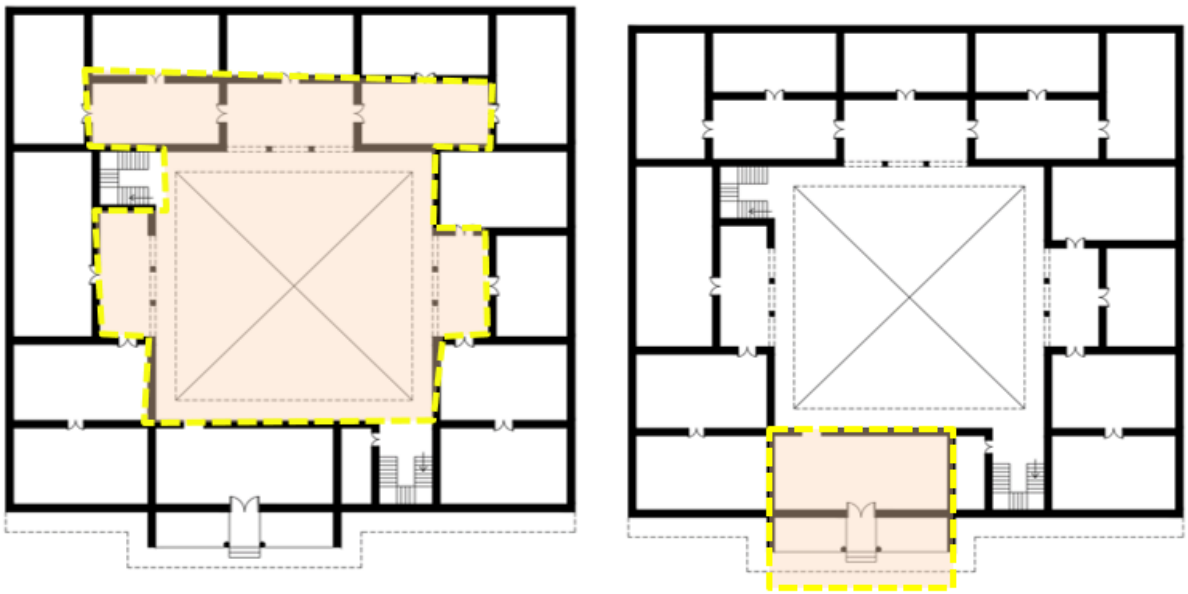
The further research is documenting the existing fabric of that era and mapping the house by using different methods to see the change in residences over the period of time.

5.1.4 *Understanding*

It is important to understand the planning pattern and impact of culture into it.

5.1.5 *Spatial Planning*

Public



(*Source: Author*)

An entrance generates a visual and physical transition from one realm to another, through multiple spatial layers

Generally male members of the family or the elderly people used to site on the outer verendahs of the Haveli

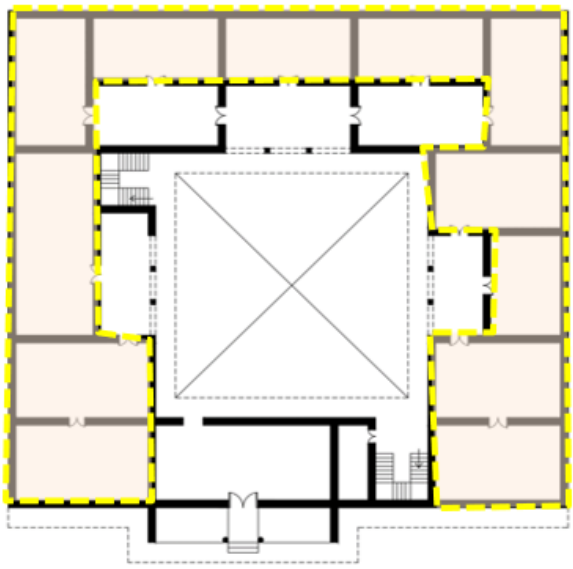
Male guests also used to sit outside only

Chopaalot the outer side of the haveli which is the social interaction space for the male members of the Haveli

(*Source: Author*)

Semi-Public

Inside space where women used to have chit chat or used to do other household works.




Stone grinding of lime mortar


Traditional lime chakki

Lobby (source-author)

Entry Foyer (source-author)

Private

Room Entry

Bed Room

Bedrooms and store areas were the most private areas of any haveli.

They used to keep there precious things in the storage area as it the safest space of the house. It is a enclosed room inside a room. Only closed people of the family used to know about these store rooms.

They used to keep there grains, jewellary, money here.

5.1.6 *Material Used*

Lime Mortar

Using lime as a material is something that is still happens in rural areas and small towns. A lime was is a dispersion of calcium hydroxide particles in an aqueous solution. Lime wash, like lime plastering, allows any moisture that enters into the masonary to evaporate again, allowing the building to breath and that's the reason those buildings are cooler in summers and warmer in winters. (context,built living and natural, 2015)

5.1.7 *Stone*

Stone masonary was done in most of the historic structures of the villages. Villagers used that technique for ages as stone was the easily available material. In an interview the author able to understand that the People used to dig stone manually from the hill and uses stone for construction. Avidances of use of stone in Haveli.



Rubble Coursed
(*Source: Author*)

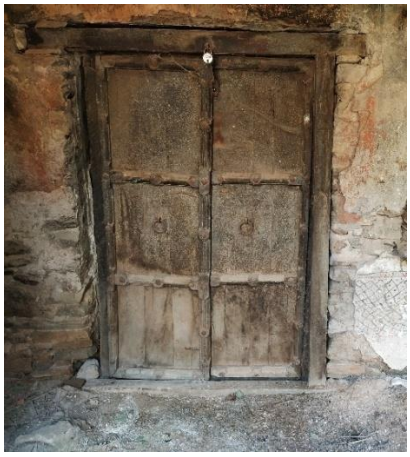
5.1.8 *Architectural Elements*

Sizes of the Wall

All the walls of the building are load bearing. The thickness of the walls are 18".


Inner Walls of Haveli (*Source: Author*)

Door/Window Style



Door of the Haveli (*Source: Author*)

Small Window (*Source: Author*)

5.2 Case Study-2: Residence From 1970

- History
- Site nearby
- Base Drawings
- Spatial Planning

5.2.1 *History*

The house is owned by the Dathik family's next generations. The age of this house is over 50 years.

There are multiple entries and exits of this house. Construction techniques used in this house are also old. Lime mortar is used in the construction of this house. Although there is advancement in the technology during that time but due to lack of infrastructure or knowledge people used the older and easily available material and techniques.

Still the segregation of spaces has not been changed. Still there was male and female spaces.

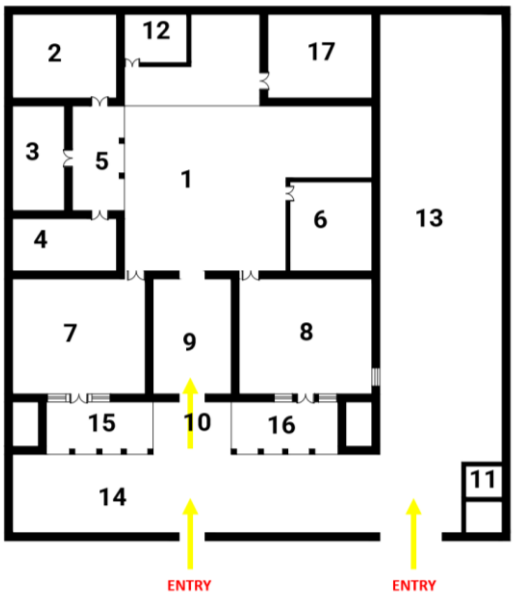
House from 1970 (*Source: Author*)

5.2.2 *Site Surroundings*

Site Surroundings (*Source: Author*)

Site surroundings (*Source: Author*)

9.3 Base Drawings



The following plan shows the original layout of the house. This house also follows the courtyard typology. There is an open to sky enclosed space in the centre of the house which is used for multiple purpose.

Legends

1 – Courtyard
2, 3, 4, 17 – Bed Room
5 – Lobby
15, 16 – Verandah
6 -Store
12 – Kitchen
7, 8 – Drg. Room
13, 14 – open Space (Multi Purpose)
10- Entry
11- Toilet

5.2.3 *Spatial Planning*

Basic amenities and services were started developing for example electricity facility was installed later on after construction

Public

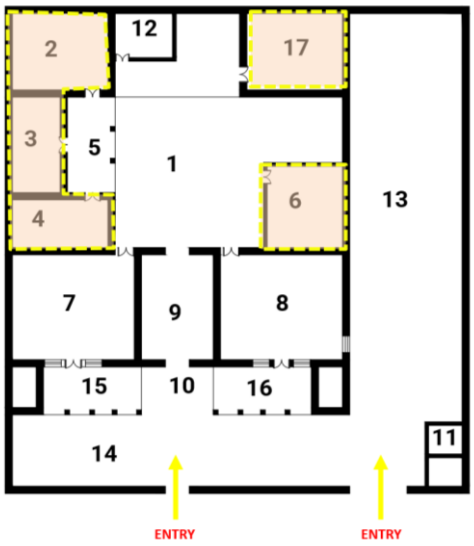
Verendha is a place where male members of the family used to sit. It acts aa drawing room also for males. It's a place of social interaction also.

Inside picture of the veranda (*Source: Author*)

Semi-Public

Courtyard

Private



Inside image of the room

Outside image of the room

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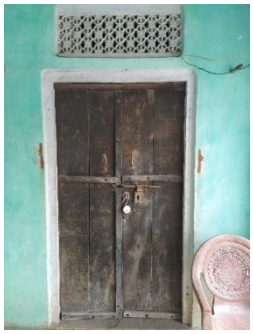
Architectural Elements

Sizes of the wall
All wall thicknessare 18”

Source: Author.

Door & Window

Windows



Door (Source: Author)

Door Lock system

5.3 Case Study-3: Residence From 2020

- History
- Site Surrounding
- Base Drawings
- Spatial Planning

5.3.1 *History*

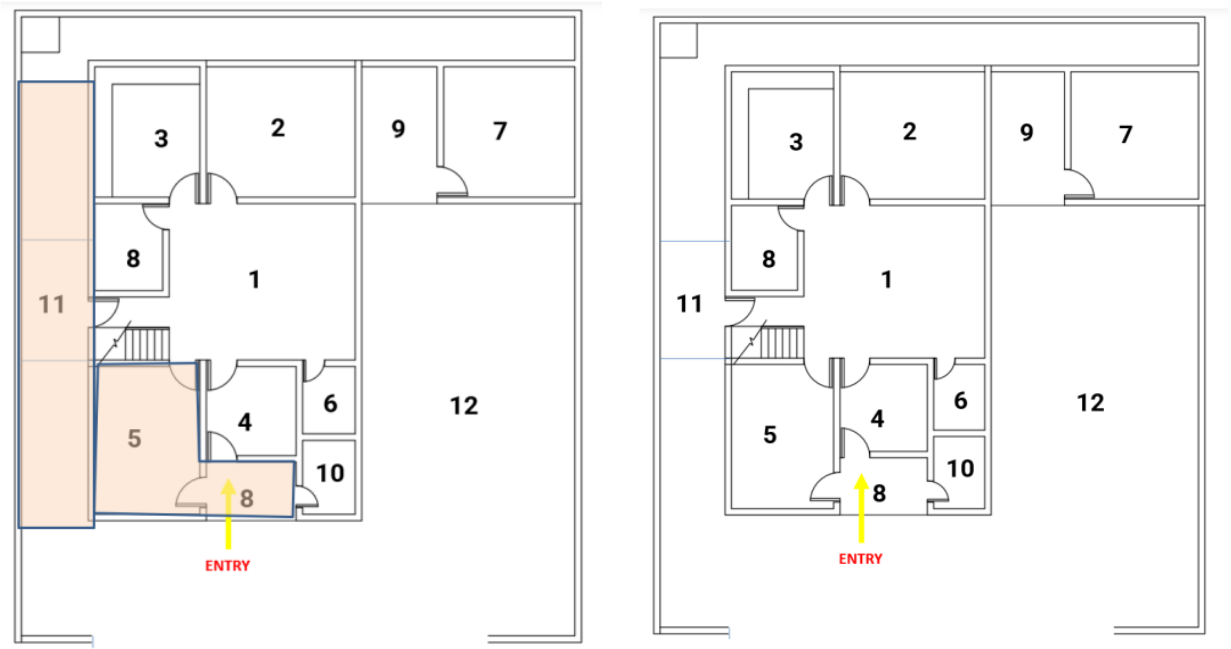
The house is owned by the Maan Family. Earlier they also used to live a haveli but then later on they shifted to the new typology of residence which is newly built. All the basic amenities are there.

Residence of 2020 (*Source: Author*)

5.3.2 *Site Surroundings*

Front lawn open files

5.3.3 *Base Drawings*



Legends

1 – Lobby
2, 4, 7 – Bed Room
3 – Kitchen
8 – Store
5 – Drg. room
6, 10 – Toilet
11 – Porch
12 – Open area
9 – Lobby

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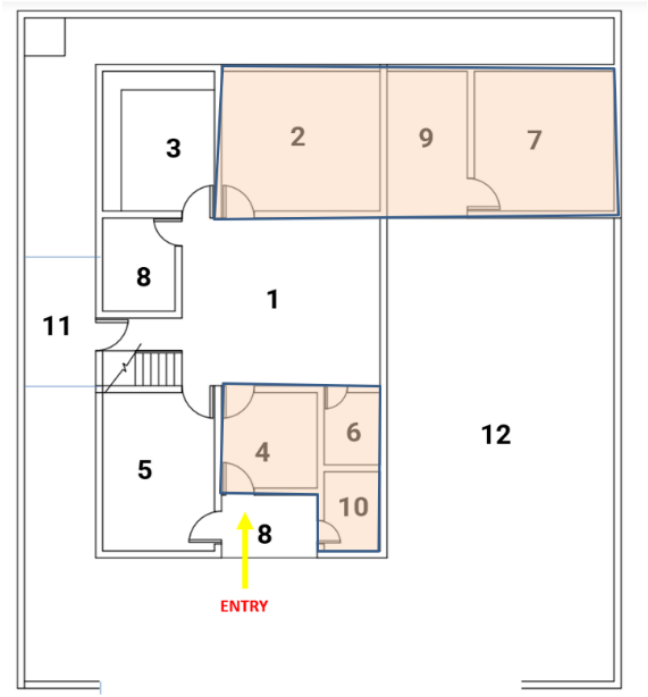
5.3.4 *Spatial Planning*

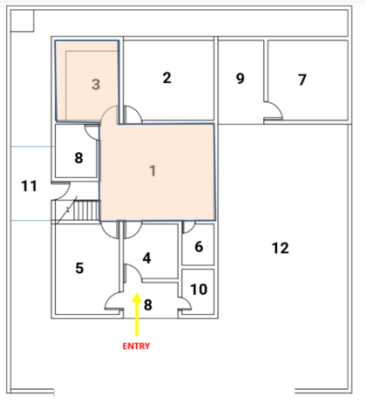
Public

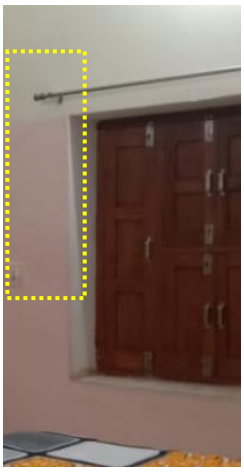
Open sitting spaces for any gender. Now there is no as such gender segeration in this village. People are more educated and they educate their daughters also so there is improvement in girl education also so that's the reason the mindset of people are changing.

Semi-Public



Private





Bed Room (*Source: Author*)

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Architectural Elements

Door/Window style

9” thick brick wall

6. CONCLUSION

This research talks about the different typologies of residences in a village. The author looked at the evolution of village that how there is changes happned in the residences of the village.

The analysis revels the change in pattern of houses and how there is demolition of culture in the modern houses.

The architectural elements are changed over the period of time for example the door window typology is changed, material is changed, wall thickness is changed the “aala” system is changed. There is invention of some new elements which is being incorporated from urban architecture in rural spaces. In the new typology of residances there is the concept of open kitchen also which was the not there in earlier ones.

People are going away from there culture, but yes the change in culture has an impact on architecture of that place.

DATE	MONTH	FESTIVAL	MEANING OF FESTIVAL	SPACE OF CELEBRATION PAST	SPACE OF CELEBRATION PRESENT	REM ARKS
14 Jan		Makar Sankranti	Dedicated to lord sun. beginning of new harvest season	Terrace	Terrace	
Shukla Panchami	Phalguna	Maha Shivratri	Great night of shiva			
Shakula Purnima	Phalguna	Holika Dahan	Represents the power of devotion	Outside space	Outside Community space	
	Chaitra	Holi	festival of colours	Courtyard, streets	Community garden, streets, porches	
Shukla Navami	Chaitra	Ram Navami				
Shukla Purnima	Shravana	Raksha Bandhan		courtyard	Drg. Room, Living Room	
Krishna Ashtami	Bhadrapada	Janamshtami				
Shukla Ashtami	Ashwina	Durga Ashtami		courtyard	Drg. Room, Living Room	
Dashami	Ashwina	Dussehra	This festival is celebrated to commemorate the victory of Lord Rama over the demon Ravana.	Outside space	Outside space	
Krishan Chauth	Kartika	Karwa Chauth				
Amavasya	Kartika	Diwali	Festival of lights, marks the beginning of the financial year in India.	Courtyard, Veranda	Porches, terraces, streets	
Pratipada	Kartika	Govardhan Puja				
Shakula Dwitiya	Kartika	Bhai Dooj				

Change in space over the period of time.

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Study of Gentrification Dynamics and Migration Patterns in City of Pune

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ABSTRACT: Urban growth is a morphological process and one of them is gentrification. Gentrification is both a cultural and economic process, and responsible for the quality of life in urban context. The changing employment structure of Pune since 1990 due to liberalization, has proved a major impetus to gentrification. Displacement is a particular form of migration where the people are forced to against their will. The socio-spatial changes in the city are an outcome of the property value. The increases in property value of residential areas have resulted in the dispersal of communities whose members find that housing in the area is no longer affordable or suitable. This paper aims at understanding gentrification process and internal migration leading to displacement in city of Pune and its impact on architectural development. It also aims to identify the displacement patterns in the city based on the factors behind the change.

Keywords: *Gentrification, Displacement, Migration, Urbanisation, Globalisation.*

1. INTRODUCTION AND BACKGROUND OF STUDY

Cities are fantastic dynamic places (Jacobs, 1961). The urban areas in India are expanding fast and hence city core areas and working-classneighbourhoods are going thru a process of urban decay and urban renewal (Gokhale, 2011). Urbanization brings about, the radical socio-spatial transformation of society as analysed by Lefebvre. This can lead to sociocultural-spatial changes, economic changes, cultural displacement, physical transformation of neighbourhoods (Saha, 2022). The Indian economy opened since 1990s and this resulted in neo-liberal economic policies fostering the economic growth of middle class (Bhagat, 2017). Indian middle class grew bigger, younger, and richer because of the economic reforms (Agarwal, 2006). The purchasing power of the middle class increased. The conservative and saving nature of the middleclass changed and the IT-outsourcing revolution brought many IT jobs to India based on the low-cost, high-skill labour force. Thus many big cities have been able to growth and gentrify their families in a single generation resulting in an affluent middle-class. Urbanisation acting as a catalyst for globalization, creates opportunities for individual enterprise and thus having an impact on many parts of the country, even though the changes are most visible in the metropolitan cities (Shaw, 2007). Urban morphological processes have transformed the cities by various trends such as urban renewal, urban rejuvenation, revitalization, redevelopment etc. (Gokhale, 2011).The processes of rejuvenation of an underdeveloped city area brings about structural and functional changes and reshuffles the socio cultural structure of those areas (Chatterjee, 2013**).** The outcome of the city redevelopment is termed differently by different scholars. Gentrification is one such term coined by urban sociologist Ruth Glass in 1964. This paper aims at understanding gentrification including the factors of the dynamics of gentrification-led displacement in core city of Pune and areas that are likely to undergo further gentrification and its impact on architectural development. It also aims to identify the displacement patterns in the city based on the factors behind the change.

2. LITERATURE REVIEW

Gentrification and urban renewal have a lot in common and yet differ from each other. Gentrification is a process whereas urban renewal is a physical action. In urban renewal there is redevelopment of the structures and gentrification is a shift in the demographics or activity from a prime location of a certain economic status. Gentrification largely affects a neighbourhood. Gentrification has always referred to both the physical and social transformation of neighbourhoods" (Badcock, 2010). Indian cities are very different from the western cities because globalization does not erase local contexts and histories of a place. (Kumar, 2014) Ruth Glass a British sociologist coined the term Gentrification for the first time in 1964 shedding light on housing and class struggle due to alterations she observed in certain areas of inner London (Glass, 1964). Gentrification is a

process of urban development where higher-income individuals move into lower-income neighbourhoods resulting in a shift of people from a city's prime location to other affordable parts (Smith, 2002). The arrival of affluent and wealthy people increases rent and property value and changes the neighbourhood's essential character (McGaffey, Vombatkere, 2018). This aspect makes gentrification a deeply rooted phenomenon in the city's social dynamics and economic trends affecting the demographic structure, land use, culture, spatial character, and real estate market (Weesep, 1994, Lees, Wylyl, 2008). Demographical changes lead to increase in median income, reduction in household size, more young singles couples. Real estate market changes reflect increase of rents and property prices and increase in luxury housing. Change in land use is characterised by an increase in office or multimedia uses, the development of live work "lofts" and high-end housing, retail, and restaurants. Culture and character changes are because of new ideas about what is desirable and attractive, including standards (either informal or legal) for architecture, landscaping, public behaviour, noise, and nuisance (Grant, 2003). Redevelopment changes the image of the space to encourage investment and the cultural change influenced by wealthier group displaces the earlier socio-cultural values and there by transforming whole character of the spaces. Gentrification does not follow any discreet process; hence whether it is in the form of displacement of population from the inner city due to the process of deindustrialisation, racial conflict or formation of new cultural capital, the various discourses of gentrification occur in various stages (Smith, 1996). Gentrification is widely identified with the supposed emergence of a new middle class because the process seems to bring with it the concentration of trendy restaurants, boutiques, other recreational and retail facilities that are frequented by the new class (Smith and Williams, 1986). The architectural scale is used to explore class-based aesthetics of gentrification (Jager, 1986). Gentrification is no longer restricted to old industrialised Western cities but it has been a global phenomenon (Atkinson and Bridge 2005; Butler 2007; Lees *et al*., 2008; Slater 2006; Smith 2002). Smith states that "gentrification is happening on a more massive scale in Shanghai or Mumbai" (Smith, 2008). Globalising cities like Mumbai, Pune have to seize opportunities for economic growth and become symbols and signs of urban globalisation. The new urban eliteand middle class, consisting of businessmen, land speculators and professionals benefiting from globalisation, is added to the old elite groups. On the other hand, the local and regional middle-class traders and commerce groups feel the impact of global competition and are losing ground. They live in fear of social decline and marginalisation. There are many examples of the vibrant economic development of the Pune Metropolitan Region (Kampen, Marcel & van Naerssen, Ton. (2008). Study of Pune with respect to gentrification and displacement is needed.

3. MIGRATION

Migration accompanied urbanisation as cities emerged as centres of economic growth with industrialisation. The nature of the city has changed from settlement to a commodity that shapes social relations, leading to unequal power, wealth, dominance, and exploitation of labour by the dominant capitalist class (Bhagat, 2017).Indian cities have evolved through in migration, out migration, and interstate migration, it has led to expanse of Pune city. The interstate migration has been the result of IT sector and large BPOs as well as floating population due to education sector. The study of migratory patterns within city essentially leads to understand the areas of future development and forecast the areas where residents are likely to get displaced by new developments. This can influence and guide the local governing authorities and the policy makers to plan necessary actions as Pune sees internal migration movement within the city too

4. PUNE A GROWING CITY

Chatterjee (2013) quotes Deb (2006) that "presently cities in India are growing according to the logic of capitalist mode of accumulation of surplus." Pune one of the rapidly growing metros with building activities catering to requirement of emerging software companies in addition to multi-national companies, has this historic city changing its cityscape of an un-believable speed.

1. The changing employment structure of Pune since 1990 has proved a major impetus to gentrification. An increase in industrial, professional, and managerial employment and high paying capacity of employees of software sector have resulted in increased demand on selected city residential areas. The city is experiencing an unprecedented increase in cost of real estate.
2. In the context of present capitalist economy, house ownership became a form of investment. Owning a home in Pune was not inherently a speculative investment but the market governance of urban real estate gives it this character.
3. Urban developers convert lower income neighbourhoods and inner-city residential units into more upscale communities with high rise apartments and wealthier tenants for renovated homes. The increases in property cost in

the prime residential areas have resulted in the dispersal of communities whose members find that housing in the area is no longer affordable. Neighbourhoods prior to gentrification often have a unique style formed by their long-time residents. As these residents become displaced by newcomers, ideas about what is attractive change, and standards for architecture, urban landscape, and public norms have been changed as well. Many buildingsin Pune that were built in 1980's was of middle class, and had its housing in critical condition and faced the threat of demolition. Today they have become prime zones for redevelopment and renewal and in some cases become affluent and upmarket urban form of housing. The city of Pune can be divided into different areas like core areas (Peth areas), central areas (Deccan, Koregaon park, boat club road) and new residential areas (Baner, Aundh, Kothrud, Bibwewadi and Hadapsar). The central areas and new residential areas see drastic rise in the property values.

5. METHODOLOGY

Photographic survey of the core city area and interviews was taken. Random sampling was selected for semi structured interviews to share their understanding of displacement from these areas. The sample size was of 30 respondents. Snowball sampling method was adopted when earlier interview suggested next person.

Figure 1: Process of Natural Gentrification Seen in Core Area

Table 1: Changes in the Pune City and Corresponding Gentrification Types

S. No.	*Forms of Gentrification*	*Area*	*Type of Changes*
1.	Classical Gentrification	Lokmanya nagar, Navi Peth. Many buildings in Shukrawar Peth, Sadashiv peth.	Old wadas demolished to have new buildings. Proposal for Old MHADA buildings to be replaced by high end towers.
2.	Commercial Gentrification	Jangali Maharaj road, Laxmi Road, G.A. Kulkarni road Kothrud.	From low end commercial to high end commercial
3.	Recreational Gentrification	Jangali Maharaj road, Shivaji nagar, Sinhagad road	From traditional cinema halls to modern multiplexes interlinked with global commodification and elite consumption patterns
4.	Rural Gentrification	Hadpsar, Bhosari,	Corporate builders' pave the way for residential development on existing agricultural land in the periphery of large cities.
5.	New Build Gentrification	City pride area-Kothrud	Limited edition high end residential areas are developed by corporate builders for very high earners who are professionally qualified. This has become prevalent after the globalization of the Indian economy.

6. FINDINGS AND DISCUSSIONS

Gentrification in Pune has taken place mainly along two distinct areas i.e., Shukrawar peth area in city core adjoining Mahatma Phule Mandai and along the Sinhgad road areas near Vithalwadi. The other is the Aundh and Baner areas. Tenements and physical transformation of the core area. Large number of residents still live-in rented apartments in

Sadashiv peth, Narayan peth, Shukrawar peth and Bhavani peth areas for two to three generations. Ignorance of the property rights of rented apartments and ownership laws has caught many inhabitants unawares. IT and automobile industry are the major contributors along with the traditional sectors like education in the phenomenal growth of Hinjewadi, Hadapsar and Kharadi. Hotel industry is also its by product. This has affected housing market creating intense pressure core city neighbourhoods and the recent suburbs like Kothrud, Baner etc. This has led to gentrification of communities. The imbalance between the supply and demand of jobs to housing has led to the migration of economically weaker section into agricultural green belt surrounding the city. Thus, increasing the time of transport and commuting back and forth. This also affects the policies of land use and planning. Higher income groups commute

from areas like Baner, Aundh and Bavadhan seeking better quality of life and amenities. The old areas like Sadashiv peth, Bhavani peth, Narayan peth etc have undergone tremendous revitalisation with new shopping centres, residential apartment, and offices coming up in these areas. These areas have become real estate markets and thus a challenge to the residents withstand this change. A resistance is observed to this shift in the character and causes of gentrification. The core areas inhabited by the Maharashtrian communities reveal that people are forced out of their homes of many years as they cannot afford the rising rent. Property owners are lured into bargains by the developers living along with the poor er neighbours becomes a social issue. Investments are done as property values shoot up.

Flow Chart 1: Gentrification Process

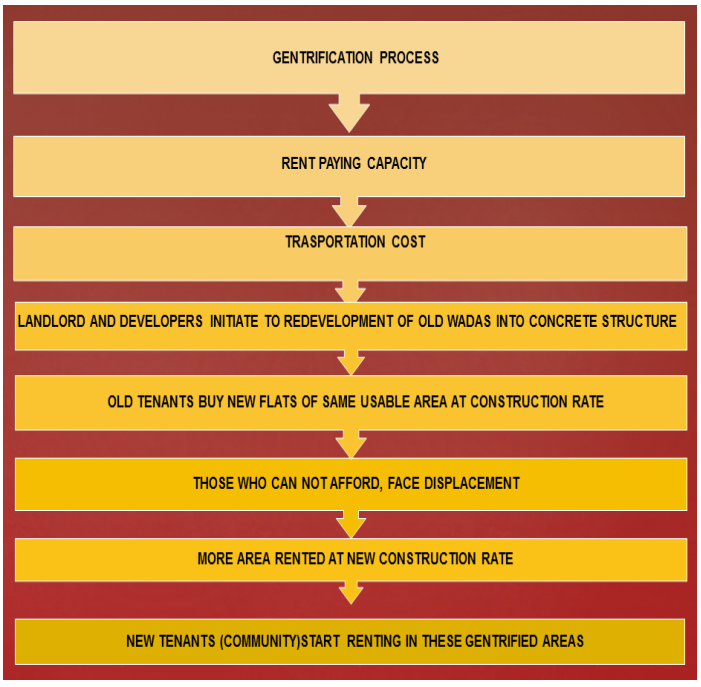

Figure 2: Redevelopment in Core City

1. Lower middle class or middle-class Brahmin families with average or good education and culturally rich. These were usually private, or government employed salaried people. 2. lower income groups of non-Brahmin families with little education and having petty business-like small shops, retail business or having small workshops or worker class activities

like house maids etc. Liquor addiction and pro crime social surroundings. Both these groups resided peacefully and symbiotically in this area for years. The housing typology that predominantly existed was the wada. The tenants living in these wada paid low rents as fixed by the Rent control Act. This led to a lot of economic loss to the landlords and building maintenance and repairs were neglected. The dilapidated conditions increased over a period leading to urban decay Economic lines distributes the residents into different areas based on their income.

After 1976 lot of wada started being pulled down by the landlords and the builders developed concrete apartments which were insensitive to wada culture. The family size was usually big, and the want of bigger space lead these people who lived as tenants especially of the brahmin class to search for ownership flats in the suburbs of Pune. Most of the residents have got displaced voluntarily for two reasons.

The first is unaffordability to pay the rising rents and second is opting for better living conditions in suburbs or because the family size has increased, and present area is small. The unorganized and economically weaker areas of Sinhgad road near Vithalwadi which were not very far away from the city centre became the target area to settle down. This area was earlier under the gram panchayat and had low tax rates and bare minimum building regulations. People bought large areas for less price. Gentrification took place along Sinhgad road near Vithalwadi because of the gentrification process initiated by urban renewal in Shukrawar peth and other city centre areas. The market force initiated urban renewal process thru society formation in the city core—Shukrawar Peth. Many of the peth residents who moved out voluntarily shifted to Kothrud for better amenities. It was found that the rent paying capacity emerges as the function of the transportation costs and thus the distance from the centre (market) matters. Thus the landlords initiated process, developed concrete apartment buildings renewing their life span. Older tenants bought the new flats for the same useable area that they had rented earlier at the construction rate and any more area if opted had to be bought at market rate. The builder making use of TDR and extra FSI built more flats which he could sell to the outsiders at market rates. Thus the new single families started to slowly come in. The economically lower families could not afford to buy bigger flats and at the same time the spill over space that existed earlier in the wada, now vanished as every inch was utilized by the developer. These people had to then move to Sinhagad road. Today Shrukrawar peth area had undergone partial gentrification.

Figure 3: Dilapidated Wada Redeveloped Initiating the Process of Gentrification Through Redevelopment

7. CONCLUSION

The social discomfort that now exists among the displaced residents could be reduced through certain policies that one can adopt to make it a win-win situation. The physical and social transformation in the neighbourhood have resulted in both positive and negative aspects of gentrification. The new byelaw and development control rules further initiate the process thru policy decisions like cluster development and agglomerations. Children and elderly are affected psychologically by gentrification. Adjustments to new school and friends is at times emotionally challenging. Relocating is a challenging task both emotionally and financially. Transportation costs increases emotional stress can lead to both anxiety and depression. On the other hand gentrification helps to revitalise the neighbourhood with better infrastructure and amenities. Property tax revenue increases and decreases the rate of urban sprawl. It also brings about better living environments. New migration trends are observed in the cities that shall provide clues to future gentrification areas.

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Daulatabad Fort— A Study of Late Medieval Landmark of the Deccan

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ABSTRACT: The Daultabad fort in Maharashtra is one of the strongest forts, invaded by Muslim rulers from Hindus, in the 12th century AD, from that period, till up to the British period, there were many changes and additions of structural elements by the various rulers.

The Paper aims to study the transformation of Daulatabad fort, one of the famous landmarks of Deccan from the late medieval period. Fort is one of the important Military typologies, Forts have played a prominent role in the military system of any Kingdom in the Medieval Period. So as per the study, the paper focused on the evolution of the Daulatabad fort, history, and Architectural interpretation over a period of time. Daulatabad fort is one of the examples of the medieval period fort, associated with the history of various rulers, development, and changes over a period of time in fort design after the introduction of Military technology. The scope of the study also focused on the condition of the fort in the contemporary period.

Case study methods have been applied to study the fort along with the literature available of this important landmark. Despite the wealth of books on religious monuments, there is a dearth of reliable literature on this particular subject: except for a few meritorious monographs, the military architecture of India is almost unknown.

The aim of the research paper is to understand and analyze the history and Architecture of the Daultabad fort in the late medieval period in Deccan and the transformation of the fort over a period of time.

In Maharashtra, there are around 450 forts out of which 49 forts are preserved by ASI and 51 forts are persevered by state archaeology. Because of lack of money and manpower, the condition of these forts is not satisfactory. The study will provide great opportunities for the historian to explore the knowledge of the forts and will be helpful to create awareness amongst the citizens.

Keywords: *Deccan, Bahamani, Daulatabad, Forts, Late Medieval period, Landmark.*

1. INTRODUCTION

Civil and Military administrations play an important role in deciding the fate of their country and people. The dynamics of the secular and welfare system are closely linked with good governance.

A fortification is a typology designed for the defense of territories in warfare and is also used to densify rule in a region during peacetime. The term is derived from the Latin fortis ("strong") and facere ("to make"). From the very early period to modern times, defensive walls were very common and necessary for the towns to survive in the world of invasion and conquest.

Jericho is the first example of forts from the Neolithic period about 7000 BC, this layout became the usual method of fortifying the City (Martin Brice, Forts and Fortress, 2005). The forts are one of the distinctive examples of medieval Deccan land forts and exemplify Bahamani style military architecture. These forts bear the administrative areas, palatial complexes, ammunition storage, and water bodies. (Major T.W. Haig, 1907 Historic landmarks of the Deccan) Forts in India were closely connected to networks of trade and communication (Gommans 2002).

Medieval-style fortifications were largely made obsolete by the arrival of cannons in the 14th century. In the age of gun powder, forts were constructed with much lower structures with ditches and earth ramparts, which can absorb and disperse

the energy of cannon fire. Walls exposed to direct cannon fire were very vulnerable, so the walls were sunk into ditches fronted by earth slopes to improve protection. (Dr. UDAY DOKRAS, 2016).

Deogiri was the earlier name of Daulatabad fort under the Yadava Period. Deogiri once was one of the leading centers of Jainism. In the 12th century, Alauddin Khilji attached on Deogiri. After that, under Tughlaqs, Daulatabad fort and city had become one of the leading cities of the world. Daulatabad was a center of great political and cultural activities. Daulatabad passed from the hands of one dynasty into the hands of the other one, yet it persisted as a focal point of Deccan politics for a number of centuries. Murar splendidly portrays the tortuous walls of Daulatabad for what they really were: one of the finest examples of human endeavor in medieval Indian history, both for the besieged and the besiegers (Mujumdar) Daulatabad, because the successive periods of the building of this most amazing fortified town can be observed from the Yadavas to the Nizamshahis i.e. from the 13th to the 17th century. Daulatabad—Ancient Devgiri, temporary capital of the Tughluqs, initial capital of the Bahamanis, temporary capital of the Nizamshahis in the later days of the dynasty, an important military and administrative center throughout the period. (Deloche, 2007)

Daulatabad was famous for the best architecture, art, craft, culture, and civilization were drawn to the heart of the Deccan. The research paper aims are to understand and analyze the history and Architecture of the Daulatabad fort in the late medieval period in Deccan and the transformation of the fort over a period of time.

In Maharashtra, there are around 450 forts out of which 49 forts are preserved by ASI and 51 forts are persevered by state archaeology. Because of lack of money and manpower, the condition of these forts is not satisfactory. The study will provide great opportunities for the historian to explore the knowledge of the forts and will be helpful to create awareness amongst the citizens.

2. LITERATURE REVIEW

2.1 Fort of Daulatabad, (Dr. Dulari Qureshi, 2004)

In this book, the author explained in detail the history of Dulatabad fort, various architectural elements, and structures left on the site along with the detailed descriptions and conditions of the structures photos, at the end author discussed the environmental degradation of the fort premises because of the tourism. The author has also mentioned some strategies and recommendations for the preservation and conservation of forts. The role and action of ASI are also explained in detail. In the conclusion, she has mentioned the Ajanta and Ellora sites, which are great tourist attractions and are UNESCO'S world heritage sites, at the same time Daulatabad fort is nearby located, now the state government has to take initiatives for Daulatabad fort become a world heritage site.

2.2 A Thousand Years of Might, Daulatabad fort by Tejas Garge (Jan. 2014)

In this research, the paper author explained the detailed history of the Dualtabad fort, various rulers, and the development in their period. The author also explained about the Bahamani period and the development of bastions and parapets to mount the cannons, as per the historic record, there was a development in military technology and the use of gunpowder and cannons introduced in this period. Therese was resultant changes on the forts. He also explained the religious places and conversion of these places under various rulers.

2.3 The Fortress of Daulatabad (Author: Deepanjan Mujumdar, Article-*Published on:* 12 December 2016)

In this article, the fortress of Daulatabad, the author has explained about Daulatabad from the Yadava period to the Maratha period. In the Yadava period, there was a fight between Ramchandra and his cousin Amana but Ramchandra succeeded (Yazdani, 1960). After that, around 1296 CE, there was an attack of AlauddinKhilji on Deogiri. In the attack, Ramchandra offered a lot of Jewellery, diamonds Pearl, etc. After Aladdin usurped the throne killing his uncle, Ramchandra paid a regular tribute to Delhi.

After Ramchandra's death, Malik Kafur occupied the citadel and a mosque was established and Deogiri also started minting coins in the sultan's name. Tughlaq period, before the transfer of the capital in 1326/27CE, the last attempt of resistance from Harapaldeva, and his aid Raghava came to naught as the last Khilji Sultan Qutb-al-din Mubarak Shah personally led his army to Deogiri.

The vestiges of the sultanate fortress city acquired prominence under the patronage of Muhammad bin Tughlaq, he also introduced substantial changes to the fort, known as Daultabad fort (City of fortunes) Under the Bahamani era (1347–1527 CE). Daulatbad became more formidable with added ramparts, a stepper scarp, and a massive ditch at the base of the fortress about 15 meters deep and 1 meter wide. After that, there was a period of NizamShahi and Mughals, and for some time it was under Marathas. To the end of this remarkable history of a fortress, the author recognizes and understands that Daulatbad, the impregnable one, it represents human history, migration, social mobility, and ambition.

2.4 M.S. Mate, 'Daulatabad—An Archaeological Interpretation', *Bulletin of the Deccan College Research Institute,* Vol. 47/48, 1988/89, pp. 207–26

In this article, the author explained and mentioned the archaeological interpretation of Daulatbad fort from earlier literature, as per the evidence available during the 10th and 11th centuries, Devgiri was a religious centre, there were around 12 to 14 temples were clustered. As per the records and brief summary of the historic events that unfolded, from the last quarter of the 12th century A.D. and relate to kings Bhillam V and Jautungi of the Yadav dynasty. Contemporary Mahanubhav literature mentions Devgiri and its other name Katak quite often and never describes it. In later Marathi literature too, the names occur several times but beyond that nothing is said. The Sukritsagara, a Jain work of the 15th century records, the construction of a Jain shrine by one Prithvikumar, and mention that Devgiri was a famous Tirth but gives no details about the place or its temple. Another record, especially Qutubuddin Mubarak Khalji, pulled down a large number of temples and constructed a mosque in their place.

Briefly stated, extant remains and monuments prove that the township of Devgiri was more religious center cum mart to begin with. Is prospered as such under the

Yadvas. The Tughlaqs and the Bahmanis were responsible for the fortification including the scarp around the hill and ditch at its foot. Nizamshahis of Ahmednagar rejuvenated and strengthened the works of these two dynasties.

3. METHODOLOGY

A various literature studies were undertaken to understand the history and architecture of the Daulatabad fort. Secondary sources such as Books, research papers and journal articles are referred. A case study method has been applied to compare and study the existing condition of the fort.

3.1 Forts

3.1.1 *The Meaning of Fort*

In ancient times, kingdoms that came into existence constructed forts, for their safety and defence. The word Durgam is used to mean impregnable or the fort that cannot be conquered.In ancient literature, forts meant 'pura'. 'Mahapura' means, the town that has safe wall (Shodhganga Thesis- Forts of Gulbarga, A historical study).

3.1.2 *Importance of the Fort*

In Panchatantra it is said about the importance of fort, "the work that cannot be contended by thousands of elephants and lakhs of horses in the war, king manages with one fort."(Shodhganga Thesis—Forts of Gulbarga, A historical study)

3.1.3 *Types of Forts*

'*Arthashastra*' by Kautilya, whereby Kautilya classifies the forts as:

1. Jaldurg (water forts),
2. Giridurg (mountain forts),
3. Vanadurg (forest forts),
4. Dhanudurg (arid/desert forts located in conditions which are devoid of a ready water supply),
5. Mahidurg (brick forts).

3.1.4 *Evolution of Forts*

The development of weaponry and armament evidently had a considerable influence on the design and development of fortifications. In Bahamaniperiod, many forts were constructed in Deccan region. In Medieval period, there was great advancement in the art of warfare. This led to changes in fort building. The height of the fortress walls, watch towers and depth and width of canals increased. Moats were introduced.

3.1.5 *Location of the Forts*

The forts were located near the river, and if there was no river on any side, it was usually encircled by a deep ditch. Many of the forts constructed on hills or on elevated ground for the protection purpose. Forts had two wall, outer and inner wall.

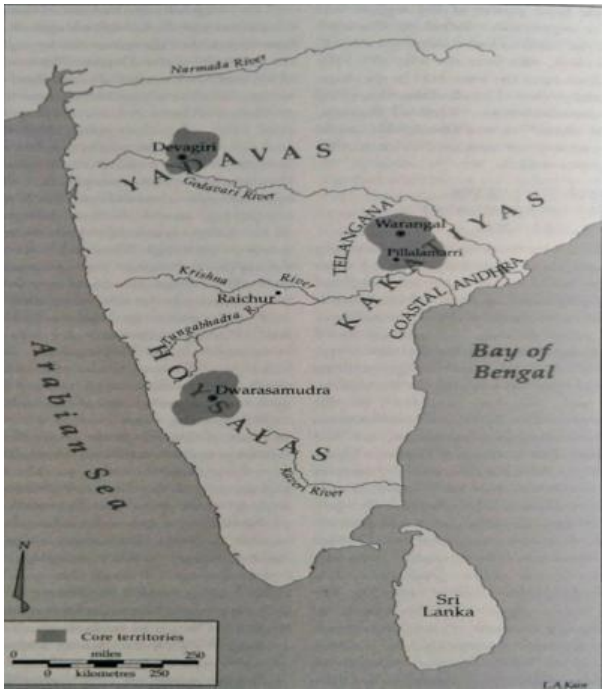
3.1.6 *Forts in Maharashtra*

Within the Deccan itself, Political unity was sporadic. Kingdom had arisen and fallen like those of Satvahans, Chalukyas, Rashtrakutas, Hoysalas, and Yadvas. The Bahamanis were important in Deccan, in their reign in 14th century to 16th century, introduction of Gunpowder in India and resultant changes in Military Architecture (PushkarSohoni, 2015)**.** Because of topography of Deccan, has always revelled in different forms of fort constructions. Its structures and architectural designs have differed depending upon their region and location, whether these are on the plains, coastal areas, and hilly terrain or in the dense forests.

3.1.7 *Daulatabad Fort Near Aurangabad in Maharashtra*

Daulatabad fort is located 16 km away on the road from Aurangabad to Ellora in Aurangabad district of Maharashtra, is one of the most unique examples of military strongholds of medieval period. Earlier name of the fort in Yadava period was "Deogiri". The fortress of Deogiri is rock situated in a plain, the rock has been excavated and a castle built on its summit. (Dr.Dulari Qureshi, 2004)

The Sultan wanted to make Devgiri his capital because it was centrally situated and equidistant from Delhi, Gujrat, Lakanati, Telangana, Malbar, DwaraSamudra and other important places. (*Source:* Shodhganga, Thesis on Daulatabad.)



An Ariel view of the fortification defence walls

The Moat is 16 m wide (Source-Google)

Figure 1: Map of Deccan, Image Source-Book Name -Power, Memory, Architecture-Richard Eaton

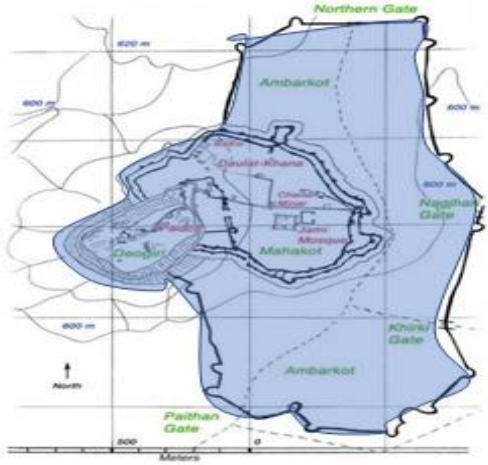
April 2022 | ISBN: 978-93-90951-55-0

4. HISTORY AND EVOLUTION OF DAULATABAD FORT

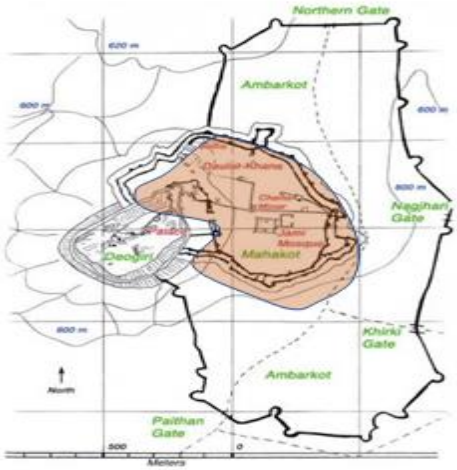
Devgiri means 'Hill of God", Devgiri was one of the leading centres of Jainism, the Yadava king Bhillam V, made Devgiri his capital, it was a prosperous town with a number of temples, after that, it was captured by Aladdin, in Tughlaqu period the name of the Devgiri was changed to Daultabad, the city of Wealth. In the Bahmani period, there were changes and additions to the moat, ditches, and the development of the water supply system. In the Nizamshahi period, many palaces were constructed, Daulatbad was a neatly planned town with religious and commercial activities. Daulatabad was under the Maratha period for 50 years.

Phase 1- During 10th and 1of1th centuries, in pre Yadava period, Devgiri was a religious centre

Phase II-The Yadav king, Bhillam V, shifted his capital to Devgiri. The existing township was perhaps enlarged, probably fortified. The main palace of Yadvas would certainly be in the lower township that is Mahakot area.

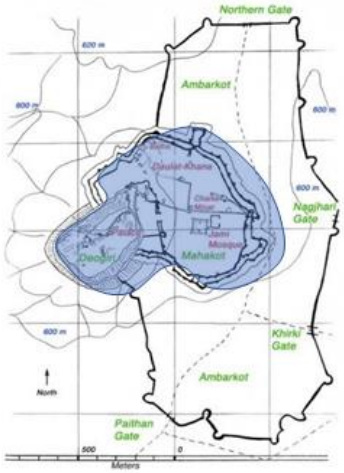


Phase III-The end of Yadva rule and establishment of Muslim rule was a process that continued for nearly 20 years, its culmination came in 1318 with the destruction of most of the temples and construction of Jami Mosque
Phase IV- The advent of Muhammad bin Tughlaq on the scene signalled the dawn of a new era



Phase V-The Bahamanis seem to be the most claimants for credit for turning Daulatabad into a redoubtable military work

Phase VI- The next phase is represented in Nizamshahi period by the addition of an inner fort, a number of luxurious palaces within it and construction of dam in northern eastern valley and raising the height of rampart of the Mahakot



Sr. No	*Date*	*Rulers*	*Events*
1.	1000–1150	**Pre Yadav**	Fast growing religious/market town with a number of temples. The hill was bare
2.	1150–1300	**Yadav**	Increase in the number of temples, cutting of caves in the hill, construction of rampart around the town
3.	1300–1350	**Khalji-Tughlaq**	Demolition of temples, construction of the Jami Mosque, laying out of the Mahakot, beginning of fortification and of Rang Mahal
4.	1350–1450	**Bahamanis**	Completion of fortifications including scarp and moat around the hill, parts of water supply system, construction of Chand Minar
5.	1450–1650	**Nizamshahis**	Construction of Kalakot, the palaces within it, dams to the north east, completion of water supply system, reinforcement of defences
6.	1650–1750	**Mughals**	Baradari and Palace in the mahakot
7.	1750–1800	**Marathas**	Maintenance of defences and Shiva temple in Mahakot
8.	1800–1950	**AsafJahis**	Mansions to the north of the Jami Mosque

Figure 2: History as per the Chronology

The architectural conceptions within the fort of Daulatbad leaves one astonished and confused. With so many successive and varied dynasties leaving their mark and impressions the fort offers the most complicated secret passages, hideouts, every self preservence defence in terms of voluminous fortification walls, with bastions, battlements, towers and fibroins, a wide moat, dark passages, ditches. Besides the several fortification walls, there are other distinctive buildings within the fort which could be classified as palaces, temples, mosques, hammams, minaret, pavilions, layers of habitation, streets. Walls and step wells. (Dr. DularaiQuershi).

5. FORTIFICATION WALLS OF THE FORT

Figure 3: Strong Bastions and Battlemented Parapet

Figure 4: Lawns and Fortification Walls with Bastion and Hanging Window

Figure 5: Entrance to Balakot, Daulatabad, Fourteenth Century

Figure 6: Royal Residence, Balakot, Daulatabad, Fifteenthcentury

The fort which according to the Indian texts falls under the classification of MisraDurg or mixed fort as it combines the qualities of Giridurg (Mountain fort), deva Durg (gods Fort), and BhumiDurg (Land Fort) The fortification walls were built at different periods by Yadavas, Khilji, Tughlaq, Bahmani, Nizam Shahi and Malik Amber and bears a marked resemblance to medieval European forts in the description of projecting towers, covered passages, and bastions.

According to the Cambridge History of India, the outer wall has a perimeter of 2¾ miles, and between it and the acropolis are three inner walls each battlemented and each furnished with fortified gateways, outworks, and bastions. The Bahamani was largely responsible for the military engineering, genius, their successors were also responsible for introducing radical changes in Military Architecture due to the initiation of artillery. AmbarKot was the exterior most wall surrounding the fort and is still popularly known as AmbarKot, built-in mid-seventeenth century it is said to have been built by Malik Ambar. The outermost wall of the fort consists of 45 bastions massively built with their connecting curtain walls and nine principal gates with their flanking bastions and towers.

The outer wall of the fort (Mahakot) is two- or three-quarter miles in circumference. This wall enfolded the entire city and was built around the base of the fortress and which can still be traced by a cluster of ruins embosomed in the perfect wilderness of custard apple trees and jungles. Moats and bridges are constructed to enter the main citadel The technique to strengthen the fortification walls by means of the use of half-round projecting towers had its origin in Baghdad around the 12th century AD. This technique was used to great extent and rampantly at Daulatabad fort in around 1327 AD. While constructing the fortified wall around Daulatbad town and fort most advanced techniques were developed in the construction of Bastion.

Figure 7: Bastion and Fortification Wall

Figure 8: Moat (Interior) Source-Qureshi Book

Figure 9: Bridge Interior

5.1 Military Advancements

Under Tughlaqs period, in 1326/27 CE, there was a revolution in military architecture in the Islamic world and prompted by new technologies of siege brought on by the Crusades and the Mongol movement, there was a substantial change to the fort of Daulatabad (City of Fortunes).

With the round bastions, a deeper and wider moat, combined with the counterscarp andglacis, the fort gradually acquired the much-vaunted aura of an unbreachable stronghold (Gommans 2002). IbnBatutta visiting Daulatabad on a tour of Malabar from Delhi in 1342 CE remarks that the fort has no equal in Hindustan in terms of impregnability. The fortalready had three divisions: the lower city, the middle 'kataka' and the uppermost citadelwhich was insurmountable (Deepanjan Mujumdar, The fortress of Daulatabad, Academia Research Paper, 2014).

Figure 11: Cannon at Daulatbad Fort

Figure 12: Cannon at Daulatbad Fort

Under the Bahmanis (1347–1527 CE) Daulatabad became more formidable with added ramparts, a steeper scarp and a massive ditch at the base of the fortress about 15 metres deep and nine metres wide. It was of great strategic importance in guarding the northern frontier of the Bahmani state versus the rising power of the post-Tughluq regional states. Flanking towers, however, are not ancient. They have been modified or rebuilt according to different principles of fortification. Most of them are massive, made of stones laid with lime mortar, circular in shape, topped by battlements of parapet (merlons are 2.20 m high, 1.40 m wide and 1.10 thick) adapted for defence by musketry and guns. (Jean Deloche, 2009)

Their most impressive architectural accomplishment is undoubtedly the Chand Minar (Pillar of Victory), erected near the Jami Masjid in 1435 by Ala-ud-din Bahmani to commemorate his gift of the fort from King Ahmad Shah Bahmani of Bidar (r.1422–35).

(Stephen Markel, Once the capital of India, The great fort of Daulatabd)

Figure 10: Storage for Ammunition

Figure 13: Detail of the Inscription on the Barrel of the QilaShikan Canon

Figure 14: View of Mendha Canon

Figure 15: Duraga Tope
(*Source:* TejasGarge Research Paper)

At Daulatabad, on the second enclosure, to the south of Delhi Darwazah, one tower has been raised three times above the parapet of the curtain walls and, in its upper outer face, it has been strengthened by vertical buttresses *(Figure;* another one, with box machicolations has been heightened twice. There are several towers, on the first enclosure, to the north-west, up to the level of curtain walls, with an upper part, made up of semi-circular wall and rectangular holes for cannons, enclosing two guardrooms, obviously of a later period.

Finally, at Mudugal, there are massive constructions rising 4 m above the curtain walls (i.e., about 10 m from the fausse-braye), about 8 m wide and projecting 4 m, accessible on the inner side by two staircases (forming an inverted trapezium in elevation): these powerful elaborated towers *(Figure)* were built at the end of the 16th century. (Book-Studies of fortification in India, Jean Deloche)

5.2 Religious Activities on the Fort

1. **Cave temples of Devgiri Fort:** Caves are located on the eastern ridge of the fort, around 400 steps from KalakotDarwaza. Caves are extremely in ruined condition and blocked today by a thick growth of wild bushes and trees. There are around 5 caves on the forts and mostly form pre Yadava period and the caves probably comprised Jain sculptures and belonged to the Jain origin.
2. **Jain Temple Dedicated to Goddess Kali:** This temple is situated towards the left of the minar and was converted as a mosque. It was an active mosque and was also used for festive occasion like Ramzan Id and Bakri ID.
3. **The Bharat Mata Temple:** This temple dedicated to India is one of the oldest and most important structures, which follows the classic plan of a mosque with access from three sides and buttresses (pseudo minarets) on its four corners. The architectural remains used in construction of this mosque clearly indicate that they are derived from the temples of the Yadava period, circa 10th –11th C.C.E. By reusing pillars, brackets and capitals as well as the stone debris of temples a mosque was built during the reign of QutubuddinMubaraqKhilji (1318 C.E.) known as Jama Masjid (Friday Mosque).
4. **A Temple and Mosque Near Kala Kot:** Around fifty feet from Kala kot gate towards the north is another pillared temple converted into mosque.
5. **Bhavani Temple:** A short distance to the right of the third gateway are the remains of what once is an elegantly Hindu temple dedicated to Goddess Bhavani. The central part of the temple is engrossed by a flight of steps leading to the roof of the temple which is flat.
6. **Dargah shah Aziz Quattal**: The dargah is in a bad condition. Towards, its west is a mosque.
7. **Step Wells**: The step wells of Daultabad offer a rich variety of the Hindu water system. Step wells of Dualtabad have immense artistic and architectural value. Four step wells are prominently seen presently.
8. **Palaces within the fort of Daulatabad:** Most of the palaces are in a very bad state of ruin. The ASI under whose control and responsibility lie the palaces seem to have neglected the maintenance of the palaces. The beautiful arches, niches, towering walls of the palaces, intricate designs, decorative motifs etc will become history if ASI does not take its first and foremost responsibility of preserving, restoring and repairing the historical memories.
9. **Chand Minar**: Chand Minar built by Sultan AlauddinBahamani (Ahamadshah-II) constructed this *minar* in memory of his victory over Gujarat in 1435 C.E. It is constructed with stone, decorated with coloured tiles and has four floors with spiral staircases inside. Small windows are provided at regular intervals for light and air ventilation. On one side of the *minar* is a mosque and on the other side is a Nagar Khana. A minaret visible from miles attract attention of all tourists, is a tower of victory, built by Sultan AlauddinBahman Shah. The minar does not have any functional value but is more a decorative piece of architecture. Chand Minar not only compares in height 21oft, with QutubMinar but also in its glory and Grandeur. The Chandminar from the top offers a beautiful view of the entire area. The Chandminar from the top offers a beautiful view of the entire area.

5.3 Inferences/Existing Condition of the Fort

Daulatabad Fort is an impressive monument, dominating the encompassing landscape by road from Aurangabad to Ellora. The fort of Daulatabad, anciently known as Devgiri, has been recognised by all scholars as perhaps the strongest piece of military architecture of medieval Deccan. History of the fort as per the chronology and architectural planning of Daulatabad fort, the various emperors made changes and created a great history, and constructed the structures as per their culture and requirements. It is also observed that as per the changing Military technology there were changes made in the planning of the forts which is already mentioned in the report and strategies and tactics assumed at the time of war under various emperors. But in today's context, many of the monuments are in ruined condition. As per the observation, the offensive transformation of Daulatabad's present environmental hazards and pin point natural reserves being rapidly turned into commercially managed tourist destinations. Daulatabad fort since the last few decades has witnessed a dramatic increase in tourist pressure which has resulted in the degradation of its environment. There has been no dearth of rules and regulations, or a formulation of conservation and preservation policy either by the union or state government. Researchers have started

digging into the conservation of heritage destinations and creating awareness amongst archaeologists, tourism departments to control adverse growth in and around the monuments especially those under the Archaeological Survey of India. Another problem is parking space created immediately outside the walls of the fort on **either side of main gate, the brick kiln exactly behind the fort**, bordering the Chandminar.

Some structures are illegally occupied, without any maintenance resulting in collapsing on the structures and vegetation growth above and around the domes. Apart from that, there are several problems within the fort, the first fortification wall through which a tourist passes have collapsed partially and its gates have disappeared. On the entrance through the main gateways as one enters the huge spacious courtyard, on the right-hand corner is another closed gate, within the gate the constructed area is utilized for garbage dumping, parking space for the employees, and storage space. Huge thick ropes from the medieval period and medieval objects are stored in arched openings. The huge thick rope is unique of its kind and definitely used during the royal residency period. This rope can be exhibited as a piece of museum object instead of allowing it to rot in this forlorn corner of the fort. Palatial building and their problems of conservation since Daulatabad have been under the domination of at least seven different dynasties, it is but natural that each of them leaves memorable imprints of their royal period., each distinctive in its own architectural styles. Many of the structures in the fort are in dilapidated conditions. Graffiti work is another problem, visitors enciphered their names on the structures.

6. CONCLUSION

As we come to the end of this remarkable history of a fortress, and transformation over a period of time under various rulers should recognize and understand that Daulatabad, the impregnable one was much more than just a stronghold. It represents the human history, migration, social mobility, ambition. It is truly a palimpsest that subsequent groups, warlords, and armies have etched for centuries to create overlapping layers of architecture, history, and myth. It would thus hardly be an exaggeration to say that even today the aura of impregnability that immediately strikes a modern visitor to the fort is not much different from the sultanate and the Mughal experiences.

The quality of the building and environment around most Indian monuments is steadily deteriorating and this is so true of Daulatabad fort so rich in medieval architectural structures towering minar commanding attention, colossal fortification walls surrounding comprehensive area elevating its towering presence. In this 21st century preserving such antiquated monuments is an absolute necessity, we have to be especially conscious about this issue because the transformation process is very fast. In the nearby surrounding, the Ajanta and Ellora are UNESCO 'S world heritage sites, Historians like Dr. R.S. Morwanchikar are instrumental in attracting the attention of the state government and UNESCO the inclusion of the fort as a world heritage site. At the same time, it will provide great opportunities for the historian to explore the knowledge of the forts. Once again, we will experience, understand this military typology, and associate the history of historical events in the past and will keep our precious treasure intact for future generations!!

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Green Concrete *vs.* Conventional Concrete: A Comparative Study

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ABSTRACT: Construction is one of the world's most important industries, accounting for 13% of global GDP and 38% of carbon emissions. The future is on the verge of collapse if the carbon emissions are not made under control or counterattacked with practices that offset the carbon emissions making it neutral and less harmful. Green concrete is a highly potential structural material that can very effectively replace the use of conventional concrete from the market. It is an eco-friendly form of concrete that utilizes at least one of the waste materials produced from other industries such as fly ash, demolition waste aggregate, blast furnace slag, etc. The research examines green concrete in terms of technology, composition/mix design, & cost. The paper contains multiple stages of analysis under which both the specimens have been compared such as compressive strength, tensile strength, etc. The research examines the influence of different mix designs by substituting concrete with fly ash& aggregate with quarry dust in different quantities.

Keywords: *Green Concrete, Quarry Dust, Fly Ash, Fly Ash Aggregate, Workability, Tensile Strength.*

1. INTRODUCTION

The construction business has gone through many changes in techniques and materials from the early days of mud construction when concrete had not yet been developed and was considered a rare material. The same concrete, on the other hand, is now a basic and popular material, and the world is pushing for greater advancement. Concrete, the second most utilised substance on the earth after water, is used to create our man-made environment. The construction industry has witnessed technical growth at every level of development, such as from cast-in-situ to precast, pre-stress, post-tension, and so on, but the material side of these technologies has seen substantially less development. Bisht *et al.* [1] Every year, cement manufacturing releases a substantial quantity of carbon dioxide and other dangerous chemicals into the atmosphere, posing a serious threat to the global environment. If India wants to cut CO_2 emissions by 1 million tonnes by 2030, it must reduce emissions from cement production alone. This challenge necessitates a one-of-a-kind solution that reduces cement usage, resulting in lower emissions.

Agarwal et al. [2] Green concrete is basically concrete made from environmentally friendly waste products. At least one recycled waste material, such as demolition waste aggregate, is used. In the future, green concrete may emerge to be much more efficient than ordinary concrete in terms of performance, life span, carbon emissions, and other aspects. The study focuses on the components of green concrete, which will ultimately replace conventional construction techniques and lead to a more environmentally green and sustainable future with increased material strength, preparing humanity for future natural calamities.

The paper aims to studya better understanding of the long-term impacts of adopting sustainable concrete types. Certain objectives of the study are: (a) Examine the material's integrity, (b) to establish the critical need of adopting environmentally friendly materials on building sites, (c) analyse the various mix designs, (d) to investigate the material's advantages and structural behaviour. The paper's scope is an analytical approach that may help address the present pressing challenges of climatic and environmental dangers created by construction. The study limits performing physical experimentation and therefore relies on existing experimental data.

2. LITERATURE REVIEW

Gutierrez [3] India is now a developing country, but by 2035 it will be a superpower. This implies that India would be a superpower by then, with a robust economy, vehicles, stock markets, food, and transportation sectors, and a solid infrastructure mainly dependent on our construction industry. The industry must rapidly evolve and test new sustainable materials and technologies. Why do the America employ a construction technique that India hasn't adopted? No green

concrete or other sustainable materials on-site? This might be due to a lack of information, cost, or structural strength. India is the third-largest emitter of greenhouse gases, with concrete, cement, and other building materials accounting for a considerable share of emissions. From the statistics, it seems that we need to revolutionise our industry, innovate and promote the usage of eco-friendly materials and practices. Resources like bricks are rapidly being replaced by more sustainable materials. Sustainable materials include solar concrete façade cladding, bamboo, hempcrete bricks, and wood crete. These materials are commonly used outside India, but not in India. Rather than addressing future materials, the focus is on sustainable structural materials in India. The emphasis is on replacing conventional concrete with green concrete. This strategy might transform the Indian construction industry and lead India to a sustainable future.

3. MATERIAL AND METHODOLOGY

For data collection, the study used a variety of primary and secondary sources. It is based on a rational approach that is necessary to demonstrate green concrete's potential as a viable alternative to conventional concrete. The research uses secondary sources to discuss the composition and mechanism of green concrete. The paper also presents a cost comparison between 1cubic metre of conventional concrete and green concrete, which is a key outcome in the study. The third phase involves analysing the study's findings and identifying possible benefits of the replacement.

3.1 About Green Concrete

Agarwal et al. [2] Green concrete is a form of concrete that is manufactured from environmentally friendly waste materials. It incorporates at least one waste component, such as demolition waste aggregate, recycled concrete aggregate, blast furnace slag, manufactured sand, glass aggregate, and fly ash. The goal is to create a form of concrete that incorporates as many recycled elements as possible and leaves the smallest carbon footprint possible. Green concrete is a term that refers to concrete that has undergone additional processes throughout the mix design and installation stages to provide a long-lasting structure that requires minimum maintenance. Additionally, it should be high-performing and long-lasting throughout its life. In other words, green concrete is a kind of concrete that is environmentally friendly. Green concrete contributes to the enhancement of sustainability's three pillars: environmental, economic, and social impacts. To assess if the concrete is green, the quantity of Portland cement substitute materials, the production method and procedures, the performance, and the life cycle sustainability effects are all taken into account. Green concrete is cost-effective to produce since it is built entirely of recycled materials and lowers energy use while enhancing strength and durability. *Goyal et al.* [4] Numerous features such as mechanical properties, fire resistance, durability, strength, thermodynamic properties, and environmental properties are considered while creating green concrete.

Glavind et al. [5] Despite the need for advancements in automated building, the sector also needs structural eco-friendly materials to sustain the automation era. As the construction industry advances, it confronts new obstacles. Numerous materials exhibit favourable qualities for green concrete production and provide a significant opportunity to boost material recycling. Six aspects must be examined when evaluating the environmental effect of green concrete: (1) mechanical properties (strength, shrinkage, creep, static behaviour, etc.), (2) resistance to fire, (3) workmanship (workability, strength development, curing, etc.), (4) durability (corrosion protection, frost, new deterioration mechanisms, etc.), (5) thermodynamic properties, (6) environmental aspects (CO_2-emissions, energy use, and recycling etc.)." The fundamental requirements that a Green concrete construction must meet are as follows: CO_2 emissions must be reduced by at least 30%; at least 20% of concrete must be made from recycled materials; utilization of leftover materials from the concrete industry; utilization of new forms of residual goods that were previously landfilled or disposed of in various ways; CO_2-neutral waste-derived fuels should account for at least 10% of the cement output. Additionally, green concrete is classified into two categories: aggressive environmental class (outdoor) and passive environmental class (indoor), which differ in terms of strength and the number of days required to attain the necessary strength.

Goyal et al. [4] When manufacturing green concrete, reduce, reuse, and recycle procedures, or any two processes in concrete technology, should be used. The green concrete concept has three primary goals: to reduce greenhouse gas emissions, to reduce the consumption of natural resources such as limestone, shale, clay, natural river sand, and natural rocks, and to minimise the use of waste materials in concrete that pollute the air, land, and water. The use of green concrete will result in long-term growth that does not deplete natural resources. To make green concrete, some of the cement might be substituted with fly ash, sludge ash, or any other substance having cementitious properties. Fine aggregates may be substituted with quarry dust or iron slag in the appropriate amounts, whereas coarse aggregates can be substituted with silica fume, discarded glass, etc.

3.2 Composition/Mix design

Khazaleh *et al.* [6] Green concrete incorporates at least one waste component, such as demolition debris, as a primary component in place of cement and aggregate. The following are some cement substitutes that may be utilised in the mix design of green concrete:

(i) **Blast Furnace Slag:** green concrete contains granulated blast furnace slag, steel slag, and flu gas desulfurization gypsum. Barnacles cannot foul this concrete because it lacks portlandite. The concrete's attachment allows for algae growth.

(ii) **Fly Ash:** The substitution of fly ash for cement enables the achievement of high compressive strength and fracture toughness at specific percentages of 0%, 20%, and 30%, as shown by Grzegorz Ludwik Golewski in his 2018 testing.

(iii) **Silica Fume:** A combination of silica fumes and marble debris may be used to substitute cement and improve concrete strength and longevity. This reduces adverse environmental impacts by up to 30% by lowering cement usage.

(iv) **Recycled Glass, (v) Date Palm Ash:**
Here are a few aggregate substitutes that may be utilised in green concrete mix designs-: (i) foundry sand, (ii) waste plastic, (iii) demolition waste, (iv) farming waste, (e) electronic waste.

Table 1: Potential Replacement for Cement & Aggregate. *Baikerikar* [7]

Sl. No	TRADITIONAL INGREDIENTS	REPLACEMENT MATERIALS FOR GREEN CONCRETE
1.	CEMENT	ECO-CEMENT, SLUDGE ASH, MUNCIPAL SOLID WASTE FLY ASH
2.	COARSE AGGREGATES	RECYCLED AGGREGATES, WASTE READY MIX CONCRETE, WASTE GLASS, RECYCLED AGGREGATES WITH CRUSHED GLASS, RECYCLED AGGREGATES WITH SILICA FUME.
3.	FINE AGGREGATES	FINE RECYCLED AGGREGATE, DEMOLISHED BRICK WASTE, QUARRY DUST, WASTE GLASS POWDER, MARBLE SLUDGE POWDER, ROCK DUST AND PEBBLES, ARTIFICIAL SAND, WASTE GLASS, FLY ASH AND MICRO SILICA, BOTTOM ASH OF MUNCIPAL SOLID WASTE

Kumar et al. [8] Certain studies were carried out to better understand the mix design of green concrete, with quarry sand and fly ash serving as the core elements instead of river sand and cement. 1: 1.39:1.7 (cement: river sand: crushed stone aggregate) and 1: 1.37: 1.7 (cement: quarry dust: crushed stone aggregate) were the two M40 grade mixes utilised. For both mixtures, the water-cement ratio adopted in the test was 0.40. To make structural grade concrete, a large amount of high calcium fly ash (ASTM Class C) was utilised, with proportions of 40 percent, 50 percent, 60 percent, and 70 percent substituting cement. For all testing, the ratio of fly ash to cement was kept constant at 1–1.25. Before analysing the test findings, below are some preliminary data on the material's individual properties:

Table 2: (a) Physical properties of cement and fly ash; (b) chemical properties of fly ash; (c) physical properties of fine aggregate and coarse aggregate; (d) details of mix proportions of concrete; (e) results of workability tests on concrete. *Kumar et al.* [8]

Sl.no	Property	Cement	Fly Ash
1	Normal consistency	29%	40%
2	Initial setting time	63 min	150 min
3	Final setting time	240 min	-
4	Specific gravity	3.15	2.412
5	Fineness of cement by sieve	1.2%	2.26%

(a)

Properties	Percentage
Ca O	12.90
Si O2	44.5
Al2 o3	21.1
SO3	7.81
Na2o	6.25
K2O	0.80

(b)

S.No	Property	Fine Aggregate(Sand)	Fine Aggregate(QD)	Coarse Aggregate
1	Specific gravity	2.63	2.41	2.707
2	Fineness Modulus	2.46	3.77	5.914
3	Uniformity co-efficient	3.33	9.28	1.479
4	co-efficient of curvature	0.948	1.06	1.201

(c)

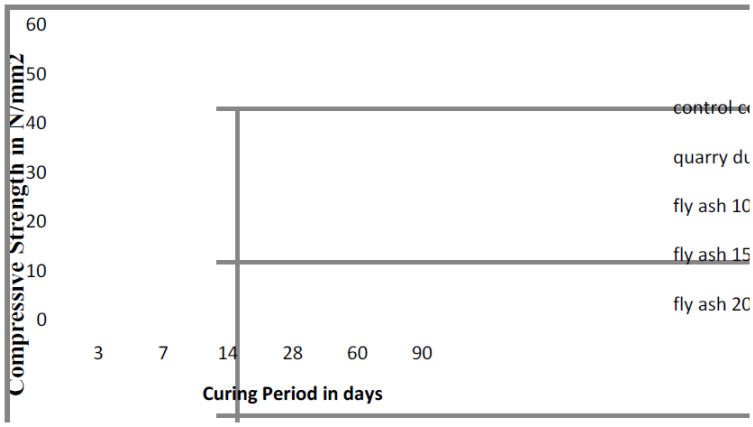
Sl No	Materials Used	CC	QCC	$QCFA_1$	$QCFA_2$	$QCFA_3$
1.	Fly ash (F.A)%	0	0	10	15	20
2.	Superplasticer (S.P) %	0	2.0	2.0	2.0	2.0
2.	Cement (Kg/m^3)	530	530	477	450	424
3.	Fly ash (Kg/m^3)	0	0	53	80	106
4.	Sand (Kg/m^3)	740.25	0	0	0	0
5.	Quarry dust (Kg/m3)	0	725	725	725	725
6.	Coarse aggregate (Kg/m^3)	901.53	901.53	901.53	901.53	901.53
7.	water(lit/m^3)	212	212	212	212	212
8.	Superplasticer (lit/m^3)	0	10.6	10.6	10.6	10.6

(d)

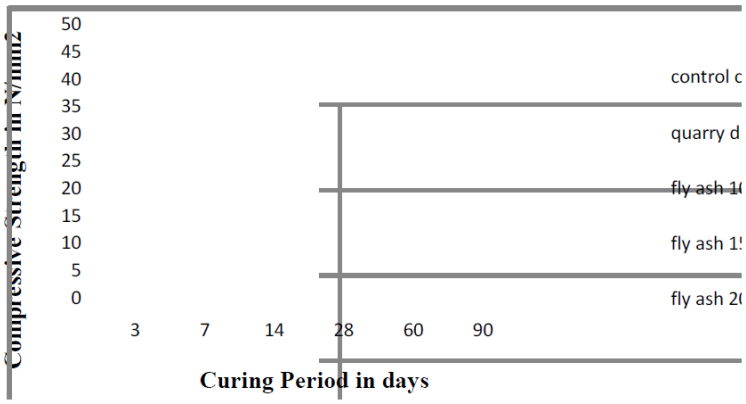
Type of concrete	Slump value Mm	Compaction Factor	Flow %
CC	85	0.88	42
QCC	94	0.90	35
$QCFA_1$	80	0.8	41
$QCFA_2$	78	0.77	44
$QCFA_3$	76	0.74	51

(e)

The experiment was conducted using concrete blocks made in the shape of 60 cubes and 60 cylinders. Strength, workability, and tensile strength tests were often conducted over a period of 3, 7, 14, 28, 60, or 90 days. The slump value reduces in Table 2(e) significantly at first and then gradually declines as a result of the addition of quarry dust. This is because quarry dust has a larger water absorption capacity, and the characteristics of fine aggregate lead the capacity to fall further.



(a)



(b)

Figure 1: (a) Cube Compressive Strength; (b) Cylinder Compressive Strength. *Kumar et al.* [8]

Kumar et al. [8] QDC (quarry dust concrete) has a slightly lower compressive strength than ordinary concrete in Figure 1, which is attributable to the quarry dust's poor particle grading. At 28 days, the same findings were made about the cylinder specimen evaluated for compressive strength. The tensile strength of sand concrete and QDC with 10% fly ash is almost the same as seen in Figure 2. Thus, substituting river sand for quarry sand sometimes improves compressive strength. The loss of early strength in fly ash concrete may be easily compensated by adding quarry dust, while the loss of workability in QDC can be mitigated by adding some fly ash. Hence we can replace conventional river sand to quarry dust with a partial fly ash mixture, which can be observed in the experiment. The initial setting time of green concrete, more precisely fly ash-based concrete, rises from 150 minutes to 200–250 minutes, depending on the amount of fly ash used to substitute cement.

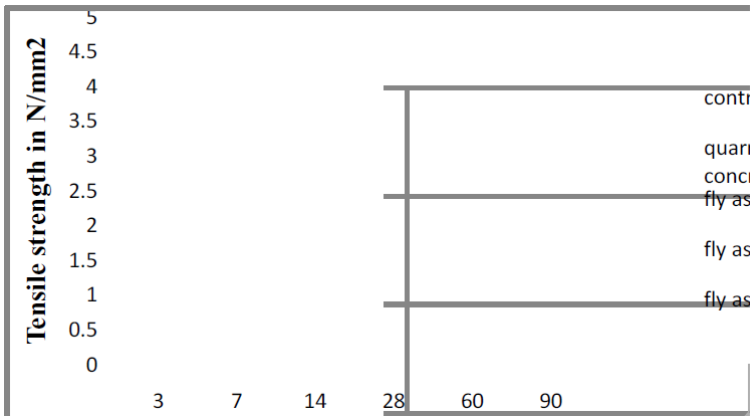


Figure 2: Cylinder Split Tensile Strength of Different Mixes. *Kumar et al.* [8]

3.3 Cost Analysis of Green Concrete *vs* Conventional Concrete

Box [9] The cost analysis of two concrete mixtures with fly ash in place of cement and bottom ash in place of fine aggregate for a binder content of 333 kg/m^3; and fly ash in place of cement, bottom ash in place of fine aggregate, and fly ash aggregate in place of coarse aggregate for a binder content of 389 kg/m^3 were performed. A cost comparison of conventional and green concrete with fly ash, bottom ash and fly ash aggregate was conducted using relevant research to determine the economic feasibility of concrete.

(i) *Cost analysis of green concrete using fly ash and bottom fly ash with 333 kg/m^3 of cement content*

Box [9] The cost of one cubic metre of conventional and green concrete was determined. The cost analysis was conducted using a proportional replacement for cement and fine aggregate, with a compressive strength of green concrete ranging from 28 to 180 days. Costs of construction materials such as cement, aggregates, and HRWRA were considered. The compressive strength at 28 to 180 days was used for the cost analysis since green concrete developed strength as it cured. The cost analysis was conducted using the replacement quantity and the strength properties of fly ash and bottom ash in concrete. The cost of 30% fly ash, 30% bottom ash, and 30% fly ash + 30% bottom ash was examined.

Table 3: (a) Cost analysis between normal and green concrete (30 FA, 30 BA and 30FA30BA) (Cement content of 333 kg/m^3); (b) Cost analysis between normal and green concrete (40FA, 100BA and 40FA30BA, 40FA60BA, 40FA100BA) (Cement content of 333 kg/m^3). *Box* [9]

Material	Unit per	Rate in INR	Normal concrete		Green Concrete					
			30 MPa		30FA [50-60MPa]		30BA [40-55MPa]		30FA30BA [40-60 MPa]	
			Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)
Cement	Bag	290	333.0	1931.40	233.1	1351.98	333.0	1931.4	233.1	1351.98
Fly ash	m^3	65	0.0	0.00	99.9	2.32	0.0	0.0	99.9	2.32
20 mm	m^3	940	516.3	175.21	516.3	175.21	516.3	175.2	516.3	175.21
12 mm	m^3	871	774.4	249.84	774.4	249.84	774.4	249.8	774.4	249.84
Sand	m^3	110	754.0	31.42	754.0	31.42	527.8	21.9	527.8	21.99
Bottom ash	m^3	65	0.0	0.00	0.0	0.00	204.0	5.5	204.0	5.57
water	litre	0	0.0	0.00	0.0	0.00	0.0	0.0	0.0	0.00
HRWRA	litre	180	1.1	209.79	1.6	300.60	1.6	300.60	1.6	300.60
Total cost				2597.66		2111.37		2684.62		2107.52
% Savings				-		18%		-3.35%		19%

INR- Indian Rupee, FA- Fly ash, BA- Bottom ash, HRWRA- High range water reducing admixture

(a)

Material	Unit per	Rate in INR	Normal concrete		Green Concrete									
			30 MPa		(40 FA) [35-40MPa]		100BA [30-45MPa]		40FA30BA [40-55MPa]		40FA60BA [30-40MPa]		40FA100BA [20-35MPa]	
			Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)
Cement	Bag	290	333.0	1931.4	199.8	1158.84	333.0	1931.40	199.8	1158.84	199.8	1158.84	199.8	1158.84
Fly ash	m^3	65	0.0	0.00	133.2	3.09	0.0	0.00	133.2	3.09	133.2	3.09	133.2	3.09
20 mm	m^3	940	516.3	175.21	516.3	175.21	516.3	175.21	516.3	175.21	516.3	175.21	516.3	175.21
12 mm	m^3	871	774.4	249.84	774.4	249.84	774.4	249.84	774.4	249.84	774.4	249.84	774.4	249.84
Sand	m^3	110	754.0	31.42	754.0	31.42	0.0	0.00	527.8	21.99	301.6	12.57	0.0	0.00
Bottom ash	m^3	65	0.0	0.00	0.0	0.00	680.0	18.57	204.0	5.57	408.0	11.14	680.0	18.57
water	litre	0	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
HRWRA	litre	180	1.1	209.79	1.8	329.67	5.5	1006.20	1.8	329.67	4.1	748.80	7.9	1438.56
Total cost				2597.66		1948.07		3381.23		1944.22		2359.50		3044.12
% Savings				-		25%		-7.39%		25%		9%		-17%

INR- Indian rupee, FA- fly ash, BA- bottom ash, HRWRA- High range water reducing admixture

(b)

Fly ash and bottom ash were found to be cost-effective substitutes for cement and fine aggregate in the above study of the cost of green concrete with a binder concentration of 333 kg/m^3 and a design pressure of 25 to 55 MPa. Due to its water absorption capacity in concrete, 100 percent bottom ash increased the HRWRA dosage while eliminating the need for natural river sand in construction.

(ii) *Cost Analysis of Green Concrete Using Fly Ash, Bottom Ash and Fly Ash Aggregate with 389 kg/m^3 of Cement Content*

Box [9] The green concrete cost analysis takes into consideration the cost of calcium hydroxide, cement, fly ash, and the power needed by the pelletizer to manufacture fly ash pellets. The cost of producing 100 kg of fly ash pellets was 50 INR. The cost of green concrete containing 30% fly ash, 30% bottom ash, and 20% fly ash aggregate was 2633.93 INR, or 14% less than the cost of conventional concrete, which was 3066.66 INR as seen in Table 4. The cost of making green concrete using 30 percent fly ash, 30 percent bottom ash, and 20 percent fly ash aggregate was reduced by 14 percent. The concrete's compressive strength ranged between 45 and 50 MPa (28 to 180 days).

Table 4: Cost Analysis of the Green Concrete with Fly Ash, Bottom Ash and Fly Ash Aggregate (cement content of 389 kg/m^3). *Box* [9]

Material	Unit per	Rate in INR	Normal Concrete		Eco-friendly Green Concrete 30FA30BA20FAA [45-50 MPa]	
			Quantity per 1m^3 (kg)	Rate (INR)	Quantity per 1m^3 (kg)	Rate (INR)
Cement	Bag	290	389.0	2256.20	272.3	1579.34
Fly ash	m^3	65	0.0	0.00	116.7	2.71
20 mm	m^3	940	511.4	173.54	409.1	138.83
12 mm	m^3	871	767.0	247.43	613.6	197.94
FAA 12 mm	kg	50	0.0	0.00	117.4	58.71
FAA 20 mm	kg	50	0.0	0.00	78.2	39.14
Sand	m^3	110	715.6	29.82	302.0	12.58
Bottom ash	m^3	65	0.0	0.00	193.5	5.29
Water	litre	0	0.0	0.00	0.0	0.00
HRWRA	litre	180	1.9	359.64	3.3	599.4
Total cost				3066.63		2633.93
% Savings				-		14%

INR- Indian Rupee, FA- fly ash, BA- bottom ash, FAA- fly ash aggregate, HRWRA- High range water reducing admixture

Box [9] The cost analysis of green concrete demonstrated that the addition of fly ash, bottom ash, and fly ash aggregate enhanced technical, environmental, and economic efficiency without losing strength and durability. This method of building replaces cement with fly ash, fine aggregate with bottom ash, and coarse aggregate with fly ash aggregate. This will provide the framework for future study by decreasing the usage of natural river sand, quarrying natural rocks, and safeguarding natural land from fly ash and bottom ash disposal. Buildings made of fly ash, bottom ash, and fly ash aggregate promote green technologies and long-term development for future generations. As a result, green concrete with a cement content of 333 kg/m^3 saved up to 25% of the cost of conventional concrete, but only 14% with a cement content of 389 kg/m^3. Green concrete composed of fly ash, bottom ash, and fly ash aggregate may be produced to be cost-effective and ecologically friendly with the inclusion of HRWRA and a longer curing period, without losing the strength and durability of conventional concrete.

4. RESULTS AND DISCUSSION

It is evident that green concrete is a better form of concrete than conventional concrete, whether it be in terms of compressive strength, tensile strength, or other important properties. Green concrete is much cheaper and helps in recycling waste materials, therefore reducing the demand for cement.

Some potential advantages of using green concrete are: (a) green concrete encourages the use of waste materials, which decreases cement and aggregate production, decreasing CO_2 levels in the environment; (b) better structural performance and cost savings as compared to traditional concrete; (c) by reusing waste materials in construction, it helps to prevent landfills and, as a result, protects our flora and fauna.

5. CONCLUSION

Based on the findings of the research, we as a generation urgently require a more ecologically friendly building material that may be utilised to replace conventional concrete construction. In terms of properties like compressive strength, workability, and tensile strength, it can be observed that green concrete outperforms conventional concrete substantially. The cost of green concrete is a crucial component that makes it more practical to utilise on the construction site. While researchers and scientists continue to turn this concrete into a more major contributor in the construction industry and to make it the next conventional concrete, it has the potential to be a game-changer in the long run, especially for large infrastructure development projects.

Although the cost of 1 cubic metre of green concrete is less, the recycling of waste materials might add an additional cost. But this somewhat can be neutralized by scaling the production of green concrete. The scope of future research can be to adopt the use of recycled toxic waste materials into the concrete, to eradicate the existence of harmful substances. India, the world's second-largest cement producer, has to reduce production and use more ecologically friendly construction techniques. As a result, green concrete should be used more often on building sites, maybe in lesser amounts to begin with.

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The Lesser-Known Heritage of Navratangarh: An Archaeo-Historical Research on its Cultural Landscape

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ABSTRACT: India is the land of antiquity and is dotted with sites of rich historical past as well as cultural values. Located in Jharkhand, the fortified city of Navratangarh is one such site that served as the fourth capital of the Nagvanshi Dynasty, the longest continuing dynasty of India since the first century CE. The Nagvanshis ruled in parts of the present-day Chotanagpur plateau. However, the glory of Navratangarh is long gone and now lying in ruins within a rich cultural landscape. Although designated as an archaeological site by the Archaeological Survey of India (ASI), it is yet to undergo systematic documentation and restoration activities. This paper attempts to document some of the significant structures and their architectural styles. It also records the living heritages and other sites in the vicinity that were/are part of the larger royal footprints of the Nagvanshi dynasty by tracking their journey in the Chotanagpur region and their contribution towards its prosperity.

Keywords: *Architecture, Cultural Landscape, Living Heritage, Navratangarh, Nagvanshi, Chotanagpur.*

1. INTRODUCTION

Navratangarh (also referred to as 'Doisagarh' for its location in Doisa), was the fourth capital of the Nagvanshi dynasty which was established during the 17th c. CE by the 47th Nagvanshi ruler Raja Durjan Sal (*Based on the list of the Nagvanshi rulers submitted by 57th Nagvanshi king Dripnath Shah (c.1762–1790 CE) to the British Government in the year 1787*). It's far located in Sisai block of Gumla district in Jharkhand. Even though it is visited by tourists and researchers in massive numbers, this heritage site has been in a dire strait.

The entire site consists of ruins and appears very similar to that of the archaeological site of Hampi, Karnataka. The Government of Jharkhand had recognized Navratangarh as a heritage site for conservation a few years ago. The Archaeological Survey of India (ASI) also acknowledges its immense potential as a heritage tourism destination as several legends are associated with this place that calls for public awareness. The Art and Culture Department of Jharkhand is making plans to develop this site into a tourist destination along the lines of Hampi.

Navratangarh Complex has been declared as an ASI protected site in the year 2019. The main palace of this complex was illuminated by the ASI among 100 monuments in tricolour to celebrate the landmark achievement of 100 crore vaccinations of Covid-19 in India.

The author studied the Navratangarh site as a part of her academic research to understand its cultural landscape in the historical context of the Nagvanshi dynasty and its living heritage.

1.1 Aim and Objectives

The aims and objectives of this paper are to explore the site potentials and needs in terms of the following:

1. Heritage Value: Document the existing structures on the site and study the site landscape, including the ancient pond and water channel.
2. Historical Value: Propose heritage tourism and understand the types of buildings constructed in that period and the historical background which led to the establishment of Navratangarh.
3. Rejuvenation Potential: Identify the ways in which the site may be sustainably rejuvenated to generate revenue as well as employment opportunities for the locals.

1.2 Scope and Limitations

The research focuses on the significant structures that were constructed by the rulers and understand the circumstances that led to the adoption of different styles of architecture. This paper particularly highlights the architecturally rich historic fort of Navratangarh, which had the tallest structure of this region in its heydays.

This site can possibly be developed as a heritage tourism destination similar to that of Hampi. On a larger scale, the cultural landscapes of the Chotanagpur region also offer a lot of opportunities for future research and inquiry.

Though this place receives substantial visitation, it lacks proper road connectivity. It was quite challenging to reach the site and study the ruins in the fort that was once inhabited for nearly 300 years.

Since December 2021, excavations have begun in the site by ASI which may reveal other exciting secrets related to Navratangarh unknown to us till now.

2. LITERATURE STUDY

2.1 Historical Background

The Nagvanshi dynasty of Chotanagpur (alternatively known as Khokhra or Khukhragarh chieftaincy), was an ancient Indian regime that ruled the parts of the Chotanagpur plateau region (present-day Jharkhand) during much of the ancient, medieval and modern period. This dynasty ranks 5th among the ten longest dynasties of the world and the longest surviving dynasty of India. The origin of the Nagvanshis is quite mysterious. According to Nagvanshi annals, Phani Mukut Rai was the first ruler of the Nagvanshi dynasty who was believed to be the son of Pundrika Naga, the descendant of the legendary Naga king Takshaka. Phani Mukut Rai was adopted by Maharaja Madra Munda (king of Chotanagpur) and was raised to the throne by Madra Munda and neighbouring rulers in the year 64 CE in Sutiambe (situated around 20 km away from Ranchi, Jharkhand) which became the first capital of the Nagvanshis. (*Source:* Wikipedia, 2021).

Brief chronological overview of the nagvanshi dynasty:

- Sovereign monarchy (c.64–1585 CE)
- Vassal state of the Mughal Empire (1585–1615)
- Annexed by the Mughal Empire (1615)
- Tributary state of the Mughal Empire (1627–1733)
- Sovereign monarchy (c 1733–1771 CE)
- Subordinate state of the British East India Company (1771–1817)
- Zamindari state of the British East India Company (1817–1858) and British India (1858–1947)
- 1st Ruler: Phani Mukut Rai
- 62nd Ruler: Lal Chintamani Sharan Nath Shahdeo (Last Ruler)

The capitals of the Nagvanshi Dynasty also shifted at different points in time (*source:* Wikipedia, 2021):

1. Sutiambe (c.64–c.310 CE)
2. Chutia (c.310–c.1100 CE)
3. Khukhragarh (c.1100–c.1613 CE)
4. Navratangarh (c.1613–c.1720 CE)
5. Lalgarh, Palkot (c.1720–1870 CE)
6. Ratugarh (1870–1952 CE)

The Nagvanshi rulers do not appear to have encountered any emperor or king till the 14–15th century. They lived a life of extreme isolation in their jungles, by and large undisturbed and untroubled by outsiders. During the reign of Akbar, the Mughals for the first time came to know about Khukhragarh which was ruled by the Nagvanshi Raja Madhu Singh at that time. It has been said that Khukhragarh energized the acquisitiveness of the Mughals after getting the reports of the presence of diamonds in the rivers of Chotanagpur. Mughals invaded this region during the reign of Raja Madhu Singh in 1585 CE. He became a vassal ruler under the Mughals and participated in an expedition against the Afghan ruler in Odisha. After Madhu Singh, his son Bairisal ascended the throne and participated in several quests with Akbar. When Akbar died, Bairisal is said to have withdrawn the tributes paid to the Mughal empire. This enraged the Mughals, resulting in an

expedition against the Nagvanshi king but failed to subjugate them. Bairisal was succeeded by Raja Durjan Sal, the next Maharaja of Khukhragarh. Due to its diamonds, Chotanagpur was popularly known as Heera Nagpur and its Raja Durjan Sal, having a wholesome knowledge of diamonds, was known as Heera Raja among the folks.

Raja Durjan Sal was imprisoned for 12 years (1616–1627) in Gwalior Fort by Jahangir when he refused to pay taxes. (*Virottam, 1972*) Legend has it that being an expert on diamonds Durjan Sal once correctly identified the real diamond out of the two stones presented to him by Emperor Jahangir, who doubted their authenticity. This pleased the emperor, leading to Durjan Sal's release from captivity.

Durjan Sal was honoured with the title Shah by Jahangir and hence, he came to be known as Durjan Sal Shah. Durjan Sal commenced the construction of magnificent dwelling places at Doisa where he shifted the Nagvanshi capital from Khukhragarh around 1636–1639 CE. Doisa was in a crucial location as it was surrounded by forests, hills and rivers. Additionally, three important rivers—the Sankh, South Koel and North Karo—along with their several tributaries, drain this place. This royal residence complex was named Navratangarh. (*Virottam, 1972*) This was the first palace that had been built for any Nagvanshi king. Earlier kings used to live in humble houses similar to their countrymen. It was only during the decision making he would sit on the throne. The kings considered themselves equal to the countrymen and they saw no difference between them and common people. (*YouTube video on Navratangarh, 2021*)

It may be presumed that Durjan Sal's imprisonment in the Gwalior fort exposed him to the concept of royal residences and their architectural splendours. This might have provided the necessary impetus that inspired him to take up the ambitious Navratangarh fort construction project. However, there was a scarcity of skilled masons and architects, besides marble-slabs and other important building materials in Khukhragarh (*Virottam, 1972*). Durjan Sal was, therefore, compelled to procure all these things from outside his kingdom. The arches, niches, domes, flat roofs and squarish plans found in Navratangarh are very similar to that of Jahangir Mahal, Raj Mahal and Sheesh Mahal of Orchha, Madhya Pradesh, India which are the epitome of 'Bundela Architecture' built around a similar time. This shows that the craftsmen of the structures in Navratangarh may have been called from the central parts of India.

Initially, a palace was made along with a kutchery (court), a treasury house and an awful prison cell with its underground dungeon which was not found earlier in this region made Navratangarh famous at that time. (*Virottam, 1972*)

2.2 Living Heritage of Nagvanshis

The Nagvanshi rulers built many structures and temples in various parts of Chotanagpur where they ruled for nearly two millennia. Some of these temples are still conducting daily worships and the palace at their last capital, Ratugarh is inhabited by the current heirs of the Nagvanshi dynasty. Some of them can be seen in Figure 1. These living heritages are discussed below:

2.2.1 *Ram Mandir, Chutia, Ranchi*

This temple was constructed by Nagvanshi king Raghunath Shah in the year 1685 according to the inscriptions found above the temple door. The verandah of the temple near the entrance and its stone projections of the sculpted columns, along with the cornices is similar to the *Ardha Mandap* which is a feature of medieval Hindu temple architecture of central India. The *char-chala* roof is the characteristic feature of the then-contemporary Bengal architecture. The stone structure of the temple has been painted and some extra structures were added in recent times.

The original temple is a two-storied structure made of granite. It occurs that the temple has developed in phases as several architectural styles can be seen within the same complex.

In this temple, both Lord Krishna and Rama are worshipped simultaneously, which is a quite uncommon practice. A similar architectural style can be observed in the Anaam Dham, the Kapilnath temples near Navratnagarh and the Madan Mohan temple in Boreya, which belongs to the same period.

It is said that Chaitanya Mahaprabhu from Puri on his way to Vrindavan passed through this area, which was then a dense forest and spent one night here. In the morning he left the place, but his shawl was lying there. It is the same place where the temple stands today.

The staircase present on the backside of the temple leads to the upper floor where the idol of Krishna is seen with his eight principal Gopis. Every Sunday morning, members of the Iskcon Society visit here to perform *bhajans.*

Figure 1: Living heritages of Nagvanshis

Source: Author.

2.2.2 *Madan Mohan Temple, Boreya, Ranchi*

This temple was founded in Samvat 1722 (1665 AD) on Vaishakh Shukla Paksha Dashami by king Raghunath Shah. It is said that the foundation of the boundary wall and door was laid on Shravan Shukla Dashami of 1668, that is, after three years and three months. It took 17 years to complete this temple. According to the inscription located in the temple premises, the construction cost at that time was fourteen thousand one rupees.

A special event is held here on the occasion of Shri Krishna Janmashtami. Satyanarayan Puja is performed on every full moon. Earlier the idol of Radha-Krishna here was of Ashtadhatu, from which one of the idols of Krishna was stolen. After five years, a bronze idol of Krishna Ji was made and installed by a goldsmith from Ranchi. Unfortunately, the theft happened for the second time and the idol of Radharani was stolen this time. In 1975, the idol was found in a fragmented state during the sand excavation in the Potpota river. (*Dainik Bhaskar, 2019*)

A thick wall of 3 feet 5-inch has been built around the temple for security purposes. The temple is constructed with granite stones and situated on a raised platform. The height of the platform is 2 feet 3 inches. The entire temple is built on 12 pillars on a platform of 1140 square feet. The height of the pillars to the ceiling is 11 feet 9 inches. The ceiling also has beautiful carvings. This temple has been renovated multiple times, resulting in the loss of authenticity.

2.2.3 *Ratugarh Fort, Ratu, Ranchi*

Ratugarh (popularly known as Ratu) Palace is a historical palace and the royal residence of the current generation in Ranchi, Jharkhand. It is used to be the official residence of the Nagvanshi dynasty and the seat of the kingdom of Ratugarh.

Though the last Maharajah Lal Chintamani Sharan Nath Shahdeo of the Nagvanshi clan passed away back in 2014, the legacy is still protected in the palace by his daughters. All the festivals are celebrated in the palace with dedication and tradition.

Special worships and events are also held during the Rath Yatra and Durga puja festivals in this palace.

The Ratu Palace was constructed in the year 1870 when the rulers shifted their capital from Palkot to Ratugarh. It is a 103 room garden palace constructed beautifully, spread in an area of over 22 acres. Its construction resembles the grand Buckingham Palace.

3. METHODOLOGY

The site and its surroundings are visually surveyed. Based on these, various parameters related to the site are studied which helped to gain a deeper insight into the site.

3.1 Site and Surroundings Study

3.1.1 Site Plan

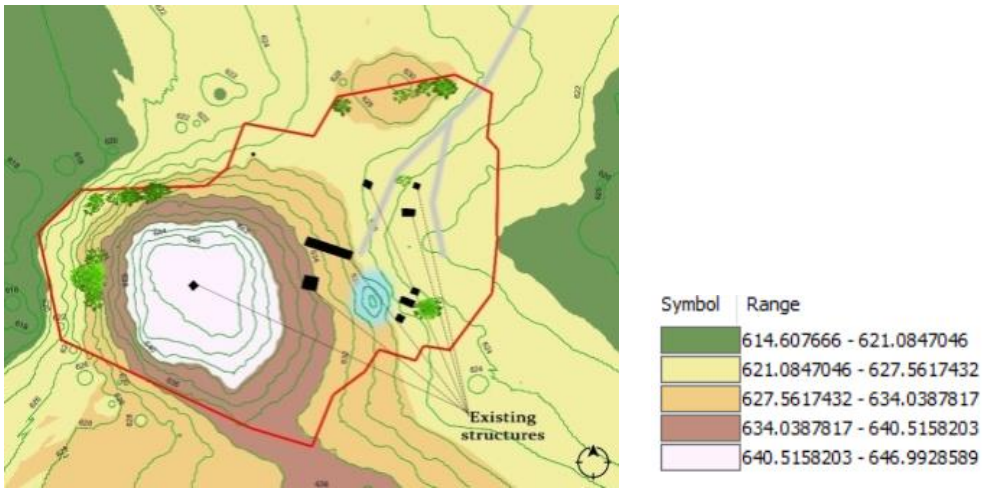

Figure 2: Site Plan of Navratangarh Showing Exiting Structures Along with Contour Lines (range given in metres)

Source: Prepared by author.

3.1.2 *Land Use and Activities Near the Site*

- 70% of the area near the site consists of agricultural land.
- There is a small market for the villagers within a radius of two km.
- The major structures found outside the site within the radius of two km are as follows:
  (a) Kapilnath temple
  (b)Stepped well
  (c)Anaam Dham

(a) **Kapilnath Temple, Sisai, Gumla:** Kapilnath Temple lies 1.5 km from the Navratangarh fort. According to a kaithi inscription found on the walls of this temple, it was constructed by the 50th Nagvanshi ruler Raja Ram Shah (1690–1715) in Samvat 1767 (1710 CE). A mixture of various architectural styles can be seen here. The pillared verandah with sloped cantilevers supported on corbelled capitals, arched windows & doors and the onion dome above the octagon has a strong resemblance to the architecture of central and southern India. (*Beyond the Forests, 2021*)

The onion dome found in the temple is influenced by Indo-Islamic architecture.

According to a local priest, the temple was built twice after an unfortunate incident and king Ram Shah built a temple structure above the existing temple.

(b) **Stepped Well:** There is a typical two-centred equilateral arch with a small dome above it at the entrance. This two-storeyed structure stands as an edifice of north Indian architecture in this province of the Chotanagpur region. (*Beyond the Forests, 2021*)

(c) **Anaam Dham, Sisai, Gumla:** This ruined and abandoned temple-like structure is locally known as Anaamnagar Math or Anaam Dham. The absence of any idol inside the temple lends it its name. The structure is quite elementary yet beautiful. The building has a flat roof situated on an elevated square plinth. There is no path for reaching this structure which is present in the middle of a paddy field.

The central garbhagriha is surrounded by a circumbulatory verandah, supported on columns with corbelled capitals. The carpentry in stone of this derelict structure is worth noting.

3.1.3 *Navratangarh: The Fortified City of Nagvanshis*

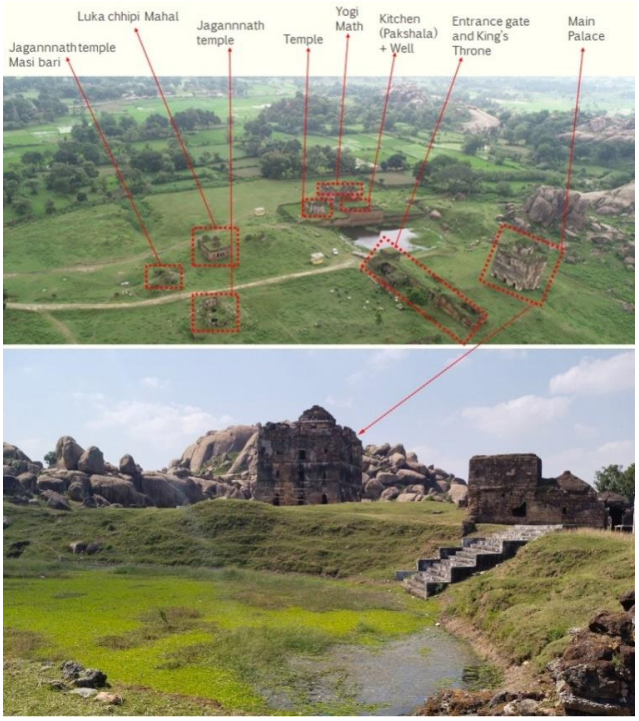

Figure 3: Navratangarh Palace Complex

Source: Author.

There are nearly 10 to 12 traceable structures all around the site. Few of them are still standing and some are almost down to the ground. There is also a large pond right in the middle of the site which still has some water almost bluish-green. This fort is surrounded by hills and forests on three sides, which helped in its defense during that period. The site plan is presented in figure 2. The structures that can still be found here are:

1. Jagannath Temple no. 1, Rani Luka Chipi Mahal, Kamal Sahi Palace, Yogi Math, Pond, Royal Palace, Lohuthopa Math, rock-cut Shivalinga with Yonipitha, monolithic rock-cut sculptures of Ganesha, Jagannath Temple, no. 2. Figure 3 indicates the distribution of these structures on the site.

The structures neither follow a recognizable pattern nor a uniform style, indicative of their construction across a stretched period of time.

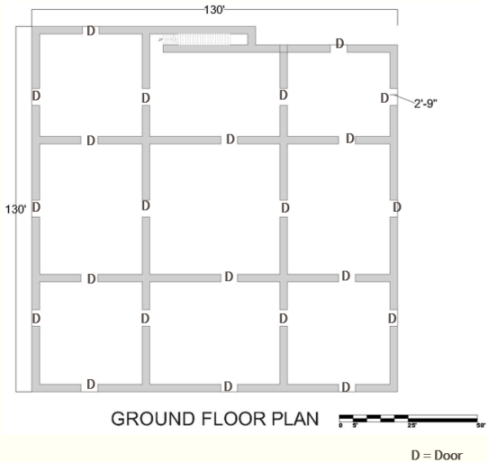

Figure 4: Plan of the Main Palace

Source: Prepared by author.

The main palace in the complex is a five-storeyed building with its 'water-gate' and 'garh-khai' (moat) arrangement. It has nine rooms on each floor as shown in Figure 4. The internal and external walls of the palace are nearly 33" thick. A staircase is present on the northern end of the ground floor for accessing the upper floors. Thick and wide stone slabs were used to make these steps. The door tops consist of Islamic arches. The rooms have both rectangular and round ceilings. There are about six to eight niches on the internal walls of every room. The broad windows present on the second floor might have been used by the king for giving 'darshan' to his subjects. It is likely that Durjan Sal was influenced by the practice of 'jharokha-i-darshan' from the Mughals and started similar practice in his kingdom. The roofs have fine interlocked engravings in wood.

- The roof of the main palace is a hollow dome. The masonry of the building consists of brick and stone slabs alternated with mortar.
- Main building materials used: Clay bricks, stone and lime mortar.
- There was a well of 3' width near the *pakshala* (kitchen) which was connected to the main pond i.e. Ratan Talab.
- The moat around the fort was also connected to the Ratan Talab.
- For the fortification of the fort, a water channel flowed near the temples till the main gate. It is believed that the devotees used to take a bath in these channels before worshipping.

4. RESULTS AND DISCUSSIONS

The author studied the site and the buildings closely and tried to map the physical condition of the main palace. These are as follows:

- Many floor slabs of the palace are missing.
- The staircase is not accessible right from the ground floor.
- Door and windows are broken and in a bad condition.
- One floor of the palace is buried in the ground.
- Most parts of the structures in the complex are inaccessible.
- The Jagannath Temple was made up of stones and joined together with iron hooks. This structure was destroyed during the Kol rebellion 1831–32 CE.
- No idol can be found in any of the temples.

Altogether three inscriptions were found till now in this complex. Of these, two are present in the Jagannath temple. The first inscription states that the temple was dedicated to Lord Jagannath, built by king Harinath in samvat 1739 or 1683 AD. The second inscription describes that king Raghunath Shah built the temple of Lord Krishna on the third day of the new moon in two weeks in Samvat 1739 or 1683 AD, and the third, lost its few letters states that Harinath Deo and his brother Gokulnath built a temple at Samvat 1767 or 1711.

Architectural Styles

This complex shows the amalgam of Mughal and Rajput architectural styles drawing similarities from the then-contemporary architectural style of Central India where king Durjan Sal spent twelve long years in imprisonment. Many structures also exhibit the Bundela architectural style. The various architectural features are shown in Figure 5.

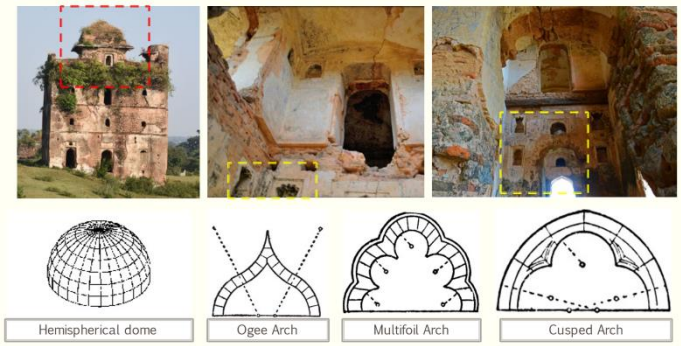

Figure 5: Various Architectural Features Found

Source: Author.

The Nagara-style of temple architecture can be seen in the temples. The traces of Indo-Islamic elements are also prevalent in some of the temples. The temples are built on a raised platform known as Jagati, which is a typical feature of Nagara-style architecture.

There are few structures where Petroglyphs and Indian architectural element *patrapotika* can be found. Floral motifs are used in the borders of the semi-circular arched gateway of the Jagannath temple. Niches with trifoil arches are commonly seen in all the structures found on the site.

5. CONCLUSIONS

According to the study, it is found that various structures exhibit different styles of architecture like the terracotta temples, Odishan motifs, north Indian temple architecture, Mughal and Rajput architecture similar to that of Bundela architecture. This palace complex might be the earliest remnant of formally constructed architecture on the Chotanagpur plateau. Today, these structures remain in the wilderness, but one can imagine the elegance when it was in its grandeur.

The road for connecting various structures within the site can be proposed along with restoring the pond beside the main palace. The dilapidated structures can be conserved by implementing suitable restoring techniques.

The Strengths, Weaknesses, Opportunities and Challenges within the site is discussed below:

- **Strengths:** The site area is large with diverse topography, providing many opportunities for rejuvenation. Moreover, it is a centrally protected monument that can play a vital role in its conservation.
- **Weakness:** Lack of electricity on the site and proper road for access and connectivity. Most of the structures are buried or ruined posing serious restoration challenges.
- **Opportunities:** The site, with its rich tangible and intangible assets, can serve as a heritage tourism destination and can generate employment for locals.
- **Challenges:** The surrounding areas have a scanty population. Care needs to be taken for an optimised solution in the interest of both visitors and local communities.

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Globalization to Localization: A Sustainable Shift for Tribal Communities of Palghar District

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ABSTRACT: At present, the world is experiencing an increase in globalization, which has both positive and negative impacts on the societies. Economic globalization is considered to have a brighter future because it aims to reduce poverty in certain areas while threatening others. It is primarily concerned with economic development rather than the well-being of people, which leads to increased competition and division. The three pillars of Indian society are the urban, rural, and tribal communities. These three communities have faced the positive and negative impacts of globalization at various levels. To reduce the adverse effects on these communities, 'Localization' as a sustainable development strategy can be implemented, leading to a happy economy. This benefits both the urban population and the local community. Tribal communities exhibit a dynamic trading economy with nature because they have accurate local knowledge, which is essential for understanding the environment, developing sustainable techniques, and conserving natural resources.

1. INTRODUCTION

We live in a world where there is a constant increase in 'Globalization' which not only causes change in the societies but also affects the remote areas across the world. The Indian society is further divided into three communities: urban, rural, and the tribal. Each community has its own distinct traits that set it apart from the others. At various levels, these three communities have experienced the positive and negative effects of globalization. Globalizing economic activity is considered to have a brighter future, which intends to decrease poverty for some people, whereas for others it is considered a threat. It seems to focus on the economic development and not on the people. These drawbacks are causing crisis in the environment as well as the wellbeing of the people.

As a result, there is a need for sustainable approach, which can be achieved through 'Localization,' which can lead to the economy of happiness. Localization reduces the dependence on export market in favor of production of local need. It reverses the trend of globalization by discriminating in favour of the local. The result focuses on the increases in community cohesion, reduction in poverty, cut down inequality, and improve the livelihood, social infrastructure and environmental protection. Local economy creates a sense of identity not only by strengthening community but by also nurturing a connect with the earth. It not only benefits the urban population but also uplifts the local community.

The Tribal community represents this system of continuous exchange with environment, as they have the traditional knowledge, which plays an important role in the understanding of the environment and methods to sustain and conserve the natural resources.

2. LITERATURE REVIEW

Understanding localization and globalization, understanding tribal communities, and the tribal communities' localization strategy were the criteria used to choose the literature reviews.

2.1 Localization and Globalization

The is world moving simultaneously in two opposite directions, where on one hand the Government and big business are promoting globalization and they are starting to forge a very different future. However, this is immensely effecting the societies and the remote areas around the world. The economy only focuses on the development and not on the people. It is causing crisis to the environment as well as the wellbeing of the people.

The Economic of Happiness is a documentary from 2011, which was directed by Helena Norberg-Hodge, Steven Gorelick and John Page spells out the social, spiritual and ecological costs of today's global economy and highlights a positive solution for it by stating the benefits of economic Localization. The communities are coming together to rebuild more human scale ecological economies. The movie highlights upon the factors of planning, agriculture, knowledge, identity and culture and other resources depletion through the lens of globalization and states the advantages of going local with the examples of the different places practicing Localization in the world.

2.2 Effects of Globalization on the Tribes

Globalization has both positive and negative impacts all around the world. India had the disparity of being the world's largest economy at the beginning of the Christian era. Then due to liberalization, how it isolated itself to protect the developing economy and achieve self-reliance and due to the growing industrialization the exports from India were inactive. Globalization has increased barriers between the countries, which has resulted in the strengthening of economic competition among nations the tribes are affected due to globalization in many ways. Indian tribes play a key part in constructing the cultural heritage of India. The tribal development policies and programs stated that all the tribes will develop and will integrate themselves with the so-called mainstream. But only some of them were able to take advantage and the reason behind some of the programs not getting implemented was inefficiency and corrupt bureaucracy.

The article Effects of Globalization on Tribes in India by Dr. Md. Abdullah concludes that the effect of globalization has been both positive and negative. But the point of concern is how the uncontrollable effect of globalization is seen on the Indian tribal culture.

2.3 Bamboo Eliminates Poverty among Wayanad Villagers

The article describes how making bamboo handicrafts has led to subtract the poverty in Wayand village. Impoverished villages in Kerala's Wayanad have found green gold in bamboo handicrafts and utility products, which have helped eliminate poverty and given them a regular source of income.

Uravu, a not-for-profit initiative that aims to bring about rural empowerment through sustainable solutions. The Uravu Indigenous Science and Technology Center, promotes bamboo handicrafts and utility products, as a means of employment for the residents, especially women, of Thrikkaipetta and a few other villages. The villagers started training themselves and started conducting workshops for the other villagers and people interested in studying the craft. Women of the village started earning and formed groups and encouraged other women to take up the craft to become independent and increase the livelihood Alcoholism and poverty permeated the village and its surrounds. Use of bamboo to make handicrafts, furniture and in construction, with a consistent demand for the products, has ensured a sustained rural livelihood for the villagers, besides social and financial empowerment.

3. RESEARCH METHODOLOGY

The present research attempts to explore solutions of localization towards the increase of globalization and learn how the tribal communities use such dynamic economy and adapt sustainable living. The primary data collection includes the interviews of the local tribal communities and the representatives. It also includes site visits and informal interactions to understand the problems faced by the communities and gain their perspectives and come up with better solutions. The secondary data was obtained through articles, books, government policies and online research. The literature review aims to understand the concept of globalization and localization and also understand the tribal communities.

4. DATA ANALYSIS

Localization shifts production away from export markets and toward meeting local needs. By discriminating in favour of the local, it reversing the trend of globalisation. It simply aids in the development of a sustainable economy. It foster a sense of belonging not only by strengthening communities, but also by developing a connection to the natural world.

4.1 Benefits of Localization

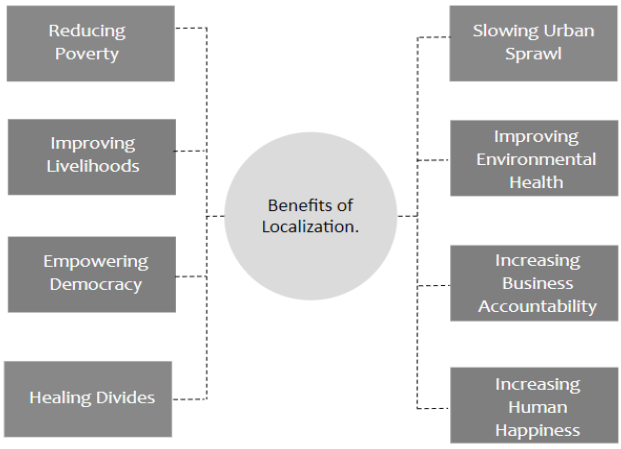

Figure 1: Benefits of Localization.

4.2 Aspects of Localization

Local economies are built by and for the people who live in them. Localized economies respect local cultures and requirements while allowing for the free interchange of knowledge and ideas across boundaries, rather than adhering to a global monocultural model. In reality, to address global issues like climate change and develop agreements to rein in the greedy power of multinational companies and banks, localization necessitates international cooperation and collaboration.

4.2.1 *Local Economy*

Local economic system is a system, which refers to the marketing and networking systems of the community. It can include a multitude of different sectors and industries that work together to contribute for creating local wealth, opportunities and prosperity.

4.2.2 *Local Food*

Local food or 'Locally Grown' are the food or agricultural products that are grown, processes and then sold within a certain area. Now, it is necessary that we realize the importance of buying local products and eat local!

4.2.3 *Local Energy*

Local energy or renewable energy is the energy generated from the natural resources such as sunlight wind or waves.it involves a range of public, private and community organizations, which benefits the local consumers who operate within a defined area.

4.2.4 *Local Material*

Local materials or indigenous materials are the resources that are found in larger quantity in a particular area or a local area which are found out to be more sustainable and relatively cheap. So the neglect of these readily available materials should be discouraged and the importance of going local should be encouraged. Usually locally produced materials has multiple advantages.

4.3 The Damage Done Due to Globalization

Globalization is the deregulation of trade and finance in order to enable business and banks to operate globally. It is an integration of national economies into the global economy. Which happens through trade and investment. The process is driven by the theory of comparative advantage where the goal is international competitiveness and growth model. The focus is more on the profit and not on the people, which rises inequality for most of the world and it, leads to increase in the competition.

4.4 Impact of Localization on the Societies

Local economies generate networks of place-based interactions that reinforce our human desire for connection to one other and to the land, from community gardens to credit unions, alternative learning spaces to small business partnerships and co-ops. Local economies turn care for one another and the earth into guiding principles of daily life by establishing this structural foundation for community. Localization, on the other hand, enables local, regional, and even national self-sufficiency to take the place of reliance on distant, unaccountable companies.

A rise in employment and discretionary money in the community, increased tax revenue for local governments, and a loyal customer base for companies are all major advantages of business in the local economy.

5. FINDINGS AND DISCUSSIONS

Some of the case studies that were studied to understand the impact of localization on the communities.

Table 1: Inferences from Case Studies

Project Title	*Inferences*	*Image*
Khamir craft resource center. By- Ar. Neelkantha Chhaya	The concept of local availability and sustainability is expressed in this design. Courtyards and activities are grouped together. The criterion for choosing a site should be dependent on the users' location.	
Bamboo research and training centre.	The use of sustainable materials to build an institution by facing the challenges while constructing with the materials.	

Humans learn about themselves, others, and life as they get older. They invent their own reality. They are formed by their internal and external surroundings and learn from direct personal experience. The tribes are quite influential, with a reasonably unified culture and basic technology. India is a multi-ethnic country with hundreds of minor ethnic and tribal communities. They refer to a group of the people who are native to the state or region and live isolated from the rest of society. The term 'Adivasi' refers to the Indian subcontinent's tribes who are considered indigenous to the regions where they reside, either as foragers or as tribal sedentary communities. Maharashtra's tribes are mostly found in the Sahyadri, Satpura, and Gondwana forest areas. They are naturally exposed to the rage of nature, which includes strong rains during the rainy season, freezing winds in the winter, and burning heat in the summer. The tribe's typically challenging life is made easier by continuous interaction with nature. They have a long history of seeing their communities as being inseparably connected to their physical surroundings. The ecosystems and sacred sites that create their world influence their culture, traditions, and identities. They are fundamentally opposed to the urban and rural populations. They believe in the law of nature, which states that "what comes from nature returns to nature."

As per the 2011 census, Maharashtra's total tribal population is 10.5 million, accounting for 9.35% of the state's total population. Nashik division has the highest percentage of tribes in Maharashtra, with 22.33%, followed by Nagpur division with 14.42%, and Amravati division with 10.87%.

Vikramgad is one of the talukas of the district Palghar. It consists of different types of tribal communities who are very well known for their rich cultural heritage and traditions. Currently the tribal population is working for 'Atmanirbhar Bharat' where the people are engaged in making products out of bamboo which is also helping them to earn a living. The tribes of Tetwali, Palghar's Vikramgad Taluka, have begun to cultivate bamboo and create a variety of bamboo products. It was started by Keshav Srushti Gram Vikas Yojana, which encouraged the women of the taluka to make and sell bamboo products. They were also given professional training. They were also taught how to build using bamboo. Following that, the men joined in and began manufacturing additional bamboo products.

4. CONCLUSION

Many people see globalization as a threat to the world's cultural diversity. It's also feared that it will destroy local economies, cultures, and languages, thereby recasting the entire world. It has negative consequences like as destroying livelihoods, depleting natural resources, promoting climate change, and increasing migration and conflict. To achieve community development that is long-term Localisation can be used as a solution that benefits not just the urban population but also the local communities. Localisation creates a sense of identity not only by strengthening the community but by also nurturing a connect with earth. From protecting open spaces to stopping the flow of money to huge business to connecting children with nature and land-based ways of living each component of a local economy has its own set of advantages. Tribal communities exhibit this economy of dynamic trade with nature because they have the traditional knowledge, which aids in the understanding of the environment and the development of techniques for sustaining and conserving natural resources.

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Impact of Green Spaces

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ABSTRACT: Green spaces play an important role in interweaving nature with human habitat. This paper deals with having a greater and deeper understanding of impact of green spaces on one's day to day life. Green spaces have a prominent role in inviting natural ventilation and lighting which are essential for human health and wellbeing. With the changing trends of lifestyle and ever growing concrete jungle the interaction with the natural greens is dwindling. Hence this study is focusing on the impact of green spaces indoor.

For the following research is validated through case studies for the same and the second method consisted of floating a questionnaire amongst samples which included people of various age group with different professions. In conclusion to the research green spaces play major role in lives of people and have various impacts including physical impact, economic impact, physiological impact and environmental impact.

Keywords: *Green Spaces, Human Health, Natural Light And Ventilation, Lifestyle, Indoor greenery, Impact.*

1. INTRODUCTION

Studies suggest the places where people live in spaces which have green spaces nearby tend to feel less isolated and are less likely to have mental health problems. Green spaces not only give us a sense of belonging, stability, comfort but also help to reduce depression and anxiety in adults. The other intangible benefits of nature, plants indoors, gardens outdoors, parks, and forests is that they help promoting both human and ecological health. Also direct effects of green infrastructure on indoor air quality and natural light for comfortable and healthy human environment were rarely studied. Apart from these benefits green space provides various social, economic, and environmental benefits, which in turn improves the wellbeing of individuals and enhances quality of life. Hence green spaces play a role in boosting our indoor environments and creating higher satisfaction, enhanced well-being, and increased productivity for people.

Aim: To study the impact of green spaces.

Objectives

(a) To understand effect of green space on one's health and wellbeing.
(b) To study how the various parameters like natural light and ventilation play their roles along the green spaces.
(c) To study how does indoor green space works in the changing lifestyle.
(d) To study what are various other impacts of green spaces.

Scope and Limitations: Study has been carried out to understand the different impacts of green spaces on an individual and its surrounding. Different case studies and research paper will be analysed in this process along with a study of 150 samples and their perspective about green space.

This research paper only deals with various impact of green spaces and the necessity of indoor green spaces and their needs and benefits.

2. LITERATURE REVIEW

Due to the spread of COVID-19 pandemic across the world it has not only produced physical health issues but also has created long-lasting psychological effects, such as post-traumatic stress symptoms, confusion, anger, restlessness, panic disorders, anxiety, and depression and many more. It is become important to disentangle the associations between the presence of green features within and surrounding the home environment and the self-reported change in psychological health when access to public green spaces was banned or restricted during the COVID-19 pandemic lockdown. Evidence indicates that green spaces from parks and trees in urban areas to indoor greenery, and even visual access to green spaces, have many psychological and mental benefits to humans and it leads to mental stability, peace and comfort. More the green

spaces mean more the comfort, hence better mental health and inhabitants' satisfaction. Due to the fact that everyone passes most of their times indoor, green space inside the home must be taken into account more seriously. The green spaces affect the indoor environment directly through climate, air quality, sonic and aesthetic aspects. However, greenery also has many secondary effects on human wellbeing, economy and ecology. These secondary effects of green spaces being social, economic, and environmental benefits, which in turn improve physical, psychological, emotional, social, and material wellbeing of individuals and thus enhance quality of life. Buildings surrounded with or within visible natural elements or scenes stimulate peoples' ability to concentrate more and also helps in increasing creativity.

3. MATERIAL AND METHODOLOGY

The present research consists of two major phases which respectively are: First, the review of literature and book case studies and second, data collection from 150 samples of different age group and its analysis.

3.1 Case Studies

3.1.1 *Menara Mesiniaga in Malaysia*

A ten-year research by Kenneth Yeang in the field of bio-climatic principles for design of medium-to-tall buildings has made it possible for this marvellous structure to win the Aga Khan Award for Architecture. The mostsentient parts of the building are the sky gardens which twist up the building on the outer edge creates a reassessed terrace in form in this 15-storey building.

Figure 1: The Outer Façade of Menara Mesiniaga and the Twisting Garden that Runs Vertically Towards the Terrace

These terraces are assessable on every floor which act as space for occupants to relax and refresh and also help in cooling and ventilating the structure. These terraces lead to the exposed pool on the roof. Yeang says: An ecological building should not be a weapon in a retreating battle. On the contrary, it can contribute positively to the environment. A green area is a productive area. So the building can generate energy instead of consume it. The studies have shown greater occupancy happiness and employee output is where the building can offer a connection with external spaces whether it is natural daylight or sky gardens that let workers relax and feel as if they belong to a whole being. (Space Design.9401-9403-1994)

3.1.2 *Zorlu Center in Turkey*

Zorlu center aims to become an alternative urban space for Istanbul. The green shell surrounding the structure in third dimension associates with the hill of Istanbul that was once used as the recreation area. The center soft and hard landscapes are overlooking the city at many angles, a grand park space, a city square is created amidst the high rises emerging through the roof-shell which covers the shopping and recreation zone. The playground's basic idea was to allow children to use their imagination to the fullest, enjoying the diversity of shapes and colors. The design elements were chosen and woven with nature in a careful manner, guaranteeing the most incredible play experience for children of different ages.

Figure 2: The Hill Inspired Green Structure around Zorlu Center and the Stepped Green Terraces and Courtyard

The landscape roof is a derivation of the original topography of the existing terrain by geometric surfaces. Zorlu center integrates with nature to provide something that is not just functional, but inspires an emotional response and lifts the spirit. It's a joyous and exciting place that brings families and children together in a revolutionary way. The project also increases the ecological value of the existing site. The structure mingles the nature with the concerted towers balancing the indoor-outdoor concept skilfully.

3.1.3 *The Interlace in Singapore*

The Interlace represents an entirely new definition for urban vertical development. The apartment blocks are in a hexagonal configuration, fitting over 1000 units with a sufficient ground level space for landscape and recreation areas, and without creating an oppressively dense environment. There is a series of 60m wide courtyards which cater playgrounds, have water bodies for an evaporative cooling effect, while others contain themed gardens. This variation helps to break up the scale of the development, and create a fascinating trail of greenery.

Figure 3: The Terrace Gardens of Interlace and Green Spaces Amidst the Staggered Concrete Blocks

This vertical village consists of cascading sky gardens and both private and public roof terraces. The Interlace incorporates sustainability features through cautious environmental analysis of sun, wind, micro-climate conditions and other natural features on site and the tackles them with integration of low-impact passive energy strategies. There sidential amenities and facilities are interwoven into the lush vegetation and helps in increasing social interaction, leisure, and recreation.

***Conclusion*:** Through these case studies mindful use of green spaces in various building typologies such as residential, commercial and office is seen. These green spaces not only add to the aesthetic value but also ensure benefits to the user's health and the surrounding ecology.

3.2 Sample Study

3.2.1 *Study Population*

The samples of this study include random people from different age groups ranging from below 20 till above 50 years. In total 150 such samples were collected to study and understand impact of green spaces in detail. An online questionnaire was floated amongst the participants and sampling technique known as "snowball sampling", or "chain-referral sampling" (Mann, and Whitney, 1947), where participants are invited to recruit other potential participants was used for the same.

3.2.2 *Measures*

The online questionnaire was developed such that it was in two sections. The first section included questions concerning sociodemographic characteristics and covariates. The subsequent second part dealt with potential confounding variables related to the interest for the study.

Sociodemographic Characteristics

The first section of the questionnaire was composed of 6 items investigating sociodemographic characteristics, i.e., age, name, level and other information regarding potential covariates or confounding variables.

Table 1: Distribution of the Sample Participants' Answers for their Relation with Green Space

	N =150 (%)
Age	
Below 20	65 (43.3)
Below 30	53 (35.3)
Below 40	18 (12)
Below 50	10 (6.7)
Above 50	4 (2.7)
Where do you spend most of your time in a day?	
Home	71 (47.30)
Institute	51 (34)
Office	17 (11.3)
Other	11 (7.3)
Does this place have Green Spaces?	
Yes	115 (76.7)
No	35 (23.3)
If yes, where are Green Spaces located	
Indoor	10 (7.1)
Outdoor	67 (47.9)
Both	40 (28.6)
None	23 (7.1)
If No would you like to have Green Space in this place?	
Yes	83 (78.3)
No	8 (7.5)
Maybe	15 (14.2)

3.4 Other Outcomes

The second section of the questionnaire was composed of 4 items. Each participant was asked to evaluate feelings related green spaces about what they feel in psychological state of mind. They were asked to list down the spaces in residence where they wold want to incorporate green spaces to have a better understanding of indoor spaces in residence. Participants were asked to answer if there was any impact of green spaces on them and what kind of impacts are these. This was done to have a better understanding of whether green spaces had a conscious impact on one's mind or not. The study helped in understanding that over 70% of people found green spaces to radiate the feeling of calmness, freshness and liveliness.

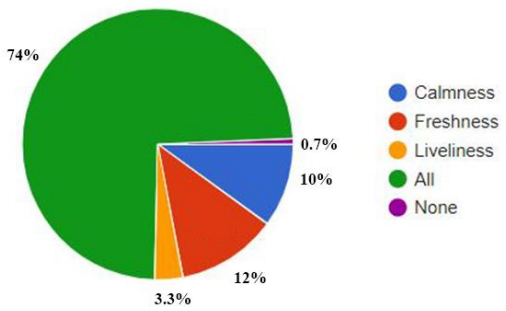

Figure 4: Percentage of Feeling Express green Space

When given a choice to include indoor green spaces inresidences, various spaces such as roof, living room balconies, dining area and bedroom were given chosen as an option. Balcony being the most common answer to develop a green space as in many flat systems the sufficient amount ventilation and light is not available in different rooms. When asked about whether a green space had an impacton one's life over 90% of participants had a positive response for the same.

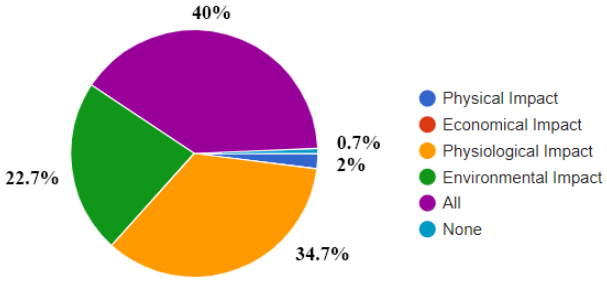

Figure 5: Percentage of Various Kinds of Impact of Caused by Green Spaces

- *Physical Impact*: The green spaces in these instances serve as a natural resource that provides a setting for various recreational activities which have a positive effect on individuals' happiness and physical health as it inspires one to explore and move around.
- *Economic Impact*: Green spaces generate revenue for governments, which aids various facilities such as development of roads, construction of schools, generation of electricity, and establishment of health facilities to support the wellbeing of the common people. Observations state that there is an increase in property values that are located around green spaces, leads to higher value of rates/taxes, which further contribute to local government funds.
- *Physiological Impact*: The presence of green spaces is associated with a lower self-reported increase in anxiety, anger, fear, irritability, and sleep disturbance. A greater amount of sunlight and ventilation due to green spaces indoor leads to lower increase in anger, fear, confusion, moodiness, boredom, irritability, poor concentration, and sleep disturbance.
- *Environmental Impact*: Green spaces were observed to contribute in regulating local climate. The heat from such hard surfaces is radiated back, which contributes to an increase in local temperature around built-up areas known as the "urban heat island" effect. Conserving of urban green spaces helps decrease absorption of solar radiation from the land surface and increase evapotranspiration, which helps in cooling down of temperatures. This further helps in controlling eat related problems, which are easy spread of infectious diseases, skin problems, and deaths associated with excessive heat.

4. RESULTS

In the total sample of survey participants, the average age was between below 20 to below 30 years, almost 78.6% was composed by this age group. The place where most time of a day is spent was home with 47.3%. Though the major population population was teenagers and students yet due to pandemic like COVID-19 home became the popular opinion. More than half of the respondents had green spaces in place where they spent their major time of the day. Out of which 47.9% people had outdoor green space and over 20% had both indoor and outdoor green space as reported in Table 1.Our results showed distinct associations with respect to the indoor and outdoor green features of the living environment and the assessed psychological outcomes. We found that the presence of green spaces was associated with the feeling of calmness, freshness and liveliness. These results are of considerable importance for the extension of previous literature on impact of green spaces in places such as the home and workplace. For example, the presence of plants in working environments seems to reduce perceived stress and, in general, to promote positive emotions and reduce negative feelings (Han, and Ruan, 2019).Altogether, our findings, combined with those on the significant role of green spaces in our day to day lives consciously. These impacts included being physical, economic, physiological and environmental effect. Study also helped in finding out of all participants only 7.5% of people did not need the feel to have green spaces in their day to day life. Where a large number of population wanted to incorporate green spaces in their residences.

***Limitations*:** The study could maximally target age group of below 20 to 30. The study deal majorly with indoor green spaces in residences and no other building typology in detail. Further studies addressing these matters are strongly recommended for further understanding.

5. CONCLUSION

The research has shown with changing lifestyle and human health problems the incorporation of indoor green spaces and its benefits. A proper understanding of how a green space binds the indoor outdoor parameter of a particular structure is seen here. The green spaces not only helped in having impact on an individual but also on the ecology around it. With increase in number of concrete jungles due with time a sensitive approach of incorporation of green spaces in our daily life has become a foremost need. With the major time being spent indoor the incorporation of indoor green spaces is a need of time to ensure benefits human mental health and comfort. Green spaces not only play a major role in enhancing quality of life but also the environment and surroundings around us.

Further studies are recommended to evaluate other possible outcomes regarding the impact of green spaces.

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Influence of Classical Art—'Sculpture' on Modern Architecture in Indian Context

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ABSTRACT: This research will discuss the influence of the classical art "sculpture". This is achieved by analysing the influence of 'sculpture' in Indian modern architecture, studying its use/application in different variables in the Indian modern architecture. The problems the physical environment of modern existence indicate towards the need for a renewed relationship between sculpture and architecture. the physical environment. Misinterpretation of 'functionalism', among various factors, influences a separation of these two art forms. Economic, social, aesthetic advantages along with historical affinity are cited as reasons obliging a greater use of sculpture in the environment. Sculpture-in-architecture is defined as the various practical and aesthetic problems confronting sculptor and architect. The determining factors for size and materials are considered. This points to the need for sculptor and architect to work together from the inception of a project. As the architects face certain problems in selecting a sculptor and makes several practical recommendations.

Keywords: *Classical Art, Sculpture, Indian Context, Modern Architecture, Functionalism, Techniques.*

1. INTRODUCTION

The Indian period is unique in its art, literature and architecture. Architecture and sculpture art was no doubt a very important step taken considering the progress of Indian art. Sculpture is the only branch of the visual arts that is specifically concerned with expressive three-dimensional form. Sculpture is loosely defined by building up of clay. It is a method of building up of a clay in a shape that is artistic of functional, like a figuring bust, bowl, or jar. This is a highly expressive way of working and at its most basic relies solely on the hands as the major tools used in the process. It is growing and changing and is continuously extending the range of its activities and evolving new kinds of objects. Sculptures vary greatly in scales and styles. From figurines delicately with thumbs and forefingers in the palm of the hands to huge life size figurines, anything in between and beyond can be a sculpture. The basic element used in sculpting is clay. Any clay can be sculpted. Grogged clay is better at supporting itself and ideal of larger sculptures and the finer clays with fine particles are suitable for small-scale work. Making sculptures or three-dimensional forms involves modelling, carving or assembling. This art form is continuously evolving and redefining itself with the help of new, developed sculptural tools and technology. Studying the classical tradition is the best way to train aspiring architects for their future careers because a firm understanding of classical conventions can be applied to all styles of design and provides the student with a better overall understanding of the architectural language. In a desire to build an elegant, beautiful and luxurious structure, a huge gap in the creative process is left behind. The aim of this research is to understand the importance of sculpture in the modern Indian architecture and to figure out how we can fill in the loopholes of the modern architecture with the help of sculpture art.

2. LITERATURE REVIEW

Sculpture and ceramics are disciplines in fine art and industrial art respectively. Sculptures in architecture can be categorized into four different types depending on where they are placed in architectural structure; Precinct, exterior, interior and integral, (Peters Edem E, 2016). Similarly, Modern architecture can also be classified as interior and exterior architecture. (James A. Herring, 2010)

The connection between dance and sculptures: In India, a deep analysis of the multivalent connection between both these art forms i.e., dance and sculptures, still awaits. We have various sculptures and idols from the ancient times, which are still housed in various museums across the country, like the "Mohenjo daro Dancer" housed in the national museum, New Delhi, or the remains of the reliefs of the dancers and musicians that used to decorate the *Stupa of Bharhut.* (Kalakshetra, issue 8, 2020)

As K. Ishwaran writes, “The main aim of image-worship is to facilitate the practice of Bhakti religion. The *Bhagvata* text which forms the basis of the Bhakti Religion, supports image-worship as a means by which a devotee can constantly keep before his eyes his deity, sing and praise his glory, grace and compassion, and overjoyed at his sight, sing and dance rapturously, meditate on him and experience the thrill of the touch of his feet.” (Ishwaran 1992:126). These ideas of sculptures like those of dancing Nataraja, lord Ganesha, *Apsaras* in various dancing positions, can be used in various ways, at the entrances of a ceremony hall or in a temple, etc.

Evolution of techniques in sculpting over the years.

Sculpture has been used as one of the many prominent forms of human expression since the pre historic period. There are various findings like small animal or human heads or figures carved in stone, ivory possibly spiritual or religious purposes. The various techniques are modelling, carving, assembling and casting. The most common techniques used in sculpting are carving and casting. All these techniques are mostly carried out or performed with the hand building method. In this method the sculpting is performed using only hands, fingers and simple tools if needed. The most common hand building techniques are pinch pottery, coil building and slab building. Once sculpted, they are decorated using different ways like impressing stamps or fingers or any other object, inlaying, glazing and firing, painting and slip decoration.

Depending on the base material used, and the resulting properties of the object once fired, it may be categorized in the following way: earthenware, terracotta, porcelain, China, bone China, stoneware or many others, (Ayodele Taiwo V., 2021).

3. MATERIALS AND METHODOLOGIES

In the procedure of data collection for this analytical type of research and in order to get references and also a better understanding of different types of modern sculptures, I had to visit various different places which hold few of the many famous sculptures in Pune. Some of the places that I visited were malls, parks, hotels, etc. The art installation at Phoenix Marketcity or the Pavillion mall, Pune, sculptures at recreational parks and gardens, the Khadakwasla Bhairavnath temple, Swami Narayan temple, sculptures on streets like JM road, FC road in Pune, etc. helped me get a better understanding of modern-day sculptures. Data was also gathered by visiting potters and ceramists in the nearest locality, especially to take a real time understanding of how pots are sculpted or created. I also inquired about why only a certain type of material is used in the process of pottery, and hence in sculpting. This was all about the primary data. For the secondary data, I had to go through many other research papers and news and archaeological articles which gave me a deeper insight into the subject.

Figure 1: Sculpture at Parks and at Streets

4. RESULTS AND DISCUSSION

While studying the entire subject about sculptures, I came across many facts about sculptures and different ways of sculpting. We realize that there is so much to learn from our ancestors and our culture and there is so much knowledge about anything and everything that we can benefit from, even on today’s date. I got to study various different methods of sculpting and also gained knowledge about various different materials that could be used for making the sculptures. Many of the sculptures in India possess or hint towards a religious meaning. We can see the sculptures of Buddha, Lord Shiva, Nataraja, lord Ganesha, the happy man, etc. throughout the country irrespective of the state where they are installed. You can find a sculpture or an idol of lord Nataraja in every dance class in the country. You can find a sculpture of Buddha in so

many hotels, meditation centres and even in the houses of so many families you can even have sculpture of you and your family carved on one of the walls in your house. Sculptures just bring more meaning to the place where they are rightly installed or created. For example, earlier on Sinhagad fort, there were no sculptures near the memorial of Narveer Tanhaji Malusare. But now, when the lifelike sculptures of the brave soldiers of Shivaji Maharaj's time are installed around the memorial, visiting that place makes you even more sentimental and it kind of raises so many mixed emotions and feeling at the same time. It seems like those sculptures brought life to that place, gave that place a meaning. Similarly, when we visit a mall during any festival, we can see huge idols and decorations installed to make the place look celebrated. Imagine visiting Phoenix marketcity on a Christmas eve and not seeing any big decorations or huge idols. It would seem like some normal day there. The sculptures on the walls of the temples or those on the pillars of the temples add up so much to the surrounding of the temple and makes the surrounding even more positive and divine.

Figure 2: Sculpture in Phoenix Mall on the Occasion of Christmas Day and New Year

All of these sculptures that were mentioned before, are of different types. Some maybe carved, some maybe modelled, some casted out of a molten material. Different sculptures are created using different methods of sculpting. The various techniques are:

- **Carving:** in this method, certain portions of a block of a material are removed using hands or a power tool, to give that block a desired form or design. Carving can be practiced on stones, glass, ivory, wood, plaster.
- **Modelling:** in this method, a pliable method is used and then the artist shapes the material into the desired 3D form. It can be done with hands or tools. The material used can be clay or wax.

The different types of sculptures are as follows:

- **Full Round Sculptures:** These are 3D sculptures and can't be appreciated from one single point of view. They must be circled to be viewed completely.
- **Relief Sculptures:** These sculptures grow out of a flat and 2-dimensional surface or background. The back of the sculpture is not meant to be seen. The entire design can be understood from a frontal view of that art form.

One of the most visible difference between the ancient buildings and modern buildings is the use of materials. In modern architecture we now use glass as a part of building material. But before, not everything around was used for sculpting. Ceramics and sculpting work would be done only on a selected type of material in earlier times. Durable sculptural processes originally used carving and modelling in stone, metal, ceramics, wood and other material but, since modernism, we have had a complete freedom of the materials and processes used in sculpting. The materials that were most commonly used for sculpting are as follows:

- **Clay:** Clay was a base of many ancient artifacts that were sculpted or carved. There are different types of clay that are suitable for sculpting different sizes of figurines to be sculpted. One is Grogged clay which holds itself better and is used for bigger figurines and the others are finer clays which are good for small-scale work. The Terracotta artifacts of ancient times were made out of clay. Clay was also shaped into pots and crockery. Pottery was one of the many important occupations in the ancient times.
- **Wood:** Wood is a very versatile substance. It can be carved, scraped, drilled, polished, laminated and bent. It appeals to sculptures because different types of wood have different durability, hardness, colour, grain and workability. You get a variety of wood textures which can be used for various purposes including sculpting. It is easier to carve in wood than many other materials like stone or marble. A famous example of wood art is the carved Pulpit of San Augustine Church.

- **Marble:** Marble is an extremely hard substance. It is also very durable and is appropriate for carving statues and in monuments. We can't carve marble with bare hands and hence we require certain tools to do the job. Stone tools like chisel, mallet and rasp are used. Artist also use contemporary power tools.
- Some of the other materials used for carving and sculpting, even today, are bronze, copper, ivory, etc.

I came across many findings while carrying out this entire research paper. There is so much we can take from the classical art. We can see that adding a touch of classical art and architecture to modern day architecture adds up so much to the entire structure and design. Sculptures are created specially to decorate and embellish a building or any other architectural structure, to add more beauty to the structure. Artists and architects take inspiration from not only the classical art and structures but also the cultures and traditions and use them in the modern-day architecture. For example, we use the sculpture of buddha in many public places or even in many homes. This is because Buddha has always been a symbol of peace and harmony and non-violence. To carry forward this message and to portray that his principles are still valid and are of great importance even in today's world, many people install Buddha's sculptures or even paintings in their respective homes or hotels or at any desired place.

There are different ways in which we use different types of sculptures in different spaces for various purposes. Some of them are discussed below. Nowadays, in modern architecture the sculptures are made in a way that portrays two concepts at a time. We can see this back in the ancient times as well in Lord Shiva's Symbols. The adjacent figure (Figure 3) is showing two opposite emotions that whether the blocks are completing the man or destroying the man. It completely depends on the individual who is seeing the sculpture and he perceives it. Such sculptures help us and encourage us to think positive.

Figure 3: Two Opposite Emotions

Also, today in modern architecture, the carved art is mostly seen in the interiors. It can be used in making the partition walls. It serves two purposes. Makes the place look interesting and the want for a partition is also accomplished. We can also use carving techniques on the exterior to make it featured. Three dimensional structures can also be seen in landscapes as well as a part of the interiors.

Relief structures are mostly seen in walls, external facades, internal facades, interior frames, etc.

5. CONCLUSION

Architecture and sculpture art was an important step taken for the progress of Indian art., initiated by Buddhists and inspired by Jains and Hindus who built similar kind of structures like Ajanta, Elephanta, Elora, Badami. Our history and culture have the potential to be our greatest guide in this subject, just as it does in other subjects as well. Art and architecture are very deeply connected. There is a need for a renewed relationship between sculpture and architecture. Theyare united through their design, their designer, and their individual meanings. Both are so different and yet so similar. A beautifully constructed house or building is nothing but a unique piece of art, and the use of various techniques and art forms like sculptures makes these constructions and designs worth constructing.

Any design of architecture must always reflect a sense and context that produced it. Architecture is more than merely providing shelter to someone or something.

Installing sculptures or carvings in a building or any other construction will always help respective place to tell its story in a better, beautiful and impressive way. It will always help to give an assembly of bricks, stones, cement, etc., a sense of its own. From the classic architecture sculpture like the Karnak temple complex to the modern versions like the buildings fallingwater and the iconic glass house by Philip Johnson, each represents thoroughly integrated combination and blend of both, architecture and sculpture, in their own way.

Here is the list of most famous architects of all time:

- *Antoni Gaudi:* Casa Milla
- *Frank Lloyd Wright:* Falling Water
- *Mies Van der Rohe:* Seagram's Tower
- *Philip Johnson:* The Glass House
- *Eero Saarinen:* 1962 JFK terminal.
- *Richard Rogers:* Pompidou centre
- *Frank Gehry:* Guggenheim Museum, Bilbao, Spain
- *Norman Foster:* The gerkin
- *Renzo Piano:* The Shard, London
- *Santiago Calatrava:* The Transit Hub for the World Trade Centre
- *Zaha Hadid:* a luxury condo in Chelsea, NYC
- *Oscar Niemeyer:* the civic buildings for Brasilia.
- *Rem Koolhas:* Central China Headquartes
- *Jeanne Gang:* The Vista Tower
- *Daniel Burnham:* Flatiron building
- *Shigeru Ban:* Shutter house

Last but not the least, we should never forget Vishwakarma. It is believed that lord Vishwakarma is the ultimate creator and the divine architect of the universe. It is believed that he has created many palaces for gods in all four Yugas.

ACKNOWLEDGEMENT

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I would also like to show gratitude to our librarian sir Mr. Avadhot Kulkarni who provide me the required references. I would like to thank people with whom I interact during my studies like potters at Kumbhar Wada, Pune, Mr. Ajit Shinde Founder of Arya Arts, Pune. They raised many precious points in our discussion and I hope that I have managed to address several of them here and the impact of their work on my own study is obvious throughout this research paper.

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Jal Sanrakshan: Awareness to Save Water

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ABSTRACT: The aim of water conservation is to reduce unnecessary water usage and the practice of using water efficiently. Ninety seven percent of our planet is covered in saltwater which is not potable, the remaining 2.7% of water is in glacier form, groundwater, 0.3% water that is potable can be found in rivers, freshwater lakes and atmosphere. Mumbai with its population of over 1.25+ crores, receives its drinking water supply from 7 lakes. The city receives 3100 million litres per day (MLD) against its demand for 3900 MLD. Water conservation management encompasses the policies, strategies, and activities made to manage water as a sustainable resource, conserve water, and meet current and future human demands.

This paper expresses the urge to evaluate the usage of water, its importance and need in upcoming years through a water exploratorium, that will sensitise, common man by spreading awareness about conservation of water.

Keywords: *Water Conservation, Scarcity, Population Growth, Water Demand, Awareness.*

1. INTRODUCTION

Water conservation is an important aspect of Indian culture and identity. Water conservation in the form of rainwater collection is an ancient tradition in India that has grown more essential in modern settings. From 4500 BCE to the twenty-first century, the goal of interventions ranging from the most basic earthwork constructions to highly sophisticated water harvesting structures has been the same: how to conserve water for later optimal use.

The issue of water conservation is not just about "saving" water—it is about having enough clean water at any given time and place to meet our needs. We have got to develop the habit of using less water and stop wasteful and luxurious use of water. Housing complexes should ideally have a robust rainwater harvesting system and draw groundwater for non-drinking uses.

Reclaiming wastewater, desalination and proper monitoring of usage of water or wisely using water reduces the need for newer projects that need transporting water from over 100 kilometres away at a significant capital cost.

The quantity of water to be compensated does not only refer to the region that has witnessed large scale extraction, but also to the types of users and the country's capacity to invest in technologies to adapt to water shortages. The purpose behind interventions in the form of simplest earthwork structures to scientifically evolved water harvesting/artificial recharge structures has remained the same–how to save water for later optimal use. Water scarcity is a big problem and it's unavoidable, if we don't care and respect what we have. Currently Mumbai is one of the most populous cities in India, hence water demand increases to provide for ever increasing population, thus reservoir projects increase which destroys ecology. To spread the knowledge of how water reaches from source to tap in Mumbai, there is a need for awareness and conservation by every individual.

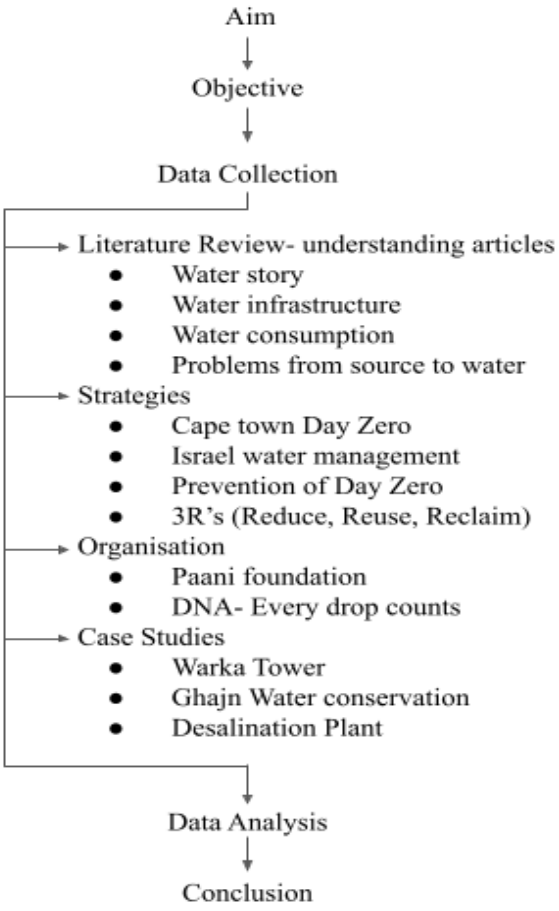
2. METHODOLOGY

2.1 AIM

The main aim of the research is to sensitise the common man by creating awareness through water awareness park to spread awareness about conservation, wise use, alternative ways to generate water and how we can contribute to reduce, reuse and reclaim usage of water.

2.2 Objective

- To study and understand different approaches to conserve water.
- To study and understand why floods occur in Mumbai.



2.3 Scope

- Creating awareness about water and its consumption patterns.
- Create ways of conserving water.
- Recreational space-play and learn activities.
- Promote products that help save water.

2.4 Limitation

- Different approaches will be showcased via architecture, in the hope of creating awareness.
- Research limited to Mumbai (MCGM) since rising population contributes to increased demand for water.

3. LITERATURE REVIEW

3.1 Water Story

Prior to 1860, Mumbai's water demands were met by private home wells or public water tanks. Only 32 MLD (million litres per day) of water supplied the island's population of less than a million people. Malaria cases were increasing, and deaths in army barracks and towns were attributed to open, unprotected water sources. The Municipal Act of 1863 made it essential to fill up tanks with questionable hygiene. Almost all private wells in the Bombay region were closed or covered after a study in 1911 claimed that home wells were the malarial mosquito's principal breeding pools.

Mumbai's water demand in the present time has increased to more than 3000 MLD. This resulted in bringing water from 7 lakes in cast iron pipes laid out over 100 km. Every year, additional water sources are needed to supplement Mumbai's water supply, and the number of new connections to the current infrastructure is growing at an exponential rate. Mumbai

being in a region of heavy rainfall and flood prone region still faces water scarcity every year, due to water theft, leakages and the manner they are controlled, distributed, and delivered to our houses.

Mumbai is built on a maze of pipes in the ground, many of which have not been repaired for years. Around 25 percent of Mumbai water supply remains unused, either from leaks or diverted at undocumented connections. But the city is making its own compromises with this unstable mechanism.

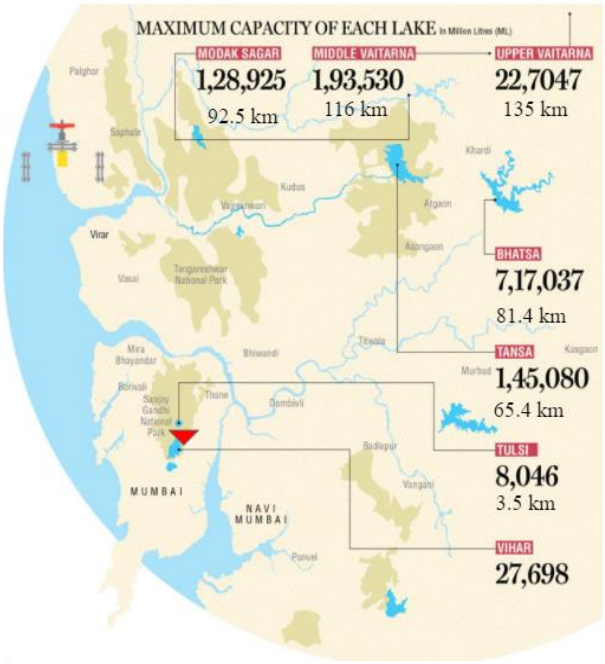


Figure 1

Source: DNA news article, from lakes to your taps.

3.2 Water Infrastructure

This is how water is transported to the city from sources located approximately 100 kilometres away. For the lower Vaitarna project 8 villages got evicted for building a dam which submerged agricultural land and caused ecological damage.

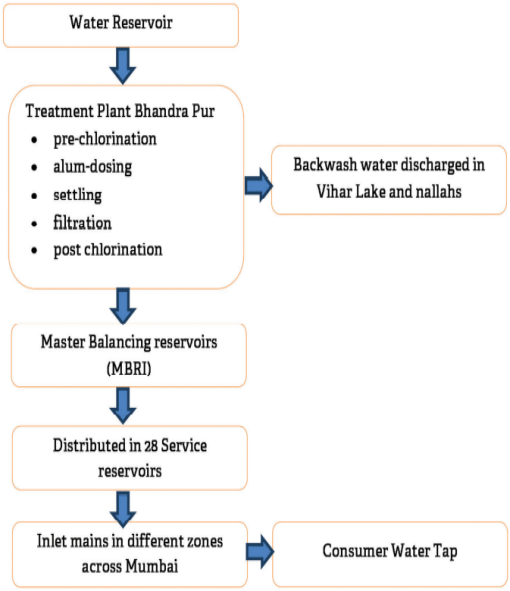


Figure 2

Source: USAID's water supply for urban poor: city of Mumbai; October 2016, Diagrammatic representation of water distribution and purification process.

Table 1

Year	Water Scheme	River	Water Supply (mld)
1860	Vihar Lake Dam on Mithi	Mithi	32
1872	Vihar Lake Dam height raised	Mithi	36
1879	Tulsi Lake - Another Dam on Mithi	Mithi	18
1891	Powai Lake - Mithi Tributary (To Aarey Colony)	Mithi	4
1892	Tansa I - Dam on Tansa	Tansa	77
1915	Tansa II - Additional Water Pipeline		82
1925	Tansa III - Dam height raised		98
1948	Tansa IV 38 floodgates provided		198
1948	Total Water Supply for Mumbai's `2 million population		541
1957	Vaitarna cum Tansa Dam on Vaitarna and tunnel between Vaitarna & Tansa Lakes	Vaitarna	490
1967	Ulhas (entire water supply to Kalyan since 1994)	Ulhas	90
1973	Upper Vaitarna Dam upstream of Vaitarna Lake	Vaitarna	554
1981	Bhatsai I Pise pick weir	Bhatsai	455
1989	Bhatsai II	Bhatsai	455
1998	Bhatsai III	Bhatsai	455
	Total Water Supply for Mumbai's 13 million population		2,950
	Sources Identified for Future Projects		
	Vaitarna River Basin		
	- Middle Vaitarna	Vaitarna	455
	- Gargai	Vaitarna	455
	- Pinjal	Vaitarna	865
	Ulhas River Basin		
	- Kalu	Ulhas	590
	- Shai	Ulhas	1067
2021	Total availability of water for Mumbai's projected 16million population		6,382

Source: BCPT organisation, showing present and future water supply infrastructure projects.

3.3 Water Consumption

Due to water scarcity, the Municipal Corporation of Greater Mumbai (MCGM) only supplies 90 LPCD, as opposed to the NBC requirement of 135 lpcd. "However, in slums, it only provides 25 litres per day per home (not person), which is extremely unfair," argues famous environmentalist Kisan Mehta. Though 90 or 135 lpcd is sufficient to meet a person's water needs, the future water sources, conveyance, treatment plants, reservoirs, and distribution network are designed for 240 lpcd to account for transit losses, evaporation losses, a higher standard of living in the future, and an increase in allied services as the city grows.

Table 2

Purpose	*Max*	*Average*	*Min*	
Drinking, Cooking & Dishwashing	50	40	30	
Bathing	50	25	15	
Toilet Flushing	50	40	30	
Washing Clothes	50	20	15	
Cleaning & Gardening	25	10	–	
Car Washing	5	–	–	
Total	**230**	**135**	**90**	

Source: BCPT organisation, shows the average requirement of water in terms of litres per consumer per day - lpcd.

Mumbai's water supply system was effectively installed, but it is mishandled and overused due to unmetered and unaccounted water supply. The system is burdened by low tariff rates, subsidy policies, and low recovery rate, as well as metering and billing irregularities. People have yet to break free from the belief that water is naturally abundant and thus a free commodity.

Water charges in Mumbai

- Domestic-Stand Post, Buildings & Chawls- Rs. 2.25–3.50/ 1000 litres
- Halls, Hospitals, Playgrounds, Swimming Pools etc- Rs. 10.50/ 1000 litres
- Industries, Dhobi Ghats, Government Premises, etc.- Rs. 18.00/ 1000 litres
- Refineries, Airports, Public Sector Undertakings, etc.- Rs. 25.00/ 1000 litres
- Race Courses & Star Hotels- Rs. 38.00/ 1000 litres

3.4 Problems Faced from Source to Tap

3.4.1 *Water Tanker Mafia*

Every day, approximately 2,500 private tankers with a capacity of 10,000 litres each supply the city, making an average of five trips to supply water to hotels, hospitals, and housing societies. Tankers make between 10 to 40 trips every day charging Rs. 2000 per trip. The non-revenue water (NRW) that has vanished and cannot be accounted for due to evaporation, distribution losses, or theft is 30 percent in Mumbai. (2)

3.4.2 *Leaks and Water Theft*

MCGM (Mumbai Corporation of Greater Mumbai) confronts numerous challenges as well, mostly because demand for services outstrips availability. The planned/unplanned growth and rising slums requires an increase in the length of the distribution network, in addition to carrying out routine pipeline maintenance and responding to frequent breakdowns on a war footing.

MCGM officials hope that citizens become aware of the difficulties in transporting water from 100 kilometres away and distributing it in a complex environment, so that they may lend a hand and fulfil their obligation to pay for services while conserving rare water resources.

3.5 Strategies

Some strategies that have been incorporated worldwide to tackle the water scarcity problem are:

3.5.1 *Cape Town Day Zero*

After three years of inadequate rainfall, Cape Town announced in 2018 that dramatic action was required to avoid running out. Residents were limited to a maximum of 50 litres per day, which was difficult given that showers alone may use up to 15 litres per minute. Cape Town was able to avoid the worst of the water scarcity issue by adjusting its habits, combined with the joyful return of some rain.

3.5.2 *Israel Water Management*

Israel's water revolution was achieved through a combination of a national drive to preserve and reuse decreasing water resources and a new wave of cutting-edge desalination plants. Only a few years ago, in the midst of its worst drought in 100 years, Israel's water reserves were on the verge of depletion. Low-flow toilets and showerheads were installed across the country in 2007, the national water authority constructed innovative water treatment facilities and monitoring of usage of water by each household. Israel was already a leader in drip irrigation technology, and in order to minimise the amount of freshwater used for agriculture, the cost of water was raised.

One-third of Israel's irrigation water today comes from wastewater processed at more than 150 plants. Huge coastal desalination facilities supply up to 80% of residential water, and others are under development, with a capacity of 200 million cubic metres of water per year.

3.6 Prevention of Day Zero

India's Dynamic Ground Water Resources are examined on a regular basis by the Central Ground Water Board (CGWB) and state governments. There has been no specific research study, policy, plan or strategy for investigating, reviewing, and drafting a "Day Zero'' policy for the country's water deficient regions. 'Inter Ministerial Committee' has been formed under the Chairmanship of Secretary to pursue the issue of 'Push on Water Conservation Related Activities for Optimum Utilisation of Monsoon Rainfall'. Augmentation of existing water sources, groundwater recharge, rainwater collecting, and grey water management and recharge are among the operations. The Ministry of Housing and Urban Affairs has developed guidelines for states to implement measures appropriate to local conditions.

3.7 Reduce, Reuse, Reclaim-3R s

Reduce: reducing use of water in daily need usage by:

- Using low—flow fixtures.
- Turning off tap when not in use for e.g.: while shaving, brushing and using a filled bowl of water to clean vegetables.
- Fixing all leaky taps.
- Notlet the water tank overflow.
- Drip irrigation for plants and lawns.

Reuse:

- Reusing treated rainwater can be used in the kitchen, toilet, washing, etc. except drinking.
- Water used in kitchen cooking can be reused for plants.
- Soapy water from the washing machine can be reused to clean the toilet.
- Stored water, water from AC can be reused for washing clothes, mopping except consumption.

Reclaim:

Water reclamation is the process of converting municipal wastewater or industrial wastewater into water that can be reused for a variety of purposes.

3.8 Organisation

Several agencies and organisations are already working towards spreading awareness these include:

3.8.1 *Paani Foundation*

Paani foundation aims for water conservation techniques that solve problems in villages facing thirst, hunger, debt, forced migration and withered crops. By helping and educating farmers about techniques to conserve water, water management and environmental restoration that will make them independent from drought.

Continuous contour trenches (CCTs), deep CCTs, compartment bunding and nala deepening and widening helped villages to develop on their own.

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3.8.2 *DNA-Every Drop Counts Campaign*

Madhukar Kamble, a water conservation specialist and former BMC hydraulic engineer, provided numerous strategies for households to save water. Some modest practices can have a big impact on water saving.

3.9 Case Studies

Case studies that helped to understand how solutions for water scarcity were evolved include.

3.9.1 *Warka Tower, Ethiopia, Africa – Ar. Arturo Vittori*

Polyester Mesh collects water from air through condensation and sent down due to gravity and stored in a tank and fabric is covered on harvested water conserving from being evaporated.

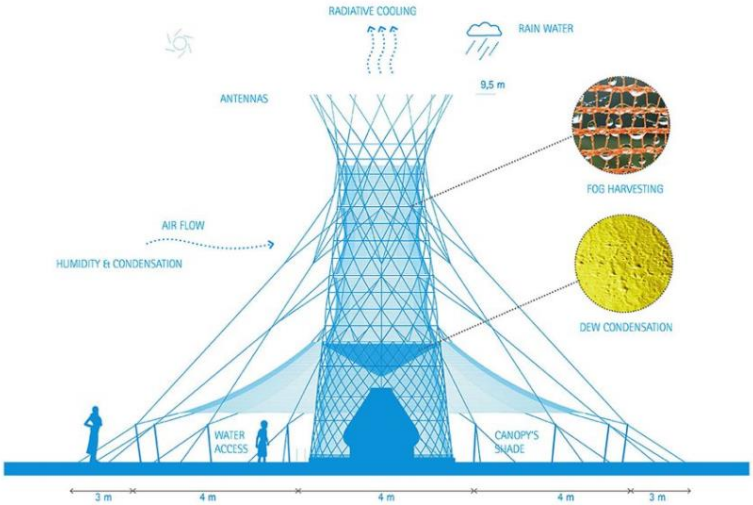

Figure 3

Source: Warkawater Tower.org, showing warka tower working.

3.9.2 *Ghajn National Water Conservation Awareness Centre*

Interactive spaces for kids where there are sandboxes, games to understand water cycles. Recreational space to play and relax are designed, Educational spaces combined with awareness spaces and Spatial organisation is such that circulation from site entry to structure while exploring other spaces is maintained.

Figure 4

Source: Energywateragency.gov.mt, showing interactive sandboxes activity.

3.9.3 *Desalination Plant—Teatro del Agua – Ar. Charlie Paton*

Teatro del Agua generates water from thin air in the desert. It uses a condensation process to convert salt water to fresh water. Cold sea water is passed through pipes, sprayed on mesh to create moisture and humidity. Hot air passes through the mesh onto cold pipes (sea water in it) and this creates fresh water on the surface of pipes. Combined with open theatre, it acts as a backdrop and desalination plant.

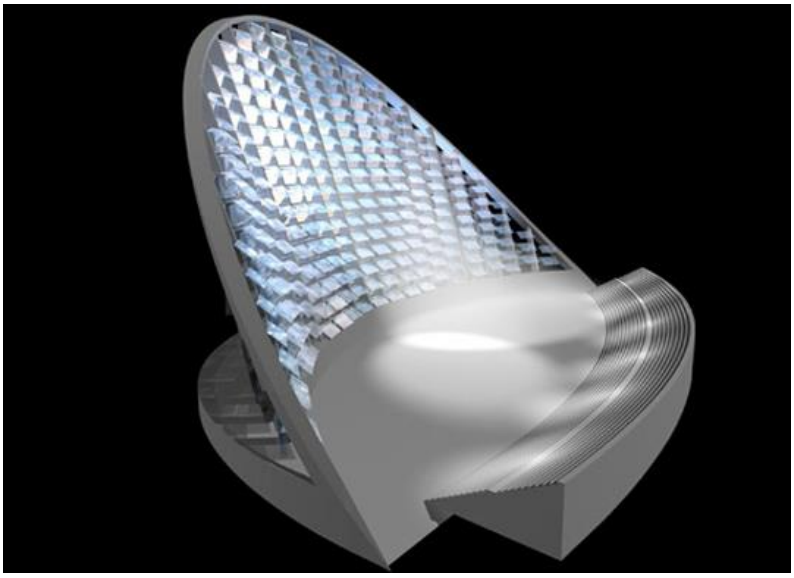

Image 5 source: dezeen.com, Spain's Stunning Teatro del Agua Solar Desalination Plant

4. DATA ANALYSIS

Population is increasing hence water demand is increasing which in turn gives rise to future projects that burden the ecology. Promoting awareness and reclaiming water can reduce water demands, reduce wastage of water, lower the demand for more water which in turn reduces needs for projects that potentially damage the environment.

Rivers in Mumbai can be used as water resources once cleaned and which shall also discourage people from putting plastics in water bodies and respect inland waters. Rain water harvesting both on roof and below ground is beneficial to recharge the water table and keep away urban floods. Since Mumbai is a coastal city a desalination plant like Teatro del Agua can be proposed to make potable water available

5. CONCLUSION

The research led to the conclusion that water demand and population increase is inevitable. In land water and water coming from over 100 km is less valued by putting garbage and using it non sensibly. And thus people need to be made aware of this situation that using water sensibly is a must and inevitable.

6. DESIGN PROPOSAL

A Water exploratorium is required to sensitize people about the value of water, and to reconnect them with water by showing the story of water till now and what future projects can be, making them aware of 3R s, so that everyone can learn to value each drop.

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Analytical Study of Materials with Potential Possibility for Light and Ventilation without an Opening

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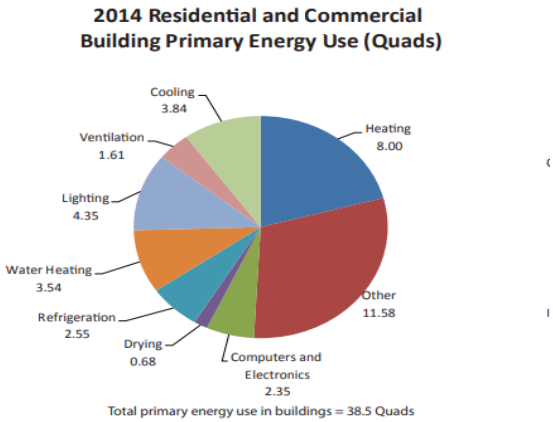
ABSTRACT: Natural light and ventilation are the major points that affect the energy consumption of a building. It plays a very crucial role in the health and behavior of the user. Many of the firms trying to have a sustainable design with innovative ideas. Advance building materials can be used to achieve light and ventilation where the openings are not possible. This research will focus on the Advance building materials for light and ventilation-Translucent Concrete and Meta-material, manufacturing, construction techniques using these materials, the uses and efficiency of working and, also critical analysis of those materials in terms of use, cost and, workmanship. The aim is to introduce more materials that can help this industry to achieve sustainable design to reduce environmental impact.

Keywords: *Advanced Building Materials-Translucent Concrete-Metamaterial-Sustainable Design.*

1. INTRODUCTION AND BACKGROUND OF A STUDY

Windows and openings are the techniques that are being used since humans started to build their shelters. It is among the dominant strategy that is being used to have Natural light and Ventilation. In the modern construction era. These strategies are lagging to fulfil the requirement resulting in more power consumption. Energy conservation is a key and emerging global.

An issue for sustainable infrastructure development. Translucent concrete and metamaterial are the materials that can be used to have both light and air, naturally and it is an innovative solution towards significantly reducing the need for artificial lighting and ventilation. (specifyconcrete, 2019)



Key: **Quad** = quadrillion Btu; **Btu** = British thermal unit

Figure 1

(Abdul Rahman, 2020)

2. LITERATURE REVIEW

Natural light and ventilation can reduce building construction and operation costs and reduce energy consumption. Moreover, it would also ensure safe, healthy, and comfortable living conditions. Providing a comfortable and healthy interior

environment is one of the core functions of building energy systems and accounts for about a third of total building energy use. New technologies for heating, cooling, and ventilation not only can achieve large gains in efficiency, but they can improve the way building systems meet occupant needs and preferences by providing greater control, reducing unwanted temperature variations, and improving indoor air quality.

The use of special materials will reduce energy consumption and will help to achieve the benchmark of sustainable design.

The best possible materials that can be used to have natural light and ventilation are:

- Translucent Concrete
  {fiber optic composed concrete}
- Metamaterial
  {material that allows air but not the sound}

2.1 Translucent Concrete

It is a concrete-based building material with light-transmission properties due to embedded light optical elements usually optical fibers. Light is conducted through the stone from one end to the other. Therefore, the fibers have to go through the whole object. This results in a certain light (re-thinking the future, n.d.) the pattern on the other surface, depending on the fiber structure. Shadows cast onto one side appear as silhouettes through the material. Also, the aesthetical properties after application and material porosity for ventilation makes it best for the application.

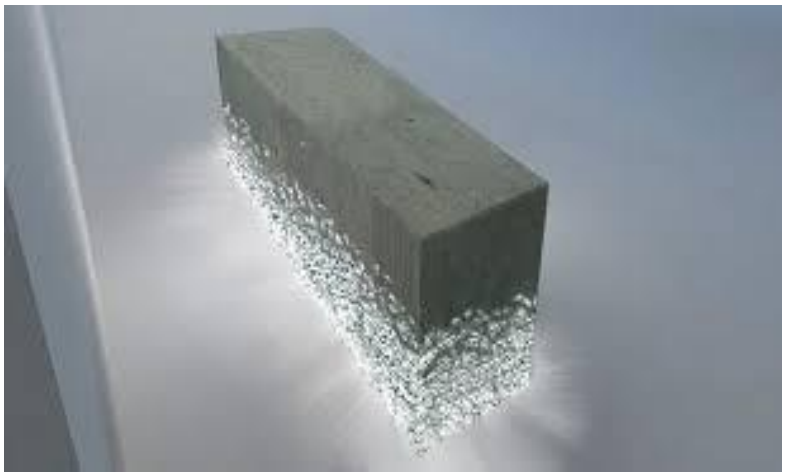


Figure 2

Table 1: Light Transmittance Property Test 100 W (1500 lumens) Incandescent Source of Light

No	*% Fiber Optic*	*Transmittance %*
1	3%	3.54
2	4%	5.32
3	5%	6.69

Table 2: Light Transmittance Property Test 500 W (11000 lumens) Halogen Source of Light

No	*% Fiber Optic*	*Transmittance %*
1	3%	3.3
2	4%	4.6
3	5%	6.4

Considering the air movement, the more percentage of fiber more will be the airflow. it will not provide the direct wind flow but can help to introduce the fresh air in the low lying area and to exhaust hot air from upper areas.

3. CASE STUDY

3.1 Al Aziz Mosque, Abu Dhabi

The facade starts transmitting light once the LEDs installed behind the backside of the panels are activated. Light transmitting optics transmit light of the LEDs to the external surface of the letters protruding from unique concrete panels, which are also weatherproof and can withstand extreme temperatures.

Here the translucent concrete blocks are custom-made concerning the design and the effect made by it. Arabic letters were made into the casting block and were cast after fiber optic weaved in a pattern.

(archello, 2019)

Figure 3

Figure 4

An increase in background light results in more luminosity. The transmission gradient and quality of fiber optic matter while casting the block. Otherwise, in strength and durability, the material is equivalent to the concrete.

3.2 Udo Krollman Corporate Centre, Berlin

These blocks are supplied in panel format and installed with a source of light of choice at the rear of the panel. The light travels to the surface of the panel, allowing for a colorful spectacle and an almost magical effect of the light glowing from the inside of the concrete. Current technology allows for RGB-LEDs to be activated and controlled through a computer or smartphone—the achievable lighting possibilities range from static colors to colors that can change on demand and the light intensity is also controllable. Light transmitting concrete itself constitutes a beautiful surface even unlit and its structural performance is similar to that of natural stone, concrete. (archello, 2019)

Figure 5: Facade Wall

Other than that, translucent concrete is used in partition walls, doors, panels, etc., and adds to the beauty of the interior by illuminating the area during day time. In addition to lighting up dark places or windowless areas like basements, it is used to construct sidewalks and speed bumps that illuminate at night and provide increased safety for pedestrians and roadside traffic.

4. CONCLUSION

- Light transmitting concrete requires skilled labor for its production, as they should be properly placed in concrete, and special attention is needed while placing concrete, to ensure no damage.
- Light transmitting concrete can be used in structures to make them architecturally and aesthetically beautiful, as various types of glowing patterns can be made with this concrete.
- The cost of manufacture of light-transmitting concrete is also high due to plastic fiber optic strands used and special care is required during its preparation. But its cost is fully justified because of its usefulness as eco-friendly, energy-efficient, aesthetically beautiful on sustainable ground.
- Minor airflow is maintained internally which helps to achieve comfort.

4.1 Meta-Material

A meta-material is any material engineered to have a property that is not found in naturally occurring materials. They are made from assemblies of multiple elements fashioned from composite materials such as metals and plastics. The materials are usually arranged in repeating patterns, at scales that are smaller than the wavelengths of the phenomena they influence. Metamaterials derive their properties not from the properties of the base materials, but their newly designed structures. Their precise shape, geometry, size, orientation, and arrangement give them their smart properties capable of manipulating electromagnetic waves: by blocking, absorbing, enhancing, or bending waves, to achieve benefits that go beyond what is possible with conventional materials ultra-open ventilated metamaterial is possible which is currently under research state. sound absorber acoustic materials, light, and frequency transmission materials have been developed which are yet not ready to be used in construction due to the high manufacturing cost.

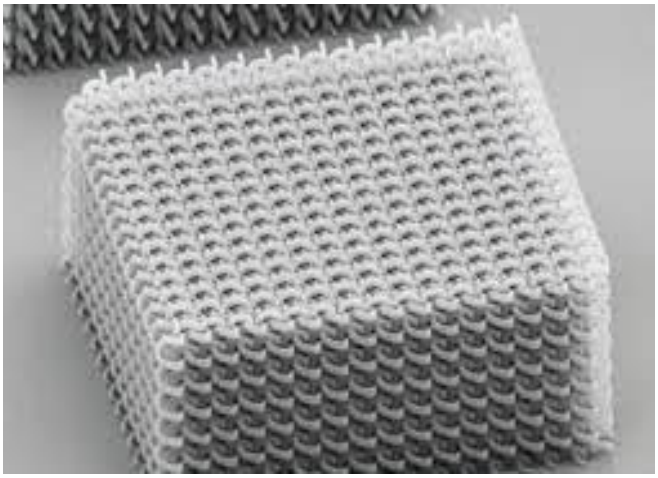


Figure 6: Metamaterial Pattern

(Wikipedia, n.d.)

Material with the ability to transmit visible range of light with air in both ways is manufactured and currently, it is in a research state.

5. PREDICTED FUTURE APPLICATIONS

- Conjusted spaces with no possibility of opening, continuous surrounding sound with high frequency, no opening resulting in zero ventilation has no any design idea to tackle. The use of this meta-material can tackle and provide an alternative that will improve the internal health of the area.

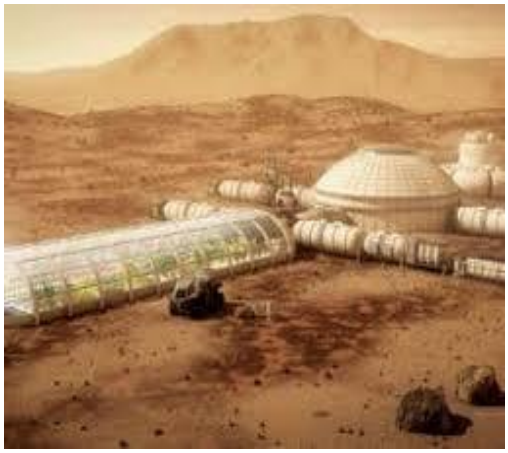


Figure 7: Mars Colony

(Bartleby, 2018)

- Some areas which can not be exposed to external areas due to security and safety reasons and which continuously depend on mechanical ventilation and artificial lighting can have these materials implemented to reduce the energy consumption with the same level of safety and security. eg. Nuclear plants, heat reactor plants, etc.
- Planetary colonization is the future of construction and it cant be carried out using the same techniques that we use regularly the complete vacuum area can be created using the envelop method but it does not give the opportunity in light and ventilation. Meta-material can add light, act as a sound barrier, and provide the heat insulation which is needed on the other planets.

6. MERITS

- Providing multiple options in materials helps to regulate different aspects such as light, ventilation, sound, etc.
- If used properly and in a precise manner it can tackle multiple design problems.

7. DEMERITS

- High manufacturing cost and very complicated manufacturing process
- For its application, a staff with all the knowledge from development to the application is needed.
- Construction methods need to be changed for its use which is not possible in one go, it will take time.

8. CONCLUSION

- High development cost, methodology, application process will keep this material element out of the construction family till the futuristic development with a high budget.
- Regular use of meta-material will not be seen but at essential spaces, it can be used as a magic element.

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Mine of Resurgence: Reclaiming and Rejuvenating the Lost

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ABSTRACT: Living on a mystical land, blessed with an abundance of mineral resources but still drowning in the degradation of lives, environment, and poverty. Jharkhand is a state of India known as a "resource-rich" state as it is immensely blessed with natural wealth. It is known for mineral resources, forests, India's largest tribal-dominated state, and also for abandoned mica mines. Minerals like mica and coal are abundant. According to statistics, 40% of the country's minerals are extracted from Jharkhand. But the current scenario is considered one of the ailing and backward states in terms of economic development. Due to a lack of attention on planning, the tribes are starving for daily needs and the ecosystem is losing its grip. The research paper looks forward to identifying opportunities to uplift the lost biodiversity, and the tribal community of Jharkhand with the help of geo-tourism to highlight the essence of the mineral resources.

Keywords: *Jharkhand, Abandoned Mica Mines, Lost Biodiversity.*

1. INTRODUCTION

Humans are known as evolving species. From inventing fire to digging earth to extracting minerals solely to fulfill human greed. It is claimed that human activities have directly altered 70% of the earth's land according to convenience and need, which has triggered damage on a global scale which includes global warming, rising sea level, deforestation, and has its direct impact on indigenous people.

To manufacture any product, minerals are necessary which is available to us directly from nature, but the proportion of demand and supply is imbalanced. As the population increased the consumption too increased proportionately leading to increased demand for raw material extraction, resulting in the exploitation of land and labor which directly impacted biodiversity on a micro and macro level leading to questions like:

Why do we exploit earth? What is the value of the river, forests, and fertile lands? Why alternative techniques are not considered? What is the value of intangibles like culture, traditional knowledge, and wisdom? There is a constant conflict between two world views: Conflict between two ideologies: sustainability vs exploitation. The conflict between technocrats versus people's traditional values. The paper aims to explore various possibilities to reclaim and rejuvenate an abandoned mica mine by intervening in the Santhal tribe and working on the concept of geo-tourism, and recreation through awareness which would act as a source of livelihood and would uplift the biodiversity of the Giridih, Jharkhand, resulting in improved economy of the Santhal tribe. The objective of the research is: Understand the mica mining cycle and its allied footprint in the region. Understanding the techniques to reclaim an abandoned mine. The intent is to study and employ techniques that uplift the environment and cultural fabric by employing tribal development programs. Understanding the biodiversity and lifestyle of the Santhal tribal community of the Giridih in Jharkhand. Scope: Protection of abandoned mica mine: Underground mining is degrading human health causing respiratory disease, the environment, the community, and biodiversity therefore, this aspect needs to be tackled in detail. A part of the research study resolved the concern around the degradation of biodiversity, preventing the selected site from soil erosion. Community Upliftment: Due to excessive mining, nature is showing adverse effects in the Jharkhand and making it arduous for the community dependent on nature to sustain. To create a platform to initiate interaction between Nature and visitors, community and visitors. Awareness: Simultaneously with the negative impacts of mining, the research scope includes the study of the biodiversity of the Jharkhand. The project will create an ideal ground to spread awareness regarding the biodiversity, consumption pattern, mining process, and the lifestyle of the tribe. Education and promotion: The research scope focuses on creating a ground to educate and exchange the cultural heritage value as well as encourage the craft of the tribal community. Limitations: The study was carried out in the affected Giridih region only. The study concentrated on abandoned mica mines in Giridih and developing an architecture program. The policies for abandoned mica mines by the Indian Bureau of Mines were referred to.

2. LITERATURE REVIEW

The relationship between man and nature nurtures and transmutes more spiritually and harmoniously when humans are closely interweaved with nature for their spiritual, physical, and psychological wellbeing. Humans and nature are without reserve interdependently interweaved. For ages, Santhals have resided in peace and serenity with nature. Nature has always been contributing different life-sustaining quality and quantitative products. Humans are meant to live in harmony and in connection with the land, the biodiversity for their physical, spiritual, and psychological well-being. The interweaved unified interconnection of nature and tribes puts responsibility for humans to respect, preach, value, and keep nature in its authentic pure self and empower it, as it was the same conscious synergy between our ancestors and nature. Thriving to balance, the interweaved relationship between nature is a community responsibility. But, with time it is seen that the close interweaved relationship is losing and degrading rapidly. The ever-increasing population and its rapidly increasing demand for consumption are altering nature and its surroundings. This inconsistency between humans and nature is leading to various problems which are threatening human existence and harming the fauna. The Santhal tribe living in serenity and harmony from ages are the victims of the conflict due to the urban setting. The conflict has led to the extinction of many tribes around the globe such as Santhals of Koderma and Giridih, Khamti of Assam, Shaur of amazon, and many more. The heritage and the cultural fabric of the Santhals are degrading with time due to migration and the constant need to fit in the mold of the urban setting. The rapidly flourishing mining industry is one of the major factors contributing to the conflict between tribe and nature. Altering land to extract minerals has a direct repercussion on nature at macro and micro levels and the tribal people living nearby. Once the land loses its value and industry has exploited areas, the tribes and once mineral-rich land becomes abandoned. Left-back land with wrecked biodiversity and altered topography due to mining on which the tribes were dependent for their survival has been abandoned. The burden of environmental destruction falls upon the innocent, vulnerable Santhal tribes.

3. MATERIAL AND METHODOLOGY

Figure 1: Mica Producing Countries

Mica mining around the globe: Minerals are a valuable natural resource that is finite and non-renewable. Minerals besides catering to the energy requirements of the world, they're valuable raw input materials for diverse industrial activities. The natural endowment of minerals in a country decides the potential wealth acquired by the country but has its adverse effects at the same time. Mineral distribution around the globe varies substantially. The world's population annually consumes thirty-two billion tonnes of natural resources valued at regarding $1,123 billion. All parts that comprise these economic deposits are present within the earth's crust, most of them within the earth's surface varies of components per million. The market generally consists of two types of mica: natural and synthetic mica. According to the commercial market analysis, natural mica accounts for 90% of the total mica market as a raw material for products that are abundantly available in Jharkhand, and the other 10% is synthetic mica. It is expected that the demand for synthetic mica is will not grow more than 2% in the upcoming 10 years, which means that demand for natural mica is going to increase eventually. Mica mineral group reveals layers or a platy kind of structural body. Muscovite (white mica) and phlogopite (amber mica) are two commercially and economically very important mica minerals. Properties of mica are, it is a crystalline layer of structures that can be further split into thin extremely thin sheets. Mica mining in Jharkhand: Jharkhand once known as the mica belt of India is losing its grip over mica mining. In the past, India was a world leader in the manufacture and export of mica sheets. The best mica deposits are located at Jharkhand, making the state the seat of a booming industry. In 2015, mica was

moved from the list of "major minerals" to the list of "minor minerals", allowing state governments to develop plans for the management and use of the mineral. There is often news from Illegal mica extraction, particularly in some areas of Koderma and Giridih in Jharkhand, which may explain the large amount of mica exported from the ports of Calcutta and Chennai. There is little or no extraction of mica in the state newspapers, as the state government canceled the leases for the extraction of mica. Mica scavenging is carried out by Santhals for low wages. In the absence of alternative livelihoods, Santhals are hired to collect mica and deliver it to processors through a local network of local aggregators and vendors. Mica mining in India dates back to the mid to late 19th century when railroad tracks were laid in the Bengal-Nagpur area. In the 1950s, around 700 mica mines were in operation and employed some 24,000 people. According to Jharkhand State Mineral Development Corporation Ltd, the total mica reserve in Jharkhand was 13,554 tonnes. Illegal mining is an invasive process that causes more damage than the mining site itself. For example, residents of the village of Tisri said that the sighting of elephants, wild boars, and rare birds in the village has decreased. However, the mica mines were abandoned after the Forest Conservation Act of 1980 prohibited mica mining in Jharkhand. But the ban did not produce any positive change in the lives of the tribes. No action was taken to restore the mines, laborers, leading villagers to continue to visit these abandoned mines to collect mica flakes. Villagers, mostly dressed in vests and pants, enter the 58-foot-deep rat holes with the help of ropes and handmade bamboo platforms. The illegal mica scrap trade has been an open secret in Jharkhand since 1980 when environmental laws prohibited mica mining. However, the global appetite for the mineral and its abundance in the districts of Mica rich has left the practice unregulated. Mica mining first gained worldwide fame around 2014, when western media reported on illegal mining in Jharkhand involving child labor. The problem of child labor persists, as evidenced by the alleged crime of Fenty Beauty.

Figure 2: Concentration of Abandoned Mica Mines in Jharkhand

4. RESULT

Resource curse can be said as the paradox of plenty which infers to the breakdown of many resources' rich regions worldwide which are deficit to be fully beneficial from their natural resource wealth. Resource-rich regions tend to witness better development outcomes due to the discovery of natural wealth, despite these resource-rich regions tend to have an extravagant higher rate of issues and conflicts and a cut-price, lower rate of economic stability and economic progress if compared to non-resource rich regions.Natural mineral resource abundance, evolution, and development in states of India.

Table 1: Share of mining N Net State Domestic Product in Indian States 193–94 to 2004–05 (Rs. Million)

State	*Parameter*	*1993–95*	*1999–01*	*2004–06*	*Average*
Kerala	NSDP from mining	82.472	136.514	251.12	193.78
Jharkhand	NSDP from mining	82.744	143.082	271.9	207.45
Orissa	NSDP from mining	83.016	149.65	292.68	221.12
Tamil Nadu	NSDP from mining	83.288	156.218	313.46	234.79
Chhattisgarh	NSDP from mining	83.56	162.786	334.24	248.46

The development differs from state to state of the same country it is witnessed distinctly, that when there is wide dissimilarity in abundance and distribution of natural resources in the states as well as the difference in institution and policies. Few important questions arise in the Indian context, they're as follows: Why have some of the Indian states been paving their path towards development at a faster rate while other resource-rich states are lagging? What is the procedure of utilization of mineral resources in Indian states? Does the resource curse hypothesis is valid in the Indian context?

A comprehensive understanding of abundance and distribution of the mineral resource is required having an index that can be sufficient to apprehend the several proxies, such as the share of mining production in GDP context, land per capita, division of natural resources exports in GDP, division of labor force in mining employment.

Table 2: State-wise Distribution of Forest Area, Total Cropped Area

State	*% of Forest Area (2005)*	*% of Total Cropped Area (2005–06)*
Punjab	6.12	160.54
Kerala	28.99	76.84
Jharkhand	29.61	26.24
Orissa	37.34	50.98
Tamil Nadu	17.59	46.39

Table 2 shows how mining contributes to net state domestic product in some states compared to others. In the NSDP, mining and quarrying account for 14.37% in Jharkhand, 11.04% in Chhattisgarh, and 8.47% in Orissa. Furthermore, these states have relatively abundant forest resources, and in terms of groundwater, these states have greater potential than other economically developed states like Maharashtra, Karnataka, Gujarat, and Tamil Nadu.

According to research, the state's gross cropped area is disproportionately small in comparison to its overall land area in Jharkhand. As a consequence of the scarcity of land for agriculture and the deterioration of land due to mineral extraction, people are becoming increasingly reliant on other natural resources such as forest products. However, owing to excessive mining, forest area is being destroyed, forcing people to rely on cities for subsistence, resulting in difficulties such as migration, cultural loss, and unplanned growth. In terms of economic development, the states' growth and development are shown in the table above. When comparing resource-rich states like Jharkhand, and Orissa to resource-poor states like Punjab, Kerala, it is clear that resource-rich states have poorer circumstances in terms of both per capita income and pace of growth in terms of domestic product. Further, states like Jharkhand and Orissa are drowning in poverty which is quite alarming wherein, the poverty rate in resource-poor states is considerably very low and also, it is statically proven that benefits from mineral resources in such regions are not equally distributed to all the sections of the society.

According to human development indices Orissa, for example, has the lowest monthly per capita spending, followed by Jharkhand and Bihar. Similarly, these three states' educational levels and literacy rates are worrying. It is said that resource-rich nations or countries attract sufficient inflows of capital and a disciplined approach to balancing growth and biodiversity but in India it's reverse. Emerging issues in resource-rich states: Hence resource curse phenomena in the Indian context center around three issues: The quality of institutions in resource boon states needs proper guidelines as it looks on to allocation and utilization of resource rents for economic development. Large scale rents give rise to agents and weak working of institutions leading to unconscious decisions towards biodiversity of the region. Unfavorable investment and reclamation policies discourage investors to invest in sustainable resource exploration. Impact of mining on a global level: Mining of any minerals affects the biodiversity of the region at micro and macro levels and at multiple spatial scales which includes mining sites, topography, landscape, regional community, and influence global climate depilation through direct mineral extraction and indirect processes carried out by industries supporting mining operation, the post-processing factories and the external stakeholders who gain easy access to wealthy biodiversity regions to carry mining practice.

This particular figure above is unsurprising focuses on the site preparation for mine exploration, explanation, and waste management is a destructive process, which has its impacts on abiotic and biotic conditions, wherein, in some cases singlehandedly causing a region-wide decline in rare and threatened species and ecosystem. Impacts on biodiversity also occur across the topography of the regions. Mining has two types of impacts consisting of direct and indirect. Wherein, direct impacts consist of chemical and physical mining waste discharge; chemical emission includes mercury or cyanide which is used to extract mica and coal raw material and at the same time acids are released from oxidized minerals when

some of the ores are exposed to the air. Negative and hazardous impacts to biodiversity occur on large scale and leave only tolerant species behind. In indirect impacts landscape and wide impact on geography and biodiversity emerges through cumulative pathways. Indirect impacts occur when infrastructure development is done and attracts the urban population causing threats to indigenous people or exacerbating pre-existing threats, which include over-exploitation.

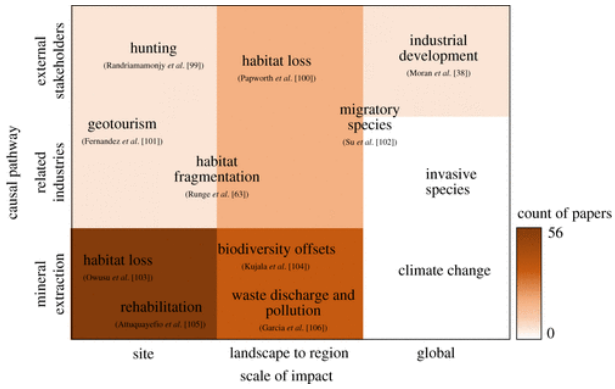

Figure 3: List of Literature Studied

5 CONCLUSION

India has one of the largest mica deposits around the globe, which boosted the economy in the early 1900s. It is witnessed that rich content of quality minerals lies in the deeper forest area of Jharkhand state. Mica consumption and demand for sheet mica grew leading to growth in the economy of India but neglecting the environmental footprint it had. The Forest Act in Jharkhand led to the abandoning of mica mines which gave birth to illegal mining and had adverse effects on the Santhal tribe, flora, and fauna of the region. The research states that abandoned mica mines can be an instrument to rejuvenate the lost biodiversity via afforestation as an important solution to combat the loss of natural forests due to heavy deforestation in recent years and create an interactive environment with the help of geo-tourism for the Santhal tribe and visitors to cherish the cultural heritage of the region and celebrate the scenic natural biodiversity of the Giridih Jharkhand. The role is to create a geo-cultural park, a space in the memory of the valuable minerals, abandoned mine, its activities, and its results. The intention is to highlight the importance of climate change, biodiversity, and indigenous tribe and to reinforce the experience and sensation which is grown by wandering about it.

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Museum of Architecture: Exploring Temporality and Permanence

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ABSTRACT: In today's era, with advancements in science and technology, architecture is progressing rapidly. Being one of the important aspects supporting life on earth, shelter and the art of building these shelters in many forms and types commonly known as architecture, has made its way through many cultures, geographies, climates, historicity, and societies. However, the conversation of Architecture is largely restricted to people in the fraternity, and involvement of the masses in this conversation would bring in different perspectives and points of view. This paper aims to identify a common platform to put up a communalized process of the building between the public and the professionals as well as students from the architecture fraternity.

Keywords: *Experiential, Museum, Architecture, Communal, Engagement.*

1. INTRODUCTION

Architecture, as per the Oxford Dictionary, is defined as 'the art or practice of designing and constructing buildings or the complex and structured designing of something'. Architecture has had many definitions and interpretations. If we think about when and how architecture or the art of building came into being, it dates back to the paleolithicage, when *Homo Sapiens* started developing measures and techniques to sustain a living.[i] This brought out the importance of architecture and create awareness about the field to increase its value as a profession, it is necessary to create a platform where the end-user can understand and interpret architecture. Throughout history, architects and designers have had been concerned with the ideas of permanence and monumentality, as to create and conserve the perception of buildings and the whole lot of emotions attached to them. This theory was studied by various architects and one of the examples in the research paper by Richard Beacham was based on the study of the old theatrical spaces in Rome which were built and perceived as temporary and permanent. He quoted that "*In short, it is the idea of a theatre that is temporary or permanent, not the materials comprising it or the particular quality of the structural embodiment of the idea.*" [ii]

The perception of spaces is subject to individuals, yet the impact of the space that is created becomes a matter experienced collectively. The concept of ephemerality plays an important role in creating spaces defined by their materiality, function, their characteristics, and the environment it provides and preserves.

The sense of temporality was observed in the art and architecture since the Baroque era as the sentiment of the inevitability of death, the idea of "*Memento mori*" which meant 'Remember that you must die. This led the people to celebrate small events with great pomp and show during that era in a way to show that the present should be enjoyed and celebrated as the future seems unpredictable.

This emotion of transience evolved in the form of exhibitions and a platform to showcase the cultural, scientific, and technological advancements the people or nation have invented to all. This ideology is still practiced and has been the basis of this thesis project. The research paper by Jaqueline Armada quotes that "*The reality of the world where change is constant and even increasing in speed is that nothing lasts*".[iii] This led to the thought that "Can architecture mediate between permanence and temporality?

This paper aims to promote and publicize architecture in India, and through changing times, adopt new ideas, methods, techniques of building and promote the need for making temporary or ephemeral spaces and highlight the consequences of obsolescence. The objectives of this research are to study and analyze spaces that can be created for temporary purposes within and outside the closed spaces, their materiality, and the concept of multipurpose pavilions. This research provides a vast scope of knowledge in terms of understanding temporal spaces, bringing permanency and temporality together to create an intervention that would fulfill the purpose of bringing together people for various purposes such as recreation, education, awareness, enhancement, and appreciation or criticism.

As much as there is a scope to delve into the constant argument between the Permanent and Temporary, there are many aspects that differ between the two. In various scenarios, what is thought to be temporary is created by the essence and existence of the permanent. Are these two concepts defined or explained by their definitions and properties, or are they defined by how they are perceived? These questions are explored in this paper.

2. LITERATURE REVIEW

The research on this topic included studying tangible and intangible aspects of museum spaces and the spatial arrangements for various programs and exhibitions. The essence of the dynamics of the spaces as interpreted and perceived needs to be carefully captured to understand the workability and functioning of amalgamating spaces of various sizes, shapes, and ambiances. Exhibiting architecture in confined spaces is similar to bringing the whole ocean in a bottle.

With the ever-increasing permanence of buildings around us, something impermanent and obsolete can create an impact that lasts longer in peoples' memories. Ephemeral architecture is closely related to its materiality and functionality. The functionality of the structure depends on the materiality, fabrication, assembly, and then disassembly of the structure.

When there was a comparison between the west, where permanence was observed more, and the east, where impermanence made its way to create an environment kinetic to its time.[iii] Temporality of spaces can be categorized as the external temporal and the internal temporal. In the case of the external temporal, materiality plays an important in the transition of the intangible to the tangible. The ephemerality of spaces opens up opportunities for designers to explore and create the dynamicity of the spaces in terms of materials, usage, and even experiences.

The difference in Materiality helps in defining the character of the building. Ephemeral and Monumental buildings have vast visual and experiential differences. From being enclosed in an enormous monumental structure, ephemeral spaces, are subject to more openness and weightlessness.

Figure 1: Monumentality and Temporality of the Built

Whilst in case of the internal temporal, dynamics of the interior spaces in creating a kinetic flow in the space organizations play an important role. Internal temporal deals with creating solutions where there can be a play with the rigidity of the walls which would create the effect of temporality within the closed boundaries of the space.

The concept of Open museums regulates the creation of open public spaces which act as a mediation between the permanent and temporal. Even though the exhibit might be permanent, the outlook of the space created changes with time.

It is often found that it is difficult to translate theory into the design. Min-Hsiu Liao (2016)describes how translating theory has been long conceptualized in spatial terms through metaphors, but in comparison to the metaphors such as "space in between" (Snell-Hornby 2001), "border-crossing" (Miller 1991), or "the third space" (Wolf 2000), the design aspects in terms of temporality is under explored.[v] In India, museums are generally visited by children during their school trips, or by actually interested people, there is a lack of interest in visiting museums amongst the people.[vi]

There are a total of 835museums in India [vii] that have been categorized into 10 different types of museums[viii] such as:

(a) Museums of National importance.
(b) State museums
(c) Archaeological site museums
(d) Anthropological site museums
(e) Memorial museums
(f) University museums

(g) Specialized museums run by the departments of Central and State governments.
(h) Science and technology museums
(i) Museums run by Societies/Trusts and Private Bodies.
(j) Private museums

As this Museum of Architecture would be a part of the network of Museums all over India, it can be categorized as a museum run by societies/trusts or private bodies like the Council of Architecture, the IIA and INTACH, according to the proposal of the NMOA. With the diversity in the geography, climate, topography, and the culture, languages and living, architecture has given the character to the place and space over the years. India has a variety of styles of architecture and a network of museums would help reflect the regional characteristics and portray the evolution of architecture in that region. Architecture has always been people centric; this needs to be discussed openly in order to create more meaningful spaces with the pacing time of modernity.

3. METHODOLOGY

The research was conducted in four stages;

1. Identifying the intent of the topic
2. Literature review, where the research gap was identified
3. Collecting data through Case studies, surveys and interviews
4. Creating a conclusion and solving the research question.

A museum is a public space where people come for education and even for recreational purposes.[ix] Generally, museums are designed in a way that people of all age groups except toddlers can comfortably walk through and view the exhibits. This project is a museum of architecture, looks at design interventions catering to mostly all age groups, from children to senior citizens.

To understand peoples' perspectives on Museums, a survey was conducted wherein architects, as well as the lay public, were surveyed on the need of having a Museum of Architecture. Out of the 80 people that were surveyed, 40 people were professionals and students from the field of architecture, and the rest of the 40 were people who weren't related to the field.

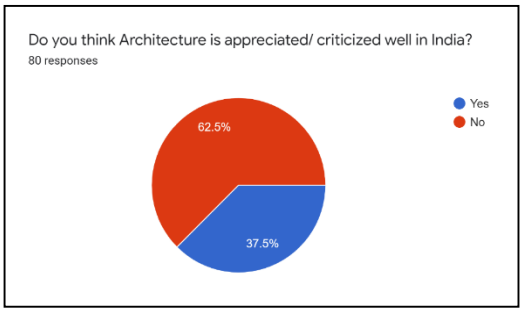
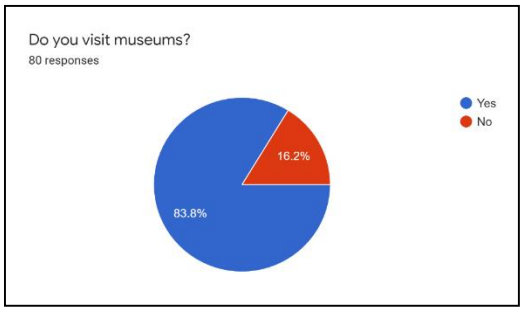


Figure 2



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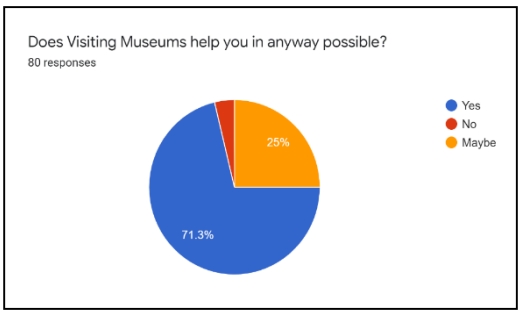

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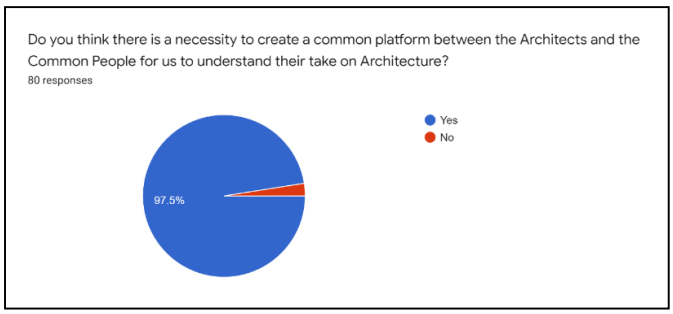

Figure 3

Figures 2–5: Survey on Museums Conducted by the Author

Field Research was one of the most important parts of this study, which answered design-related questions like the identity and language of the museum, space distribution and organizations, and the character of the building according to the context. Permanent Museums and exhibition spaces like The Bihar Patna Museum by Maki and Associates + Opolis, The Hall of Nations by Raj Rewal, Dr. Bhau Daji Lad Museum, National Gallery of Modern Art, Mumbai were studied to understand the above-stated aspects of the design study.

4. RESULTS AND FINDINGS

In 2016, Greha (गृह) drafted a proposal for the National Museum of Architecture in Delhi.[x] the proposal states that it would be a network of museums all over the country depicting and showcasing regional and local architectures of the city it is located in. This project takes into consideration this proposal along with the play of temporal and permanent spaces which otherwise would have been impossible to achieve.

The need for this museum, by the means of a survey, was found that many Architecture professionals and students think that Architecture in itself is not appreciated as much as the other professions. It was mostly because of the lack of appreciation and awareness by the common people. Through this survey, it was found that 83.8% of the people who took the survey visited museums and only 71.3% thought that visiting museums actually helped them gain knowledge. 97.5% of the people agreed that it is necessary to have some kind of a common platform for people to understand architecture. A museum is a way to communalize this platform to create an experiential space that would change peoples' ideologies about museums in India.

The difference in designing exhibition spaces in a museum of architecture and other kinds of museums (such as a History and Art Museum, Living Museums) is that the design depends on the scale and proportion of the exhibits, the characteristic of the location of the museum, the footfall, basically the population of the said location and the surroundings.

Designing temporal spaces is a need in today's times with the growing concrete jungle around us. In India, the rate of urbanization has increased from 30.93% in 2010 to 34.93% in 2020.[x] This impulsive rate of urbanization is creating the need for more buildings in an urban context. Between this rapid concretization, spaces that are more obsolete and temporary create a longer-lasting impact on people.

Materiality in the design can help fabricate different emotions and change perceptions of the space according to the user. While one may feel the grandeur, others could feel claustrophobic. The choice of materials depicts how people would enjoy, and revisit the space for it to be fully functional.

Temporal spaces are generally characterized by light-weight materials like bamboo, steel, and timber which create feelings of openness and connectivity to the surroundings, whereas permanent spaces are characterized by bulky materials like concrete and bricks that take the user away from the outside, producing a barrier between the outside and the inside. One of the important aspects of curating the temporal-built spaces has been the economy; the cost of the materials that keep changing, the labor costs and their maintenance costs. The feasible solution to this problem was found to be the use of recycled and reusable materials like steel, timber, strawbale which can be dismantled and assembled easily.

5. CONCLUSION

A Museum is a*s pace holding multiple possibilities of exploration and experiencing complex knowledge and information systems. It is a space more permanent than Exposition spaces and more experimental than permanent Built forms of Architecture built as different building topologies over many centuries.* They are storehouses of information of the past, present, and also future. Studying the past helps us build a better future and replenish the present. Temporality in and outside museum spaces holds different importance in this era. It is observed spaces that are short-lived are usually visited by most people this phenomenon in common terminology can be described as 'Fear of Missing Out.

Temporary Exhibitions attract a lot of people in today's times. Creating Spaces for the same is in the hands of the designer, where the materiality, functionality, and utility of the spaces can be maximized to create a user-friendly experience for everyone.

This research plays with the psychology of people about museums. The temporality of spaces cannot only be defined by the time frame it needs to be defined by the concept, the use, the purpose, and the perception. To attract people to museums,

more public-friendly, allied activities and other sorts of interesting interventions need to be designed. The narrative that the museum wants to display should be translated properly through the design. This can be achieved by systematically listing the spaces and understanding the spatial requirements and organization. Absolute Temporality in the exhibition spaces can also result in the dysfunctionality of the space. The balance between the temporary and permanent has to be maintained by understanding the nexus between the two.

India has had many arts, historic, living, science and technology, and multidisciplinary museums, adding value to the respective fields. India has a rich history of architecture, from the Indus Valley civilization to the modern-day architecture, our country has seen the evolution of the finest architecture which has given India its own unique identity. The identity of the buildings has transformed over the ages, and has been influenced by many factors such as the context, climate, geography, economy, culture and the society.

The translation of the output of these factors in a museum is the real challenge. From the Stone Age to the present, from traditional to modern, from organic to man-made materials, the design of the museum is expected to be eclectic in order to justify the existence of architecture in India. As much as the exhibits, the museum itself would be like an open museum of harmonious amalgamation of various elements, styles and materials.

The play of temporality and permanence within a said space could be devised by creating a narration through the perception of spaces. The two concepts, have been perceived as strong characteristics of spaces that render different emotions in people. Museums in India have generic tone and lack the narrative and context to the Seir exhibits. Architects all over India have been in the process of recognizing this gap in the culture of visiting museums, and how museums could be made into places that imbibe fundamental means of observing and learning.

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Connecting Indoors and Outdoors— Balcony, Porch, Courtyards, Corridor

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ABSTRACT: Streets serve as an important element for connecting people. But during wars and covid times when the outdoor movement is not allowed, how can they interact with Neighbours? How can they get daylight and an open space sitting at home? With the ban of movement in plazas due to covid19, it can be said that there has been a shift in the social space from the plazas/square to outdoor spaces of house such as balcony, terraces, corridors, courtyards, verandas, etc. which has become the public space of each individual's life. These spaces not only provide views but act as transition spaces between the public spaces and the private spaces. The study is a comparative analysis of the Apartment, Mixed-use and Bungalow Typology. The aim is to understand and analyse the component on different parameters like the density, area, size, positions and usage patterns of the balconies, corridors, courtyards and aangan.

Keywords: *Connecting, Indoors, Outdoors, Balcony, Terraces.*

1. INTRODUCTION AND BACKGROUND OF STUDY

Streets, squares are the most important social space in people's lives as it keep people connected and it serves as a gathering space. It is the place where people come together and discuss, children play and also festivals take place which make the space interactive and lively. Rather than connecting people inside out, the lockdown has made people outside in. This has made people to use spaces which are outdoor-like spaces indoors like balcony (in apartments), porch, courtyard (in bungalows) which has access to sunlight and fresh air. These spaces not only provide views but act as transition spaces between the public spaces (exteriors) and the private spaces (interiors). During old times, balcony was used for military purposes like wars, disputes, etc. but now, balcony bridges the people with the outside environment. The balcony is attached to the living room, kitchen or the bedroom and is shared by the members of the house. The need and use of balcony has increased during lockdown mostly. Like majorly in the apartments where people don't get any open space to use. So in this case, how do people connect with each other when the movement to the outside environment is not allowed and the people are asked to stay within the interior of the house? These spaces connect home with the outdoors spaces, to the streets and with higher density cities. The internal and exterior, private and public, human and collective spaces are all separated by the balcony. So, there is a need in studying the above factors to study the transformation between the spaces. The research would help in understanding the planning of semi-open and open spaces and what role it plays in an individual life.

2. RESEARCH QUESTION

(a) How do people stay in contact with each other when the outside environment is banned from access and they are asked to stay within the interior of the household?
(b) Does the size and orientation of balcony change the usage and activity pattern of the space?
(c) Does the view provided by the balcony affects the quality of the space and also does this cause an impact on the people?
(d) Is the extent of visual prevention affected by the placement of balconies on the exterior (on top of each other or staggered placements)?

Aim: This paper aims to answer the question that how do an individual connect with each other and the outdoors when there are restrictions in moving outside.

2.1 Objectives

(a) Balcony not only act as an aesthetic element but also it provides access to natural air and light. Therefore the size, proportion, orientation and the placement are the important factors.

(b) Balcony varies in size, and so the activity performed also differs which changes the amount of time spend by an individual.
(c) How does density and area affects the usage of the above semi-open spaces.

2.2 Scope

Study of different typologies of buildings in different geographic, climatic, context will provide us the way of how people can contact with each other and stay connected

Even before the pandemic, balconies had many advantages in terms of livability, mental stability, and the pleasure of life in urban environments. Are we willing to reconsider our previous beliefs on whether balconies are a smart idea or not"?

2.3 Limitations of the Study

The research is only related to the build spaces like balconies, porch, courtyards and corridors.

3. LITERATURE REVIEW

Balcony is a platform that access people with exterior environment. Balconies, terraces, corridors, and other features connect homes to towns, highways, and the outdoors. Balconies, which are an attractive feature of the exterior, often affect daylight access, so balcony location and proportions are critical and needs to be taken into consideration. And therefore, does the view provided by the balcony change the quality & nature of the space? From the different articles studied before writing the paper there are some arguments put forth by scholars which help in building the research paper. From the article—A Review of Balcony Impacts on the Indoor Environmental Quality of Dwellings written by Catarina Ribeiro tells us a detailed overview and thorough discussion of the characteristics of each balcony design and compares its effect on the quality of the indoor climate, examining the relationships between the balconies. The argument raised by the author in this paper is how the balcony styles affects the efficiency of the indoor environment (IEQ) and dwelling energy use. Azadeh Mahmoudi Kohneh Rood Posht's second paper, The Effect of Balcony to Improve Natural Ventilation in Local Houses in Mazandaran Province, aims to answer questions like "Are the styles of local houses in moderate and humid regions of Iran (Mazandaran) consistent with the regional environment in terms of patterns introduced in internal functional spaces?" (Azadeh Mahmoudi Kohneh Rood Posht, June 2017). The other paper studied was: Post-occupancy evaluation of sunshades and balconies' written by benefit in improving the indoor climate as green features of daylight. The other paper by Elham Mehrinejad Khotbehsara aims to research on the questions like- A) What are the key components which made balcony and porch as the remarkable elements in the West Guilan? B) In Guilan's vernacular and conventional architecture, what are the various aspects of Balcony and Porch? C) What influence do sustainability considerations have on the shape and position of the balcony and porch? In the last paper studied, written by Edwin Chany tells us the eight building criteria for safe buildings that have been established. They include the residential unit's orientation, view, height (floor level), size (gross floor area), headroom (floor to ceiling height), balcony, cross ventilation in the sitting room, and whether the residential unit faces a high-traffic area. (Edwin Chan, Value of buildings with design features for healthy living: a contingent valuation approach, 3 April 2009).

The bridging elements that connect people with the outdoors are- Courtyards, Corridors, Porch, Balcony, Terraces. Corridors facing towards centrally located courtyard becomes socio-cultural congruent providing cultural and social realm for the people. A corridor also connects indoors with the outdoors. A corridor is a passage that links multiple sections of a structure. It could be external or internal, or it could be a corridor that leads to multiple rooms and apartments. Balconies and corridors serve as a connection between the building's outdoor open space and its internal closed space. For instance, in Mumbai's Chawls, corridors are used for reading, storage, sitting, sleeping, and playing. In the evenings, the corridor is used by the elderly to rest, read, and talk. The corridor is where the majority of people congregate, connect, and socialize. When people talk in the halls, they are both indoors and open to the outside world. Corridors in chawls are of small size, but they are one of the most multi-functional places of the structure. The shared courtyards and corridors serve as meeting points for community events and exchanges, and the corridors serve as a link between inside and out, as well as private and public spaces. Corridors, courtyards, staircases, and other similar spaces are places where social relationships are created. Courtyards offer secluded outdoor space with views of the sky. Family events will spill out while remaining hidden from the exterior environment. The space became a socio-cultural factor providing ground space for the family acting as a gathering space to celebrate and gather. The balcony is an essential space where one's private life can be opened up to the benefits of fresh air, natural light, and socialization. The balcony serves as a gathering spot for the resident common activities. This open-to-the-

outside room is useful in terms of increasing contact with people outside. The usage of the space changes with the time and structure and needs to be taken into consideration at the time of planning and development.

4. METHODOLOGY

The paper explains the role of an open or semi-open space in an individual's life and how it binds the people with the internal and external spaces. The proposed methodology adopts the following process:

- Interviews with the people and asking them about the space usage and the space usage now and then graphically analysing it with plan and views.
- Study of the different forms and sizes of the balcony and its uses.
- Preparing pie diagrams, graphs and showing the usage of balcony in different slots.
  - Independent Variable-
    Spaces (Balcony, Porch, Terraces, Corridors)
  - Dependent Variables-
    Activities taking place in the space
- Discussions with the Experts on this Topic.
- Reviewing Research articles and incorporating that in my research paper.
- Questionnaire Survey

The above points helped in analysing the space requirements, its usage and its connection with the people.

5. RESULTS AND DISCUSSION

They act as connectors between the interior and the exterior environment. Anciently, it was used as a platform for discussions, announcements, talking with neighbours, etc. Also, at the times of wars when the outside movement was not allowed balcony served as a connecting platform. In older days, people would read the newspaper, talk to neighbours, dry spices watch processions of Ganesh Chaturthi, dahi-handi from their balconies. In bungalows, people also have verandas where they gather during festivals, celebrate together, and during winters they sit together in mornings for warmth of sun, dry clothes, etc. Mostly before balcony, verandas were used to dry clothes, plantation purpose, etc. but now it is totally different. Now, we can witness balcony used by a large number of people using balcony in high density apartments. While in low density cities we can witness people mostly using verandas, courtyards, rather than balcony and corridors. Balcony which was served for aesthetic purpose now connects people. It is a bridging link between indoors and the outdoors.

A balcony is connected to living room, kitchen or bedroom. Balcony that is accessed from living room or kitchen is used more than that connected to bedroom. Balcony varies in size, and so the activity performed also differs. Some balcony carries furniture which make people spend a more whereas some balconies are so small in size so it serves for standing purpose only. So, does the size of balcony change the usage and activity pattern of the space and amount of time spend by an individual? Balcony not only act as an aesthetic element on the façade but also it provides access to natural air and light. Therefore the size, proportion, orientation and the placement are the important factors which needs to be considered and studied. So, the orientation of balcony should be also considered. Balcony, porch, corridors in the residential unit has varying size and proportion. The position of balcony depends upon the context—what kind of view it provides and what happens into the alternate unit. The size of balcony changes the use of the space. A more spacious space accommodates different activities and used multi-functionally, while in the case of a small space provided there is a restriction in the use of the space.

5.1 Type A

This typology has shops on lower floors while residential unit on upper floors. The residential unit is provided with balcony that is attached with the living room of the house but still the balcony remains active as it has commercial shops on the lower floors which remains active throughout. But due to alternate floors balcony there is interaction between the neighbours. The balcony that is attached to the bedroom is mostly used during morning by residents with activities like reading newspaper, morning exercise, studying, etc. While, the balcony that is attached to kitchen remains active throughout the day where some other movement of the residents is seen. It is used as a dining space where all of the members of family gather

and talk and interact with each other. As compared to the balcony attached to the bedroom and balcony attached to the kitchen, balcony provided as an extension is used more and therefore it remains as a quite lively.

Figure 1: Floor Plan of the Type A Studied for the Research

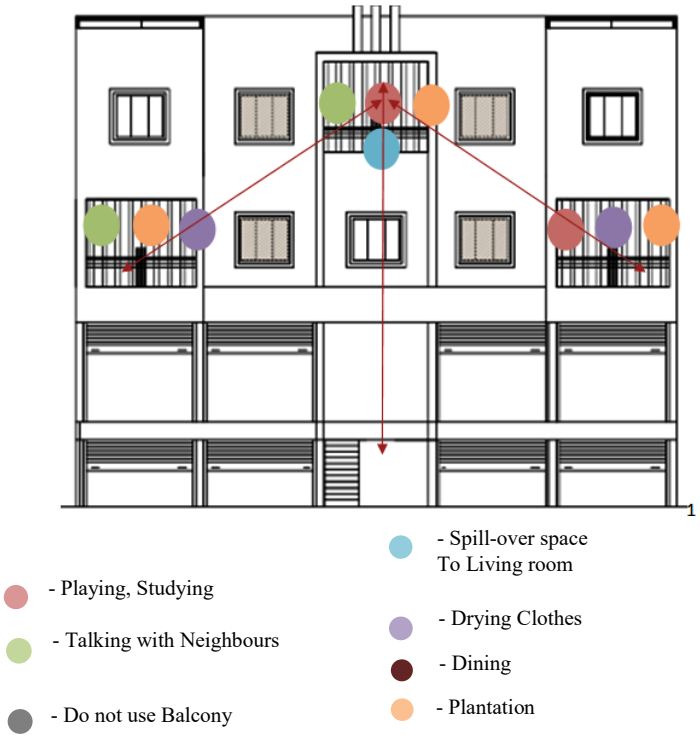
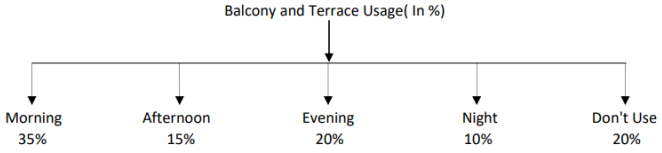


Figure 2: Elevation of Type A Along with Activity Mapping

In the above elevation shown, the Balcony acts as a spill-over space to the bedroom which is not used by all the members of the family every time. It is used to celebrate, talk to neighbors, learning space, etc. There is plantation in balcony to provide the spaces with natural air and ventilation. The corridors on the lower floors also helped the people in interacting with each other.

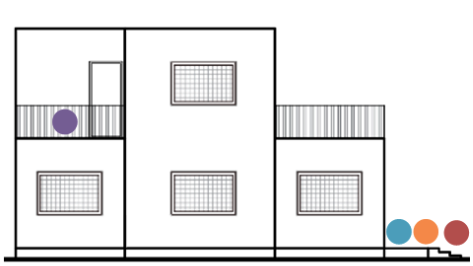


Flow Chart 1: Shows usage of Balcony and Corridor

The above table shows that during which time of the day the people of the apartment use the balcony/corridor most. During morning time slot the use of balcony is the most (35%) whereas during afternoons it is the least (10%). Around 5% of the people don't use their balcony.

Type B

This typology is Bungalow Typology with balcony attached to the bedroom. Here, the connecting spaces to the exteriors are the porch, aangan, terraces, balcony, etc. As the unit density of the house is 4 people, the upper floors are:



- Spill-over space to Living room
- -Drying Clothes
- -Dining
- -Plantation
- -Playing, Studying
- -Do not use Balcony
- -Talking with Neighbours

Not used much due to which there is no usage of balcony, but here, people mostly use the aangans and porch which remains active all throughout the day where some or the movement of the resident is seen. The aangan space is used for various activities like drying space, sitting space, yoga and meditation space, gathering space, playing space for or some food items or a place to interact with the neighbors and is used as a celebrating space at the times of functions and festivals where all the neighbors gather and celebrate.

This type is apartment typology which is purely residential. The balcony is attached either to the bedroom or to the kitchen and the balcony placements are one above the other as shown.

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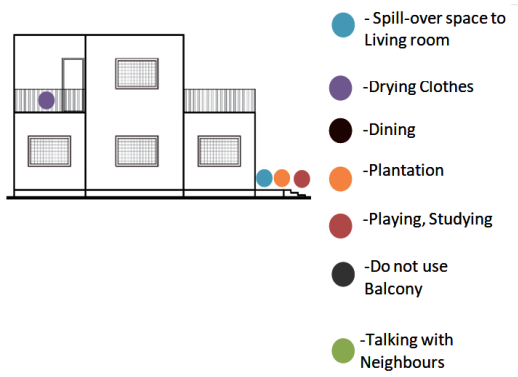
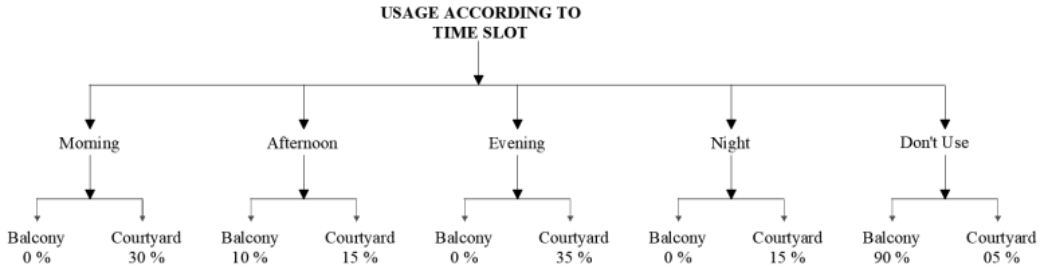


Figure 4: Elevation of Type C Along with Activity Mapping

The Figure 5 shows the spaces that connect the people with the outdoors is aangan, porch, terrace, balcony, etc. The Balcony provided with the bedroom is not used at all as there is no movement of people on the upper floors. Whereas, the porch and the aangan space is used for gatherings, playing and for interacting with people.



Flow Chart 1: Shows Usage of Balcony and Courtyard during Different Times of Day

The above chart shows time spent by an individual in Balcony. It was observed that there was no usage of balcony expect for some time in afternoon which is rarely seen. Therefore, in this case we can tell that there is no usage of balcony. Also it shows the time spent by an individual in Porch or Verandah. It was observed that the usage was maximum during the mornings and evening slot and during afternoons or night time, the use was moderate. Around, 5% of people don't use these spaces otherwise these remains most active spaces throughout the day. So, a diagram was prepared as a comparison which tells the usage of the space according to the time and space factor.

Type C

This typology is a mixed-use typology which has a multi-purpose hall and shops on the lower floors whereas on upper floors it has residential units the flat system. The residential unit has balcony that is attached to living room acting as the corridor space and the connector connecting the people with the outdoors. It also have balcony that is attached to the bedroom of the apartment which is used less or very rarely as compared to the balcony that is attached to the living room. The study carried out for the use of balcony and corridor tells that the use is maximum around 25–30% during morning time slot and evening time period and least during afternoons 15% whereas around 7–10% of people don't use balcony.

Figure 4: Elevation of Type D with Activity Mapping

Type D

The diagram shows the balcony that is attached to the kitchen of the flat system. It is mostly used as a dining space, drying clothes, storage and also there is more interaction between the ladies of one flat to another as it is attached to the kitchen. The balcony attached to the living room and kitchen acts as a porch on the ground floors. The time spent is more in case of balcony attached to living room as compared to balcony attached to the kitchen.

The research carried tells during what time of the day, individual would like to use the balcony. During morning and evening time it is used frequently about 35% and 30% respectively. The use is less in the afternoon time slot, around 10% due to its orientation mostly and around 4–5% people do not use balcony at all.

Type E

This type is the bungalow typology. This is provided with porch, aangan, verandah, balcony, terraces, backyard, etc. In this type mostly the open spaces like aangan and porch are used more acting as extension to the house which has planting, seatings for the people to sit and interact with each other. This space is used in morning for exercises, studying and playing space for the kids, interact between the neighbors. Due to plantation the space remains quite cool and shaded. Aangan remains mostly active during morning, evening times and during afternoon it is not used much. As the aangan space is quite huge and large sometimes it is used for get-together and celebrations during evening and night times. During afternoons, it remains mostly quite but it remains active throughout the other times of the day.

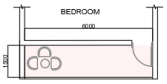
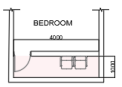
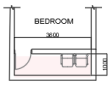
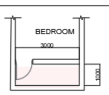
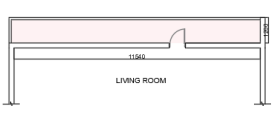
The research carried for this type shows that during morning time slot and evening time period the use is maximum around 35% and least during nights 10%. Around 20% of people don't use balcony as they have alternate spaces like verandah, porch, courtyard which is used more.

6. CONCLUSION

After conducting the interviews and visiting the site during different times of the day and analysing the data obtained from it, has helped me in identifying the different aspects related to my research. After studying different typologies, it has made me listed down the spaces that make people connect with the outside environment. In bungalows typology, aangan, verandah were more used whereas in mixed use or apartments, balcony, corridors were more functional. This is due to the density and ratio of the open space it is providing. Therefore, it can be also said as that in higher density cities the use of balcony and corridors is more as compared to low populated cities as it is provided by open spaces.

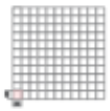
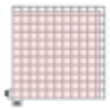
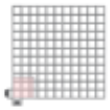
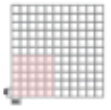
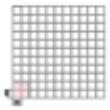
A. Size and Position of Balcony.

Table 1: Size and Position of Balcony of the Different Types Studied for the Research

GROUP NO.	TYPE	ANALYTICAL DRAWINGS	PROPORTIONS	REMARKS
1.	A		1: 4	This type of balcony is attached to the bedroom of the house. The balcony is **rectangular and linear in shape**. The width of the balcony ranges from 1000-1500 mm and the length is around 4000-6000 mm, so we could see some kind of furniture in the balcony. The balcony here attached to the living room is used for various activities like **plantation purpose, clothes drying, study space for the children, talking to neighbors,** Compared to the balcony attached to the living room of the house, this balcony that is attached to the bedroom space is used less as this balcony is not used by all the members of the house together. The movement is less in this balcony as compared to other type.
	B		1: 4	
2.	C		1: 3	This type of balcony is attached to the bedroom of the house. The balcony is **square or rectangular in shape**. The width of the balcony is 1000 mm and the length is around 3000-3600 mm, so we could see some kind of furniture in the balcony which is flexible and can be moved in and out. The balcony here attached to the living room is used for various activities like **plantation purpose, clothes drying, study space for the children, talking to neighbors, extended space to the bedroom,** etc. Compared to the balcony attached to the living room of the house, this balcony that is attached to the bedroom space is used less as this balcony is not used by all the members of the house together as this balcony act as a private component sometimes.
	D		1: 3.5	
3.	E		1:9.5 - 1:10	This type of balcony is attached to the living room of the house. The balcony is **rectangular in shape**. The width of the balcony is 1200 mm and the length is around 12000 mm, so we couldn't see any kind of furniture in the balcony. The balcony here attached to the living room is used for various activities like **plantation purpose, clothes drying, talking to neighbors, spill over spaces to the living room, discussion and gathering space,** etc. This type of balcony is used more as this balcony is used by all the members of the house together.

B. Density

Table 2: Density of the Different Types Studied for the Research

GROUP NO.	TYPE	TYPE OF TYPOLOGY	TOTAL HABITABLE AREA	TOTAL OPEN/ SEMI-OPEN SPACE AREA	NO. OF RESIDENTS	PER PERSON OPEN/ SEMI-OPEN SPACE		REMARK
1.	A.	Mixed-Use Typology	120 SQ.M.	16.5 SQ.M.	7	2.35 SQ.M.		In this typology, each individual is provided with **semi-open space like balcony** and has no access to the open space, so, the use of balcony is more in such case as per person gets less access to open spaces, so each one has only this space to connect with the outdoor environment.
	B.	Bungalow Typology	130 SQ.M.	85 SQ.M.	4	21.25 SQ.M		This typology is bungalow typology where each individual is provided with **semi-open space like balcony, porch** and **open spaces like aangan, backyard,** etc. In this, as there is provision of open spaces, they are used more whereas balcony is not used at all as the per person open space is more in this case.
2.	C.	Apartment Typology	100 SQ.M.	37.2 SQ.M.	4	9.3 SQ.M		In this typology, each individual is provided with **semi-open space like balcony, porch** and has a little **open space on the ground floor** which is restricted. In such case, the neighbors gathering take place in the open space whereas the family has balcony to access and is used more by all members as per person open space is less and this space make them connect to the outdoors.
	D.	Bungalow Typology	140 SQ.M.	81 SQ.M.	8	10.12 SQ.M		In this typology, each individual is provided with **semi-open space like balcony, porch** and **open spaces like aangan, backyard,** etc. In this, as there is provision of open spaces, they are used more whereas the balcony is not used more as person open space provided is more.
3.	E.	Mixed-Use Typology	130 SQ.M.	17.92 SQ.M.	5	3.58 SQ.M.		In this typology, each individual is provided with **semi-open space like balcony, corridor** and has no access to the open space, so, the use of balcony and corridor is more in such case which helps them to contact with the neighbors and the outside world.

C. Usage Pattern

The provision of the balcony connected to which part of the house affects the type of activity happening. If the balcony is attached to living room it acts as a spill-over space to living room and is used by all the members of the house for some or the other kind of activity, whereas, if the balcony is attached to the bedroom of house it is not used by all and acts as a private space. In, apartments as there is no other open or semi-open space than balcony or corridors, therefore these spaces play a major role and most of the activities spill-over in balcony; whereas, in bungalows where there are both open spaces like aangan, verandah, backyards which acts a public space and semi-open spaces like porch, balcony, there is less usage of balcony due to open spaces on the ground floor and here major activities spill-over in verandas, porch and aangan space.

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Bridging the Gap between Mental Health and Community

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ABSTRACT: The study evaluated a community and design-based intervention aimed at fostering individuals' mental health and well-being and understanding how architecture can help design a healing environment that generates a balance between medical treatment and patients' freedom. The role of community in mental health and its impact is analysed, as well as how the mental healthcare model can be made easily accessible and affordable to the masses.

In India, 150 million people require mental health intervention, 80 million don't have access to it. It's strange how individuals have annual physical and dental exams yet are hesitant to get their mental health examined. Architecture plays a vital role in the design of health facilities; it influences our mood, behaviour, and cognitive abilities when we are in a certain space. Factors such as colour & environmental psychology, sensory elements, and other design elements are essential in the design of facilities and are analysed in the paper.

Keywords: *Mental Health, Community, Psychology, Architecture.*

1. INTRODUCTION

What defines a mental disorder? A mental disorder is a condition that has an impact on a person's thoughts, feelings, behaviour, or mood. These disorders have a significant influence on our daily life and may impair one's capacity to relate to others. As per WHO (World Health Organisation) mental health has been classified as follows, "it is a state of well-being in which an individual is able to cope with their usual day-to-day demands and can successfully provide a result of their work as well as contribute to their community". A wide range of social, psychological, and biological elements all have an impact on our mental health. It is a powerful, dominating, and essential component of our health. The mental wellness of an individual is quite more than just the absence of a mental disorder, its well-being has an impact on our daily activities and our ability to complete easy daily tasks. An individual's mental health can be influenced by a variety of factors such as genetics, significant life events, day to day activities or our surrounding environment and so on.

In the past 30 years, India has witnessed rapid growth and development along with it its cities have undergone a big shift in ways of living, working, thinking etc. many people have been migrating to urban areas from rural or countryside in search of greater opportunities that urbanised places offer. As beneficial as these major changes may appear to us, they have also put a strain on people's lives as the pressure and stress of surviving them begins to rise, and impacts our mental health. In India, mental health has begun to receive considerable attention, but no concrete steps have been undertaken to tackle the issue; with problems like a pandemic, economic crisis, and unemployment on the horizon, India does not appear to be prepared to combat a mental health crisis that could adversely affect the country. Mental disorders are one of the significant causes of disease burden in India and globally.

Since the late 90s till date, there has been a meteoric rise in the number of mental disorders among adolescents and adults of different ages, more than 65 percent of Indians aged 18 to 24 are said to be suffering from depression. In this same period, one out of every seven Indians suffered from a mental disorder ranging from depression to anxiety to severe mental disorders such as schizophrenia, according to a study published by The Lancet Psychiatry Journal. WHO has ranked India as one of the topmost depressing countries as of 2020 is taken into account. The biggest reason for this is a lack of awareness surrounding mental health and disorders, which is followed by the stigma associated with it, as well as factors such as affordability and accessibility. A person suffering from any form of mental disorder whether it be mild or severe was labelled as a lunatic by society, which resulted in the individual being stereotyped and outcast by society. Although mental health issues are common, what is also common is the lack of infrastructure needed for the same. By analyzing the effects of a community-based intervention in a certain region, the current study adds to the research of community-based prevention of

mental health disorders. There are various ways to cope with mental disorders right from seeking professional help to opening up to a support group or social workers.

A large portion of India's population suffers from mental disorders however, there is a lack of research concerning mental health in the Indian context the surveyed data identifies number of people suffering from mental disorders in only a few states across India. The extent to which society is aware of mental health and concerns linked to it is uncertain. There exists a huge gap between the facility and patient; wherein factors such as accessibility and affordability of a facility, prison-like settings of institutions, community mental health and other such factors are interlinked but studied as an individual component in academic studies. There is a lack of empirical evidence regarding the impact of these factors identified on each other, formulation of strategies to overcome these factors for the wellbeing of the community and mental health etc.

The aim of the research was to examine how architecture can aid in designing an environment that generates a balance between medical treatment patient freedom and connection with the community. The impact of architectural design on human psychology was also investigated through different elements of light, ventilation and other spatial elements in design; and the efficacy of the intervention in terms of accessibility, demography and an individual's socio-economic background is studied. Intervention to be designed is aimed to offer alternative treatments and aid in generating awareness amongst the society. The role of community in the mental healthcare paradigm is analyzed keeping the context in mind and what impact is expected from it. The principal objective of the research was to identify the need for mental health care facilities and why there exists such few of their kind. Multiple factors influencing and impacting this predicament are studied. The study posed several limitations. Firstly, the study heavily relied on the data obtained from online sources like research papers, news articles. The intervention planned requires the community to function at a close-knit level and help reach out to more people although there could be a gap within the community itself that could poses a threat to the intervention.

2. LITERATURE REVIEW

The literature reviewed helped analyze the significance of mental disorders and their impact in Indian states and the work of renowned French philosopher Michel Foucault which investigates the situations of psychiatric institutions of the past and renaissance views of madness was studied.

The prevalence of mental disorders, disease burden and risk factors associated with mental health in the Indian context were investigated which resulted in gaining essential information regarding the number of people affected in different states of India, prevalent mental disorders, risk factors associated with it etc. (The Lancet Psychiatry, 2020). The study conducted was age and gender-specific thus resulting in demographic data for each mental disorder in different states of India. The data obtained from the research could aid in deriving mental health policies and program planning at the individual state level. The data also gives an insight into how the numbers for mental health disorders have doubled from 1990 to 2017. The key concept observed here was the need to understand the prevalence of mental disorders, who is affected, the risk factors associated with it, the lack of government policies and the gap between the community and mental health.

Michel Foucault's philosophy was deeply rooted in the historical context of mental health and the issues surrounding it. Wherein he defined mental health, mentally ill, and normality in his terms as opposed to society's perception of the same. In his book 'History of Madness' Foucault describes various events that took place across the European continent in the seventeenth century which resulted in the establishment of asylums or institutions for the mentally ill wherein the idea of being locked up or punished equalled to a person being treated or disciplined for their misbehaviour or misdemeanour by the society (Foucault, 1961). He argued that society is based on certain norms created by society itself. Throughout his work related to mental health, he heavily references 'The Panopticon' by Jeremy Bentham, a design for a prison that Foucault uses as a metaphor for the operation of power and surveillance in modern society. He analyses the types of practices used for treating the mentally ill rather than focusing on institutions and ideologies.

Another work named 'Madness and Civilization' by Michel Foucault published in 1961 discusses the shifting connection between insanity and rationality. The real essence of both words is rarely stated or allowed to speak in the text, and they frequently overlap. The key question addressed is the significance of a general hospital, the purpose of confinement or institutionalisation of "mad people" in the early periods. The animality of lunacy was a prominent issue in imprisonment, madness along with a variety of other social deviants, were exiled from society. Houses of confinement were not medical facilities, but rather locations where authority was wielded.

Later on, asylums were established, where the patients became moral outcasts. After which came a new relationship between the doctor and the patient, thus culminating in Freud's psychoanalysis. Madness, according to Foucault, is placed

in a specific cultural "space" inside society; the shape of this space, and its consequences on the crazy, are determined by society itself. Madness and civilization illustrate many ways in which civilizations throughout world history have understood and responded to the seemingly illogical, psychotic, and mad. The book covers the appearances and meanings of madness, its difficulties and repercussions, and our diverse reactions to it, right from the Bible to Sigmund Freud, from exorcism to mesmerism, from Bedlam to Victorian asylums, from humour theory to current pharmaceuticals. It also examines how insanity has plagued the minds of artists and authors, as well as the enormous impact it has had on the arts, ranging from theatre, opera, and the book to drawing, painting, and sculpture. The key concept interprets the treatment of those suffering from mental health issues/disorders and how it all began with confinement.

The literature analyzed gives an idea into the present situation in India concerning mental healthcare and how people's perspective of mental disorders was shaped throughout history through the societys' perspective. This information can be utilized to identify the programs needed to overcome the limitations in designing and spreading awareness.

3. MATERIAL AND METHODOLOGY

The statistics available from pre-conducted surveys and research papers were utilised to analyse the research problem. Review of different literature gave an idea to the past and present beliefs of society; problems prevailing in the society were also highlighted through news articles and research papers. To gain better insight into the improvement and design of mental health facilities, research conducted helped to understand the psychology of spaces, colour, light; design and planning of other such facilities, issues and current scenarios concerning mental health, types of mental disorders, treatments; the role of sensory mediums in the design of mental health facility and so on. Analysing different facilities gave an idea as to what could be incorporated and what could be redesigned for better functionality.

Further for a more keen understanding of the problem to be studied an online survey with 70 participants was conducted in an attempt to learn more about people's mental health their views about it and the challenges they confront whilst seeking help. The demographic for the survey ranged from 15–60 years old individuals from different fields of work ranging from a student to homemaker to a working professional. The survey concluded in people dealing with different mental disorders and refusing or hesitating to seek help due to various reasons, some being confidential and others due to lack of accessibility, affordability and denial of any such disorder etc. A majority of the people who participated learned about mental health through social media or the internet which thus proves its significance in today's time and how the awareness is being spread. Social media or any internet platform can also be used to generate more awareness about mental health and assist in providing better access to mental health care as well. The survey helped get an insight into people's perception of mental health and its scenario in the social circle. On a scale of 1–5, only 33% of people prioritize their mental health the most, whilst the rest 67% do not.

There are more than one hundred mental disorders listed in DSM 5 (Diagnostic & Statistical Manual of Mental Disorders). Depending upon the type of disorder the severity of a disorder can be concluded. A person diagnosed with a severe mental disorder requires more critical care and long-term treatment depending upon the diagnosis by a medical professional. Whereas a person diagnosed with a moderate or mild mental disorder may not quite require critical care although the duration and type of treatment may vary from person to person.

Diagnosis of a mental disorder plays a crucial role in determining the type of treatment and care setting required. Just like any other health-related problem, there are various symptoms accompanied by the disorder such as mood swings, inability or difficulty in managing day-to-day tasks, overthinking etc. It is also important to understand the type of medical assistance required for an individual as there is a hierarchy amongst the medical aid available (Legg, 2018). Further, some of the most common mental disorders are listed along with a short description of each disorder (Figure 1).

They are segregated based on their severity and type of support needed (APA, 2013). Diagnosis of a mental disorder as compared to a physical disorder is a multi-level step process. Treatment for mental health issues varies considerably based on a person's specific diagnosis and the intensity of their symptoms, and outcomes vary widely on an individual basis. Treatment is determined by the type of mental disease and the severity of the disorder. Treatment plans may frequently contain a variety of treatment choices and will need some trial and error before determining what works best for an individual. Some people may require more extensive treatment, while others may not. Following a diagnosis, the medical expert will inform you of your problem and collaborate with you to build a treatment plan. (First, 2020)

MILD MENTAL DISORDERS	
Anxiety Disorders	Characterized by significant feelings of anxiety or fear, accompanied by physical symptoms such as shortness of breath, rapid heartbeat, and dizziness.
Depressive/Mood Disorders	Characterized by the presence of sad, empty, or irritable mood, accompanied by physical symptoms and cognitive changes that significantly affect a person's capacity to function.
Eating Disorders	Characterized by a persistent disturbance of eating patterns that leads to poor physical and psychological health.
Obsessive-compulsive Disorder (OCD)	Characterized by the presence of obsessions and/or compulsions.
Post-traumatic Stress Disorder (PTSD)	Characterized by episodes of reliving or re-experiencing the traumatic event, avoiding things that remind the individual about the event, feeling on edge, and having negative thoughts.
Paranoia	Characterized by irrational and persistent feeling that people are 'out to get you'.
MODERATE MENTAL DISORDERS	
Gender Dysphoria / Sexual And Gender Disorders	Occurs when a person feels extreme discomfort or distress because their gender identity is at odds with the gender they were assigned at birth.
Somatic Symptom Disorders	Characterized by extreme, exaggerated anxiety about physical symptoms–such as pain, weakness, or shortness of breath.
Factitious Disorders	Characterized when an individual intentionally creates, fakes, or exaggerates symptoms of illness.
Dissociative Disorders	Characterized by an involuntary disconnection between consciousness, memories, emotions, perceptions, and behaviors–even one's own identity or sense of self.
Neurocognitive Disorders	Characterized by a decrease in a person's previous level of cognitive function.
Sleep-wake Disorders	Characterized by misalignment of circadian rhythms with the surrounding environment or abnormalities of the circadian system itself. Common sleep-wake disorders include insomnia and narcolepsy.
SEVERE MENTAL DISORDERS	
Psychotic Disorders	It is distinguished by delusions, hallucinations and confused thinking.
Bipolar Affective Disorder	It is distinguished by mood swings as well as variations in activity and energy levels. The condition frequently involves mood swings between high and depressed states.
Personality Disorders	It is pronounced as experiencing extreme and inflexible personality traits that are distressing to the person and/or cause problems in work, school, or social relationships.
Disruptive, Impulse-control, and Conduct Disorders	It is distinguished by symptoms of difficulty with emotional and behavioural self-control.
Impulse Control and Addiction Disorders	It is distinguished by inability to resist urges, or impulses, to perform acts that could be harmful to themselves or others.
Schizophrenia	It is distinguished by disruptions to thinking and emotions, and a distorted perception of reality.

Figure 1: Types of Common Mental Disorders

In the past few decades, the scenario of mental health in India has evolved into something more complicated and inaccessible to the masses with a lack of awareness and healthcare facilities. Along with this, there has been a shortage of doctors in India as far as time goes. In India, 2017 according to WHO for every 1,00,000 people suffering from a mental health condition, there were 0.301 psychiatrists and 0.47 psychologists. (Indian J Psychiatry (NCBI), 2019) The doctor to the patient ratio has always been alarmingly low thus resulting in a lack of treatment and care. The National Institute of Mental Health and Neurosciences (NIMHANS) estimated in 2016 that one in every seven Indians suffers from a mental disorder at some point in their lives. There was a 30-month national mental health survey conducted by NIMHANS (Bangalore) across 12 Indian states in 2016. Which resulted in an astounding 150 million people having mental health problems, and nearly 15% of them needed active or immediate intervention. Out of which only 30 million seek aid for it. The survey helped point out some of the most common mental disorders which are anxiety, depression and substance abuse. The study accounted for less than 2% of the population suffering from severe mental disorders such as schizophrenia, bipolar etc. but a majority of the population suffers from common mental disorders. According to reports, 10% of Indians require immediate assistance. However, due to stigma and limited health infrastructure, only around one-fifth of those affected received the necessary medical care within a year after being unwell (The Lancet Psychiatry, 2020).

4. RESULTS AND DISCUSSION

A study was conducted with over 50 participants helped investigate the problems identified in research, out of the group of people surveyed 51% agreed to have felt anxious or depressed in the past four weeks and about 40.8% were not so sure about their feelings/mental well-being while the rest 8.2% have firmly denied feeling anxious or depressed. This concludes how each one of us deals with mental disorders without realising them and getting help for the same. The help could be in the form of the simplest of treatments i.e., going to therapy sessions, talking to someone or indulging in some sort of creative group therapies like art, music or ceramics.

From the group of people surveyed a whopping 77.6% of people have said to not have been diagnosed with any mental disorder, whereas 22.4% have said to have been diagnosed with a mental disorder. The form of diagnosis whether it is self-diagnosis or from a medical professional is not clear. From the group of individuals surveyed a majority had common mild to moderate mental disorders namely anxiety disorder, mood disorder, PTSD, OCD, eating disorder and sleep-wake disorder. Although confirming the above-mentioned mental disorders only a mere 6.1% of people have gotten medical assistance. The majority of the individuals are said to not have accessibility or affordability to mental health care in their neighbourhood. Insight was gained into how people would appreciate and welcome the idea of being able to integrate community into the mental healthcare paradigm and also have the facility for it located in the city rather than it being pushed to the outskirts and isolated. The need for such facilities is of utmost importance in the current day scenario and for the future. As answered in the survey the group of individuals also are said to have been affected by their surrounding environment and design of spaces they inhabit.

The study measured the types of disorders their duration and prevalence in Indian states. The spectrum of mental health ranges from long-term to short-term effects which changes the dynamic of programs required for the same. The findings from the research shows an increase in common mental disorders over time. And an intervention shows the importance of a design and community-based facility that could very well change the way we perceive mental health and seek help for the same. Identification of the type of care setting required for a mental health facility, how it can be made easily accessible to the masses was understood through the research material gathered. The impact of socio-economic background, gender and age heavily impacted the number of people experiencing mental disorder symptoms.

5. CONCLUSION

Concluding from the research conducted, given that most previous initiatives to improve mental health have malfunctioned over the past six decades or more, the time has come to take on a fresh strategy with renewed zeal. Mental health awareness can serve as both a means and the way end to this indifference within the community. The research envisions a Community Mental Health System based on India's past approach to community health and is in sync with the government's 'Atmiyata' Project, which emphasises the patient's degree of functioning and capabilities rather than their limitations and psychopathology. These initiatives will promote community awareness, early diagnosis, as well as patient rehabilitation and reintegration into the community. The intervention will aid in resolving the issue of accessibility, isolation and social stigma, affordability and so on. The use of design elements, principles and other such factors will help in evolving the

intervention for people dealing with mental disorders and generating spaces for the healing and holistic treatment of the patient, a step towards deinstitutionalisation and away from institutionalisation.

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I would like to express my gratitude and appreciation to all those who participated and assisted through this process. First and foremost, I would like to express my sincere acknowledgement to my guide, Prof. Anuprita Surve, for her valuable guidance and assistance throughout the research. Also, grateful and appreciate those who participated in the survey conducted for the research purposes of this study.

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Transformation of Building Material in Rural India—Khandesh, Maharashtra

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ABSTRACT: Houses in Indian villages were constructed in the traditional methods, which have their own unique style having a unique material palette based on the availability of material in particular regions, which effectively worked as climate responsive typology. New technologies such as Load bearing construction and R.C.C framed construction have been seen emerging in the villages in the India. The research has been conducted in a village Gojore from Khandesh region. The transformation in building material of traditional houses in Gojore Village is identified by comparing the research objects with traditional houses that still maintain their original layout and design. The concluded factors responsible as per data analysis are based on two major aspects: socio-economic aspect and technology (physical) aspect. This research is based on empirical evidence for transformation of material and it will help to bring material sensitivity and awareness within designers and architects/Engineers while designing houses in villages.

Keywords: *Transformation, Rural, Material, Local, Technology.*

1. INTRODUCTION

From Pre-colonial times, houses in Indian villages are constructed in the traditional Indian way with the locally available material. Materials used for the construction were wood, mud bricks, mud and thatches made from dried agricultural crop waste. All the material used was a waste product of something and locally available. Transformation is a natural phenomenon, which is a need-based response of the users arising out of various factors. Hence, the reasons for transformation in vernacular houses vary from place to place and from one case to the other, more as a need based response to the needs of people from time to time. After every consecutive interval of time, new technologies have been seen emerging in the villages. Now, we are witnessing concrete houses emerging in villages over traditional methods so what are the factors because of which this transformation in material is evolving in villages and which affected the character of the Indian villages.

India as a country has many climatic zones, where there are six dominant climatic zones. The research context falls under Khandesh region in northern Maharashtra with hot and dry climatic conditions. Climatic conditions played an important role in Evolution of village settlement.

1.1 Traditional Khandeshi House

1.1.1 *Cluster Pattern and Spatial Arrangements*

Village consists of linear row house typology, which open up on the street ends. All the houses shares at most two common walls and houses opens up only from street ends. Streets were closely arranged to create compact planning to resist from excess heat and provide mutual protection.

1.1.2 *Light and Ventilation*

Streets are closely arranged which used to cover front yard and backyard of the houses to provide proper ventilation to the house. Linear Arrangements of deep openings provided to opposite walls with similar sizes forming a wind tunnel effect through the structure as a major contributing factor providing proper ventilation to the internal areas. This arrangement enhances the thermal comfort in the house. Provision of light was from the roof. The flat roof act as a good reflector and re-radiates heat efficiently as it is finished with a white sand.

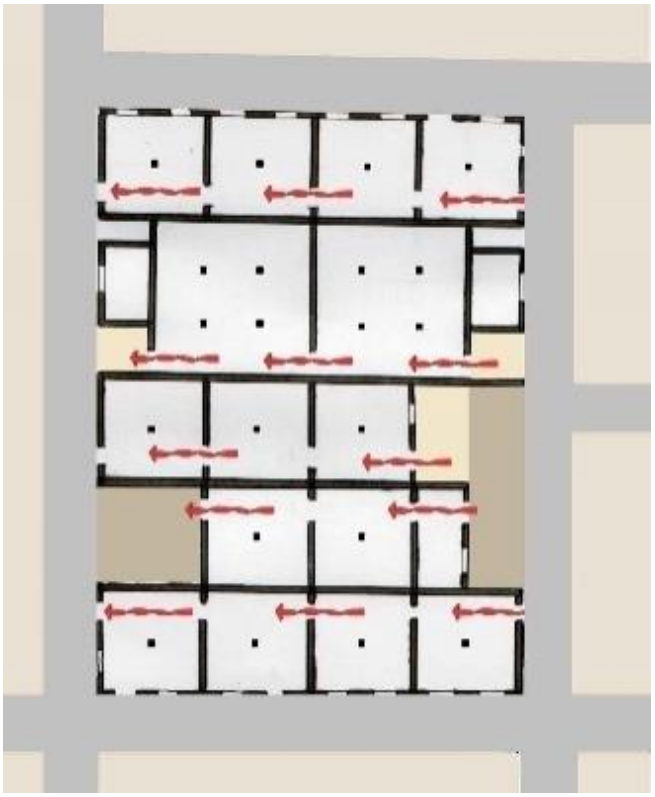

Figure 1: Cluster Arrangement
Source: Author.

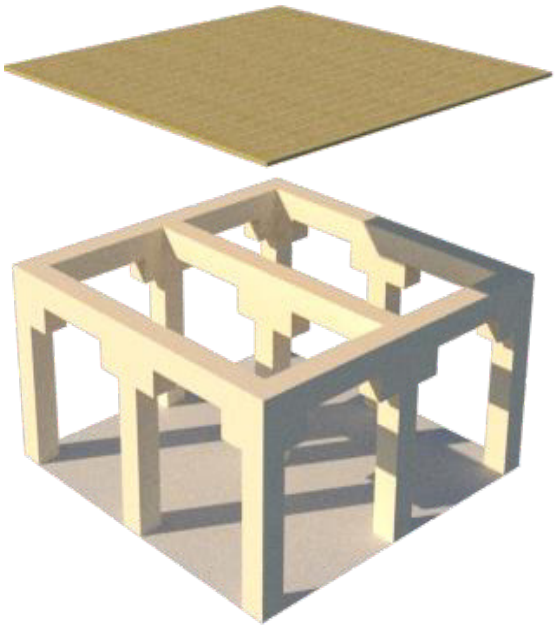

Figure 2: Wooden Frame
Source: Author.

1.2 Construction Technology

House Structure is a wooden framed structure where structural Grid of 3 feet followed throughout the house due to length availability of wooden logs as per convenience to transport. Wood Used for the construction are Teak wood (Saagwan) and Indian rosewood (Shisham). Local labourers or Marwari artisans and skilled labourers (Karagars) did construction of the houses.

Table 1: Construction Materials Used in Vernacular Houses

Building Elements	*Construction Material*	*Finishing Material*
Foundation	Rubble Stone	–
Floor	Mud	White sand + Cow dung
Columns	Wood	–
Beams	Wood	–
Wall	Stone/Bamboo/Bricks	Mud + Cow dung/Lime Mortar
Doors and Windows	Wood	–
Roof	Crop waste/Bamboo + Mud	White sand

Source: Author.

2. LITERATURE REVIEW

'India is witnessing a major shift from mud houses to brick houses. Most people are not too concerned with the plasterwork itself. But while you are busy re-plastering your houses, you always have your neighbor's brick house in the corner of your eye and they do not need to bother plastering' (Kulshreshtha, 2017)—In the above lines a PhD candidate is talking about a

factor of maintenance. Maintenance in houses, which are encouraging to user group to step forward for the new material with less maintenance, it also responds further to the factor of Time and Energy, required for the maintenance.

If we focus on social aspect here, we can see some sense of pride in people just shifted to modern houses and get more respect in society than people having traditional or old culture houses. In the book "*Changing Facets of Rural Transformation in India*" which shows the approach towards Indian Rurality is written by Dr. Dhanrajpatil and Mr. Amar Dhere which was published in Saarbrucken, Germany through LAP LAMBERT Academic publishing GmbH & Co. KG in 2012. Social context refers to substitution in the basic character of its components: social relations, goods, environment and units of social structure, which denotes the successive changing patterns, conceived in rural sets in its structure, function, form and character in both positive and negative directions in rural context.

In the Paper "The Potential and current status of earthen material for low-cost housing in rural India." (Kulshreshtha, *et al.,* 2020) researchers identifies the fact that the enormous demand for rural housing in India needs to be catered for within a short span of time. Where, Building with earth (mud) is proposed as an economical and environmental friendly alternative due To the rising costs of conventional building materials where the construction of earthen houses has significantly declined in India and thus it is necessary to evaluate if they can make a valuable contribution to contemporary housing shortage. The research concludes with recommendations that can lead to better acceptance of earth for housing construction.

In the Paper "Transformation of Traditional Housing in Traditional Village of Gunung Sari, Jatiluwih, Tabanan Regency" (Dwijendra, Putra, Wirawibawa, & Darma, 2017) according to researcher the responsible factors identified are Technology, Changes in demography, Lifestyle, social, cultural and economic development.

Using the above discussions it is clear that transformation is defined as the creation of houses including the architectural designs and traditions therein, explored to understand the ways people construct their houses and the house compounds as a physical form of culture in response to the new conditions and to show their identity.

3. METHODOLOGY

This research is **Empirical research** using empirical evidence followed by the below stage.

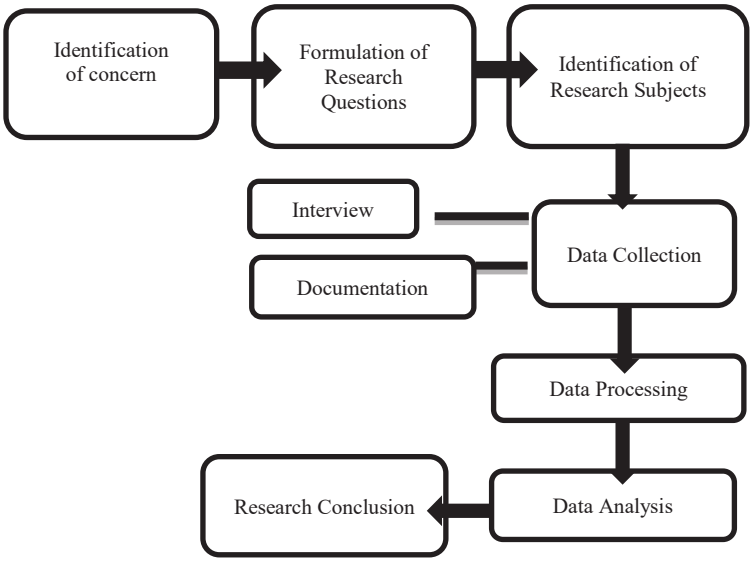

Figure 3: Stages of Research

Source: Author.

Stage 1: Identification of concern.

The topic of research identified through the observations and identification of issues in architecture, built environment or social issues affecting the built environment. After observing rural areas, the concerns identified.

Stage 2: Formulation of Research Questions.

Concentrating on concerns identified, as a research inquiry certain questions were formulated.

Stage 3: Identification of Research Subjects.

Research subjects have been selected on following criteria mentioned using local residents as informants who have witnessed the transformation in traditional construction technology in villages. Potential subjects were communicated to author by resources which was further shortlisted

Research subjects have been selected with the following criteria:

1. Traditional houses that have undergone changes in modern Construction Material and Technology.
2. Traditional houses that have been abandoned.
3. Reconstruction of new house on same site by demolishing traditional house.

Stage 4: Data Collection.

(A) Semi structured Interview

Semi-Structured interview covered points as listed below:

(a) Year of construction.
(b) Restorations or improvisations work that have been performed and there reasons.
(c) Factors, which affected them to change, improvise, or abandon the structure.
(d) Maintenance Required.
(e) Aspirations behind using new construction material.
(f) Acceptance or normalization of new technology in different age groups.
(g) Drawbacks noticed by the residents in new houses.

(B) Documentation

Documentation of Research Subjects covering tangible and intangible layers for space understanding.

Stage 5: Data Processing

1. *Data Sorting:* Collected data was compiled in form of file in sections under: Photographs, Interviews audio recordings.
2. *Data Process:* Transcripts of interviews were written in Devanagari script and further written as summary. Scaled Drawings has been produced as per the data collected during the visits.

Stage 6: Data Analysis

Analysis of Data was done under points are:

- Family Structure, Type of work done in terms of renovation, addition or reconstruction, Scale of work, Material and technology adopted for performing the changes.

Stage 7: Research Conclusions

Formulating conclusions regarding factors affecting or responsible for the material and technology transformation in villages have been concluded by categorising common factors found through analysis from the data collection.

4. RESULTS AND DISCUSSION

The transformation in building material of traditional houses in Gojore Village is identified by comparing the research subjects with traditional houses that still maintain their original layout and design. The houses were categorized to show the degree of change of the materials used in house construction that undergo transformation.

Category A: Houses, which undergo minor transformations in material with addition of building elements, while the space function also gets defined which was earlier used for multiple purposes. Building Elements like Toilets, Rooms were added to the structures using the latest R.C.C construction technology. New elements are constructed over the old elements using required precautions while combining two different construction styles.

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Figure 4: *House 4 Plan*
Source: Author.

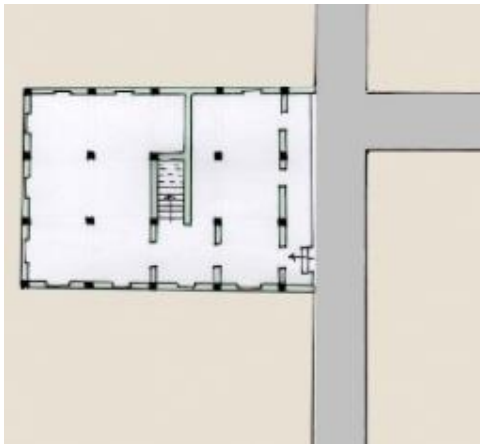

Figure 5: *House 10 Plan*
Source: Author.

Category B: Houses, which undergo minor transformation changes of finishing material.. This category can be seen from the change in the materials used for upgrades of some elements like floorings, plastering, etc. while the space function remains the same, and there is no new space in one compound. Finishing material used for flooring in old construction was a mixture of white sand and cow dung and was replaced by mosaic tiles. Finishing material used for flooring in old construction was a mixture of white sand and cow dung and was replaced by Lime Plaster.

Category C: Houses, which undergo minor transformation, change in Roofing Material. To prevent from Climatic conditions Corrugated steel sheets are used to temporarily cover the houses. Affordable materials are used instead of traditional material to maintain houses.

Material like corrugated steel sheet used synthetic fabric sacks, Gunnysacks for roofing and covering vertical sides.

Category D: Abandoned Houses with rich architectural value but poor maintenance.

These old houses are the best buildings that blend in with the environment. Every traditional house has a marvel its indifference and beauty. The artistic forms and natural native natural materials in the Khandesh region of Maharashtra, village residential dwellings themselves give people a chance to fully understand the local culture. The houses with rich Cultural value have been neglected through the years and resultant to the unsafe areas for residence. They are either used for storage purposes or abandoned or demolished. Temporary work has been done in terms that houses are getting used for storage purposes.

Figure 6: House 2
Source: Author.

Figure 7: House 5
Source: Author.

4.1 Factors Affecting Material Transformation

4.1.1 *Unavailability of Material and Skilled Labour*

Construction technology and typology used in the time of construction of the traditional houses was based on locally available material on that time for e.g. Wood, Mud, and Bamboo. However, in the present scenario it is hard to find skilled labourers and masons practising traditional methods.

4.1.2 *Acceptance by Society*

Society Acceptance plays a very important role in families' social life. Villages formed due to combinations of different communities clustered in a place. House or a residence is considered as a major factor to judge family background, Economic strength and lifestyle. This factor plays its hard part while fixing marriages in villages. A clean, modern home that offers individuality of spaces catches more attention, respect and is considered as a positive factor while judging the family from bride as well as groom side.

Table 2: Evolution in Family Structure and Construction Technology

Year	*Construction Work Done by Owners*	*No. of Family Members*	*Construction Technology Used*	*Material Used*
1800	Old house Construction	5	Wooden Frame	Wood, Mud, Bamboo, Bricks
1982	New house Construction to outskirts	12	Load Bearing	Stone, Brick, Lime
1997	Addition of rooms	15	Load Bearing	Brick, Cement concrete
2015	Renovation of house	20	R.C.C. Frame	Brick, Cement concrete

Source: Author.

4.1.3 *Evolution in Family Structure*

Case: The house constructed in 1800 by elders. As the family expanded, the joint family was divided into smaller nuclear families. New family head constructed a new house at the outskirts of the village due to lack of space in comparison to family members. In 1982 the new house was constructed using materials available at that time like Bricks, Stones, Lime plaster, mosaic tiles. Then within 20 years from construction of new houses, as need increased addition was done to houses using bricks and cement concrete, which got evolved in the construction technology market rapidly. Consecutively after 20 years due to increase in number of family members and need of individual spaces, renovation was done along with addition of new elements. As per activity and function, required spaces were added using the latest available technology of R.C.C Construction technology. The above case suggests the relation between evolutions in family structure and demand, which can be considered as a secondary factor responsible for the material transformation.

4.1.4 *Individualism*

Traditional houses consist of three layered spaces such as veranda, kitchen and room. Veranda acts as a semi-public space, kitchen and room as private activities. Cooking, Bath and washing were activities that took place in the kitchen area. Room acted like a multipurpose room catering all activities except kitchen and nahni (Bath). Due to evolution in individual lifestyle, individual spaces also got recognition along with common spaces. Old houses could not fulfil this need of individual spaces as per specific functions (Spaces like Toilets, Living Room, and Bedroom). This led villagers to add on spaces or reconstruct new houses as per requirement.

4.1.5 *Unavailability of Effective and Affordable Alternative*

in market. During times traditional construction was done, material palette used was unique as per local availability and mostly owners themselves or skilled labours as per economic strengths of the individuals constructed houses. Due to lack of natural resources, cost of construction increased and villagers could not find an effective and affordable alternative practised in markets.

4.1.6 *Economic Strength*

The cost of construction is a major factor while building a house. Villagers practice agriculture for livelihood and as a source of income. Maintenance cost required for old structures as per availability of practice in the market is high. Farmers could not afford investing large amounts of money in residences as they are still struggling for the basic needs. This resulted in negligence toward the maintenance of traditional houses. Due to Restriction of cutting trees wood costs high in the market. Villagers demolish the old traditional houses as new techniques offer them less maintenance and construction cost. Wooden members in the old houses are sold out at high prices, which profits villagers in this situation.

4.1.7 *Generation Gap*

Old age groups are satisfied with the old traditional houses and they admire the construction that lasted more than 200 years, where new generations would love to spend their life in modern houses fulfilling all the needs evolved over the time due to factors of individuality and family structure. This difference in thinking is a factor attracting the younger generation towards modern practices over traditional practices.

5. CONCLUSION

Based on results and analysis above, the conclusions are as follows:

1. There have been transformation in material used in house construction from minor transformation as temporary roofing to the major addition of building elements having combination of both the technology.
2. The responsible Socio-economic factors are as follows:
   (a) Primary factors: Economic Strength, Generation Gap, Acceptance by society, Unavailability of Material and Skilled Labour, Individualism.
   (b) Secondary factors: Sense of pride, Unavailability of effective and affordable alternative, Evolution in Family Structure.
3. There is a need to conduct preservation activities to maintain the existing potential and support the development in accordance with the potential of the area.
4. There is a need to work and spread awareness about affordable traditional practices.

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I would like to take this opportunity to express my deepest gratitude to my guide Ar. Anubandh Hambarde for his valuable assistance and insights leading to the writing of this paper.

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Topic-Translucent Concrete Innovative Building Material to Achieve Sustainability

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ABSTRACT: As the concept of green architecture has become a common interest in many disciplines, innovative materials are continuously developing to meet the requirements of green architecture. The solution lies in sustainable development, which leads to far less waste than any other type of materials, such as translucent cement, meaningless landfill waste, less energy consumption, and less impact on the environment. where cement absorbs the sunlight in the day and emits it in the nighttime which makes it a viable material for reducing power consumption. This paper totals and evaluates the previous studies in terms of translucent concrete applications and deals with the advantages it brings in the field of smart construction. We identified possible areas for future research and suggested recommendations in the conclusion to fill the gaps between studies examining the results on the environment.

Keywords: *Green Architecture, Innovative Materials, Sustainable, Smart Construction.*

1. INTRODUCTION AND BACKGROUND STUDY

World-wide, concrete is the most widely used building material However, researchers and manufacturers have been working together to produce different types of concrete to improve the overall quality and the economic value of construction.

As a result, translucent concrete has gained popularity in many industries across the world. As a resource-saving, eco-friendly building material, Light Transmitting or translucent concrete is increasingly used in high-end architecture and interior cladding.

1.1 What is Translucent Concrete?

Translucent concrete is designed using the Nano-Optics principle, in which optical fibers act as slits to transmit light from one side of the surface to the other. These optical fibers are spread evenly through the concrete and are visible on both sides of the block. As patterns form on one side of the surface, they appear as shadowy outlines through the concrete.

1.2 A Brief History of Translucent Concrete

Translucent concrete dates back to the early 1900s, when advances in polymer-based optical fibers led to its invention. Light-transmitting concrete has been an idea for years, but the actual concept of translucent concrete was introduced by Hungarian architect Aron Losonczi in 2001. A pioneer of translucent concrete, Losonczi was able to produce the first transparent concrete block within two years after pitching the idea.

This new material was called LiTraCon (short for Light Transmitting Concrete), and soon became popular in countries including Italy, Germany, and even China.

1.3 How is Translucent Concrete Manufactured?

Translucent concrete is made by combining two major materials; fine concrete (with cement and aggregates like sand) and optical fibers.

Optical fibers replace other aggregates in concrete and conduct light from both artificial and natural sources even at angles of incidence greater than 60 degrees. The optical fiber consists of three layers—the buffer coating, the cladding, and the core, which transmits light.

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The process of manufacturing translucent concrete is similar to that of traditional concrete; the only difference lies in the introduction of 4%–5% optical fibers, based on volume, The process involves adding a layer of fibers to a mold alternatively, on top of small layers of concrete at intervals of 2mm to 5mm.

It is important to note that translucent concrete does not contain coarse aggregates since they damage the fiber strands and prevent light from passing through.

In addition, fast-setting cement is preferred when preparing the concrete mix; craft clay is also added as a base for the fibers to set in the concrete. Additionally, because translucent concrete is precast concrete, it is cut into blocks or panels, polished, and sent for use.

1.4 Application of Translucent Concrete in the Construction Industry

Concrete that transmits light is less common than traditional concrete. As a façade material, it has been used in a number of fine architectural monuments and buildings. Translucent concrete blocks are suitable for floorings and pavements, and are also used in staircases and desks.

In addition to that, translucent concrete is also used in partition walls, doors, panels, etc., adding to the beauty of the interior by illuminating it during the day. It is also used to make sidewalks and speed bumps that illuminate at night and provide increased safety for pedestrians and drivers.

1.5 Examples of the Use of Translucent Concrete

The “European Gate,” built in 2004 as a monument to celebrate Hungary joining the European Union, is one of the most popular landmarks in the country due to its light transmitting quality.

Another example is the Stuttgart City Library in Germany. Designed by Yi Architects, the structure is popular around the world for its cube-shape and translucent roof that allows natural light to illuminate the area.

Source: http://www.garciabarba.com/cppa/hormigon-translucido/?lang=en

2. RESEARCH QUESTIONS

What is translucent concrete, its aspects as a sustainable and innovative material and its future in the construction industry.

2.1 Aim

To study the sustainability aspects of light-emitting cement

2.2 Objective

- To study the impact of translucent concrete in the smart construction industry as a sustainable and innovative building material.
- To identify the advantages and disadvantages in comparison with the current development of translucent concrete.
- Reviewing the application and examples of light-transmitting concrete.

2.3 Scope

- A room is enhanced by indirect light, especially with special optic fibers; the panel on the wall varies in color from every angle inside the room.
- Decorative wall panels can be installed due to their liveliness in fibres, appearing almost like a work of art.
- When fibers of varying diameters are used irregularly in spaces between them, the single light points appear brighter—giving the appearance of a starlit night. The concrete material disappears into the background with this kind of look.
- If required, the light-transmitting fibers can be arranged in logos, names, or logos for an individual and distinctive appearance to create the design.

2.4 Limitations

- Competitively the cost of light transmitting concrete is night than any other concrete.
- Due to limited applications and less awareness of light-transmitting concrete in the market, the cost of manufacturing light-transmitting concrete at a small scale is very high.

3. LITERATURE REVIEW

3.1 Optical Fibers in the Modeling of Translucent Concrete Blocks

(International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com Vol. 3, Issue 3, May-Jun 2013, pp.013–017)

Summary: Translucent concrete is a concrete based material with light-transmissive properties, obtained due to embedded light optical elements like Optical fibres in it. Light is conducted through the stone from one end to the other. This results in a certain light pattern on the other surface, depending on the fibre structure. There is virtually no light loss when light is conducted through optical fibres. This paper discusses translucent concrete blocks, including their design, production, and applications, as well as their advantages for smart construction.

Keywords: *Translucent concrete, optical fibre, energy saving.*

3.2 An Experimental Investigation on Light Emitting Concrete—Translucent Concrete

(Article in Xi'an Jianzhu Keji DaxueXuebao/Journal of Xi'an University of Architecture & Technology · May 2020 DOI: 10.37896/JXAT12.04/1008***)***

Summary: This paper deals with the study of light emitting concrete which has the property of transmitting light from concrete by using optical fibers. Since years concrete has a low impression because of its dirty greyish color, opaqueness and sharp edge but this concept has been changed after the development of light emitting concrete, which gives the increased strength, better looks and light transmitting features. Plastic optical fibers are used because of its total internal reflection as its working principle as it gives maximum efficiency in transmitting light. The percentages of optical fiber added in this experimental study are 5%, 10%, 15%. The moulds are casted in a special type of formwork which has slots to place optical fibers. The moulds are prepared by cement mortar mix and optical fibers embedded in them alternatively. After the casting process it is left for curing. The strength is determined by compression test and compared with the conventional concrete. The maximum strength is obtained at 10% of optical fibers. This paper gives the structure a good aesthetic look without loss of strength parameters and serves as an eco-friendly building material and is also an energy efficient which reduces energy consumption by 30% by allowing the natural light by transmitting light through optical fibers and will also have a good scope in future. This experiment will be a series of initiatives to look closely at new and emerging advanced construction in future.

Keywords: *Light Emitting Concrete, Optical fiber, Compressive Strength.*

3.3 Translucent Concrete: A Research Paper

(1 Research scholar, Civil department, B.I.T., Gorakhpur, U.P. (India). 2 lecturer, Civil department, B.I.T., Gorakhpur, U.P. (India). 3,4,5,6 is the associate research scholar, civil department, B.I.T., Gorakhpur, U.P. (India)

Summary: In this research paper we are casting a block and slab of size 18×7×7 cm^3 & 100×7×300cm3 respectively by using cement, sand, aggregate, with optical fiber & glass. In this research paper we should try to reduce its cost by using glass rod

with the small composition of optical fiber. We observed the light transmission in this block is 90–95% & minor loss of energy can be observed. The strength of slab by using optical fiber is increased 4–5% in the comparison of the normal block & slab.

Keywords: *Optical fiber, High strength concrete, transparent concrete, Aesthetic transmitting concrete, light transmitting conc.*

4. RESEARCH GAP

After reviewing the remarkable studies carried out, especially in the last 10 years in translucent concrete techniques. Notwithstanding the advantages, the literature concurs that several gaps were found in translucent concrete studies. Translucent concrete's strength and proper ratio of fibres are key limitations. The gap between the studies showed that by examining the effect of using different optical fibres and materials, the strength and energy-saving concluded that the proper ratio of fibres should be less than 5% for strength, and the optimum ratio ranges 4.3% to 6% for energy-saving. This research identifies the possible areas for future research and suggest recommendations in the conclusion to fill these gaps.

5. MATERIAL AND METHODOLOGY

The two main basic materials used for making of translucent concrete are, the first one is from the construction field and the second one is from the sensing field. According to Pre-design Road, the optical fibre has good light guiding properties and sunlight transmits without light-heat, photochemical reaction, or light-electrical effect, which can be used to calculate stresses in structures. The main material which is used for the making of transparent concrete is optical fibre.

5.1 The Types of Optical Fibre

1. Multimode step-index fibre.

The raw materials used for this material are silica, river sand, industrial waste, alkali, and water. This process can be done at room temperature which includes the polycondensation of raw materials that doesn't require much energy consumption. The chemical reaction between cement dust and water produces a strong mixture that looks like a gel and crystal flakes.

Cement is a binding material with excellent cohesive properties and possesses an opaque body that does not allow the passage of light to penetrate inside the material.

Principal: Transparent concrete works on the total internal reflection. When a light ray enters the optical fibres from the one end or denser medium to the rarer medium then it's created an angle and that angle is greater than the critical angle, the ray later reflects the same medium. Minor loss of energies can be observed in this process. The main functioning of translucent concrete is that; it takes light from a natural resource like the sun. In the form of pure energy and then Adding certain additives during manufacturing, However, it is manufactured like ordinary cement, but the change in the microscopic structure creates a nanocrystalline structure identical to the glass that allows passage of light inside.

5.2 Manufacturing Process

Product	-	light-transmitting concrete
Form	-	prefabricated blocks
Ingredients	-	96% concrete, 4% optical fibre
Density	-	2100–2400 kg/m^3
Block size	-	600 mm × 300 mm
Thickness	-	25–500 mm
Colour	-	white, grey, or black
Fibber distribution	-	organic
Finished	-	polished
Compressive		
Strength	-	50 N/mm^2

Bending tensile
Strength - 7 N/mm^2

6. RESULTS AND DISCUSSION

Have you ever imagined that the walls of your room can illuminate without using any electric power? Have you ever thought that it's easy to drive and walk on the roads in the middle of the night without any streetlights? Well, it's time to believe that construction technology has emerged in a way that you have never imagined. Innovation of light-emitting cement is a new innovative and energy-efficient construction material that can produce light without any energy sources, save money and the environment.

At present, it comes in two colours: blue and green and is adjustable during the production process.

Even its eco-friendly also as the gel is made from sand, dust, clay, and water. The material has a life acceptance rate of 100 years because of the inorganic nature of the cement components. This new material is tough compared with other materials like plastics or paints, which decay with UV rays in the long run.

These types of innovations are turning up the trends in the construction industry and technologies are evolving to the next level.

6.1 The Future of Translucent Concrete as a Building Material

Translucent concrete let's just about enough light to pass through it to make it a viable material for reducing power consumption. Hence, it can be used as a sustainable alternative to typical concrete in the near future.

Other than its economic and environmental advantages, translucent concrete also makes architecture more visually appealing and increases the overall aesthetic value of a structure. Scientists have predicted that translucent concrete can bring about a positive impact in the overall market and become an economical and sustainable alternative to typical concrete. As a result, producers are now working to develop translucent concrete at a lower cost, so it can become an affordable alternative to use.

6.1.1 *Advantages and Disadvantages of Light-Transmitting Concrete*

Advantages

1. You can use white or coloured illumination elements to create special light and colour effects. Light
2. The display layers of glass optical fibres transmit light from the back to the panel to the front.
3. Contributing positively to energy saving.
4. Light transmitting concrete is frost resistant
5. Highest UV resistant panels can be built.

Disadvantages

1. The main disadvantage is this concrete is very costly because of the optical fibres.
2. The casting of transparent concrete block is difficult for the labour so a special skilled person is required

7. CONCLUSION

The results and conclusions of translucent concrete previous research are presented here so that further studies can be conducted about this field, and these conclusions are based on the observations from this previous research. Translucent concrete has many uses not only for aesthetic purposes but also used as an alternative for illuminating interiors of the building. As it is mentioned in this paper earlier, translucent concrete can insert the light inside the spaces and can, therefore, be applied in educational buildings instead of windows.

As it was concluded with the help of studies and experiments in this field, the research gap stated a deeper study and research is needed for acoustic isolation of translucent concrete where there is little or no research on this field, which is significant to inflate the scope of applications of translucent concrete.

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Re-imagining Learning Environments

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ABSTRACT: Learning environments are spaces for exploring, growing, education and are in immediate association with young individuals of the society. Since children spend a majority of their day in school, the architecture of these spaces, the volumes and openness, have an immense impact on how they learn, interact and get influenced.

This research aims at exploring ways to transform education through design. Child-centric spaces need to be created by adopting the multidisciplinary approach and inclusion of play-based learning environments that are enriched through the built and unbuilt. These spaces are required to inspire students and motivate their holistic development. The intent is to inspire and support the diversity of learners and provide a platform for a multitude of learning scenarios. Schools are the backbone of a country and a strong system will create competent citizens.

Keywords: *Multidisciplinary, Learning Environments, Interactive Spaces, Child-Centric Design, Holistic Development.*

1. INTRODUCTION

"The goal of early childhood education should be to activate the child's own natural desire to learn."
—Maria Montessori

Right to Education is one of the primary rights of every citizen of India. Education is a tool that develops knowledge and skill, and helps in the creation of a better society. The growth and development of a country is determined through the quality of its education system. Schools, the base of this system are places where children are educated and molded for the future, and thus the learning environments of schools have a great impact on children's minds.

Figure 1: Elements of School Education (By author)

Over time, education in India has experienced varied approaches. Initially, it started with gurukuls that provided diverse knowledge and life skills. It gradually transformed and adopted various systems and eventually got centralized into boards governed by different federations. Currently, India is undergoing a paradigm shift with a new perspective towards learning. The National Education Policy 2020 which is the 21st century's first education policy, proposes to revise and revamp various facets of the education system. The policy also aims to achieve Goal 4 (SDG4) of the 2030 Agenda for Sustainable Development, adopted by India in 2015 – to "ensure inclusive and equitable education and promote lifelong learning opportunities for all". Holistic development of children and multidisciplinary education are at the forefront of this transition. Hence it is essential to comprehend the upcoming 'multidisciplinary approach' towards education, its application and align it with the goals of NEP 2020.

Multidisciplinary learning methods include a topic by integration of numerous knowledge domains, which cross the boundaries of a discipline to strengthen the scope and depth of learning. Through this holistic and interactive approach towards education, it is possible to make learning, student-centric and an interesting experience. Following the multidisciplinary approach, learning environments are required to offer students an opportunity to connect with themselves, their community the local environment and help develop a varied skill set. The need of the hour is to create learning environments where children can absorb, discover, play and acquire knowledge from the moment they step in.

The research seeks to answer the question—How can an appropriate spatial form be developed for a pedagogy that seeks to create a multidisciplinary approach and impart values and abilities consistent with the social and environmental context in everyday learning and teaching environments of schools?

2. LITERATURE REVIEW

The literature study is based on the key concepts that are critical to understand, represent and analyze previously conducted research and its developments.

2.1 Education Systems

One of the largest in the world, the schooling system of India consists of 1.55 million schools, 9.43 million teachers, and 248 million students (India, National Education Policy 2020, 2020).

The Indian education system has undergone many changes through the centuries. The educational structure, curriculum and teaching standards which have been significantly modified have different effects on the development of children. The learning environments which are extremely important to assist and intensify the all-round progress of children, are dependent on these factors. Hence, it is necessary to study and analyze the education systems followed in the country along with their built environments.

As per P.K. Misra, the key challenges are delivering interactive, academic environments for learning while having adequate infrastructure and teaching-learning facilities. (Misra, 2021)

2.1.1 *Education in Ancient India*

India has a rich heritage of ancient knowledge, culture and philosophy. Nalanda, Takshashila, Vikramshila, etc. were world-class institutions of ancient India, also known as gurukuls. They accommodated students and scholars across various backgrounds and had the highest level of research and multidisciplinary teaching which combined arts, scientific, vocational and professional fields as well as soft skills. The gurukuls followed occupation based education and trained students in life skills.

The built environment of gurukuls had a schooling system with residential facilities and classrooms in outdoor settings under the trees. Since disciplines of arts, crafts and sports were equally focused on provision of workshops and grounds with the necessary equipment was made. Being close to nature and participating in extra-curricular activities generated mindfulness and assisted in the personality development of students.

Indian philosophy and culture have strongly impacted the world. These prosperous legacies of ancient India must be preserved and nurtured while also enhancing them and putting them to new uses through the education system.

2.1.2 *Current Education Systems in India*

School education originally was a state subject. But with the constitutional revision in 1976, the Government of India announced educational policies at the national level and freedom was given to the state governments for the implementation of the programs. A consistent structure of 10 + 2 for school education is followed by the entire country currently.

Mainly, there are three streams in school education in India. Two of these are applicable at the national level and one is pertaining to the different states. The first one, Central Board of Secondary Education (CBSE) was originally meant for children of central government employees. The Indian Certificate of Secondary Education (ICSE) is the second central scheme based on the Cambridge School Certificate. The third are the state schools, each state has its own Department of Education. They run their own school systems following the guidelines formulated by the National Council for Educational Research and Training (NCERT).

This system was first introduced in India by the British. From the colonial era, only a few changes have been brought about without understanding the consequences it has on the students. The authenticity that the gurukuls had was lost over time. The learning spaces now are largely bounded within enclosed classrooms and no attention is given to other extra-curricular activities. This environment of conventional classrooms without integration of outdoor spaces and play areas is insufficient for the all-around development of the students.

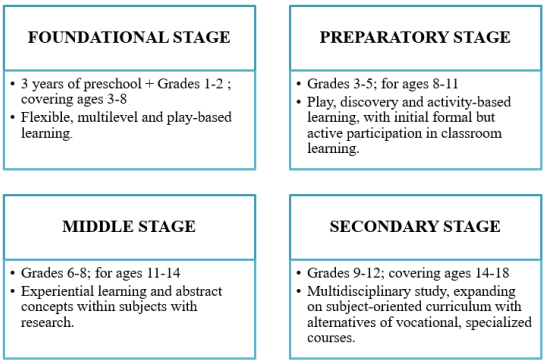
2.1.3 *National Education Policy 2020*

The purpose of this policy is to create a secure and proactive learning environment, where an extensive array of learning experiences are made available with adequate physical infrastructure and relevant resources beneficial to learning for all students.

The foundational principles that will pilot this education system include—promotion of each child's holistic development in academic as well as non-academic spheres, multidisciplinary and comprehensive education across all subjects from arts, mathematics, social sciences to humanities and sports with the aim to integrate knowledge.

The reconfigured model is to make school education more pertinent to the cognitive skills of children as per their age groups. (India, National Education Policy 2020, 2020)

Framework for the same is guided as:



The goals of NEP 2020 thus involve practicing experiential learning; inclusion of different vocations; arts and sports integration; learning from local artists and master instructors; universal access to quality education. An overall child-centric environment with adequate play areas, workshop facilities for hands-on training, well-lit and ventilated classrooms while also incorporating nature into the space will result in upgradation of the whole learning experience.

2.2 Multidisciplinary Approach to Education

The multidisciplinary approach is an effective pedagogy that weaves together various disciplines to share knowledge and enhance learning. The approach to integrated curriculum is more effective for a student's learning than the traditional one-discipline-based approach. Through research, it is proved that mono-disciplinary approach does not enhance creativity, while the synergy in multidisciplinary education broadens the scope of learning (Sivakumar, 2018). The advantages of this

approach include—holistic understanding, real-world approaches and collaborations. It helps children develop cognitive, emotional, physical and social skills.

The built environment is an integral part of learning spaces. To accommodate the functions of varied disciplines in this approach, an array of spaces are essential. Emotional skills can be developed by creating a connection with nature, while physical skills can be refined by play-based and sports-integrated learning. Social skills such as engagement and teamwork can be enhanced by the provision of interactive courtyards and transitional spaces. The synergy of multidisciplinary education along with efficient infrastructure and a compelling environment will result in an ideal learning abode.

2.3 Understanding Children

Cognitive development is a process every child goes through. They develop physically, mentally, socially, emotionally as they grow. It is essential to understand this process, since learning environments hold the power to support and enhance cognitive development of children.

In the article 'The Importance of Understanding Child Development When Teaching', the author, Paula Kay Glass talks about the development processes of children. Through extensive research, it is established that the brain grows very rapidly with billions of neurological connections during the early stages of life. There are five main areas of development in which children develop skills: cognitive, social and emotional, speech and language, fine motor skills, gross motor skills. Each child has a different scope of development and should be given the adequate resources and atmosphere to reach their highest individual capacity.

Thus for the overall development, utmost care must be taken which brings their potential to light. A play-learn environment that enhances the child's learning ability with age-specific activities and spaces, along with child psychology must be designed for school environments.

2.4 Learning and Spaces

The spaces people inhabit have an impact on how they act and feel. The spatial quality is determined primarily by the users' instinctive acknowledgment of it. Children spend a major portion of their developing years in school. The spaces they interact with, have a powerful impact on their minds. Therefore, it is critical to study the space-user relationship and the psychological impact of the learning environments.

The new education system requires more collaborative relations between learners and compelling architectural design which brings about interactive spaces. This process is needed to motivate social relations besides learning via open, multifunctional and versatile design.

In the design cycle of schools, particularly three users—student, architect and educational experts should unite to build ideal institutions. (Hessari, 2016) Understanding behavioural preferences of each specific age group according to psychologists and educational experts play an important role. The priorities of students who are the primary users of the space should be considered.

3. RESEARCH METHODOLOGY

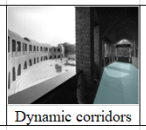
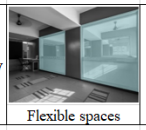
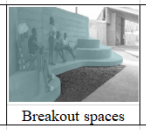
The present research has evolved from an attempt to extensively study child pedagogy, children's spatial cognitive abilities, and education systems found in the country along with their built environment. The primary data collection for the research looked at interactions and interviews with children and educators to understand their approach towards learning. It also included the analysis of the development process of children and observing their response to different spaces. The secondary data pertaining to various education systems was collected through books, articles, government policies, and online research. The literature review aided in learning about the various ideas of multidisciplinary approach to education. Observations and conclusions from the research determined the nature of schools to be considered for analysis. The case studies further assisted to comprehend the design elements and impact of learning environments on children.

4. FINDINGS AND DISCUSSIONS

Through the literature reviewed it is seen that learning environments have an extensive impact children's minds. They must be competent to encourage curiosity while serving as an uplifting element to the community and foster holistic growth of

students. A few interactive and design-oriented schools were studied to explore the unique features offered by them, which proved to be advantageous for the students.

Table 1: Inferences from Case Studies

SR.NO.	PROJECT	ARCHITECT	FEATURE	FEATURE
1	School of Dancing Arches, Gujarat.	Samira Rathod Design Associates	 Dynamic corridors	Planning - The child-centric plan organically weaves its way through trees forming niches, mezzanines, alcoves, sculpting a composition of playful experiences for children to run, climb, roll and explore.
2	The Outdoor Classroom, Pune.	Studio Infinity	 Flexible spaces	Materiality - To establish a human connect with nature, an earthy material palette has been adopted. Bamboo, agro wood and kavdi flooring has been used with pops of color and quirky graphics.
3	Burkina Institute of Technology, West Africa.	Kere Architecture	 Breakout spaces	Spaces - A transition of spaces is seen from the classrooms to the semi-open corridors along the courtyard further leading up to the small amphitheater setting. The staggered modules helps the flow of air.
4	Rane Vidyalaya, Tamil Nadu.	Shanmugam Architects	 Connect with nature	Interactions - The structure has been developed around an enclosed central courtyard which is visually connected at all levels. Classrooms are provided with gardens to blend the indoor and outdoor spaces.

These inferences helped develop a better understanding of the subject, investigate and build-up ideas for the application of multidisciplinary approach towards learning environments.

Physical spaces are extremely significant to learning processes. The architectural features that are quintessential to learning environments and provide guidance to design development are listed further.

4.1 Circulation

The circulation within the built form is stimulated by various architectural elements. It is a comprehensive experience of visual connectivity, psychology, movement and response to sensory stimuli. It is one of the most multifunctional spaces in a school. Easy way-finding along with the introduction of interactive spaces are features of circulation to be developed.

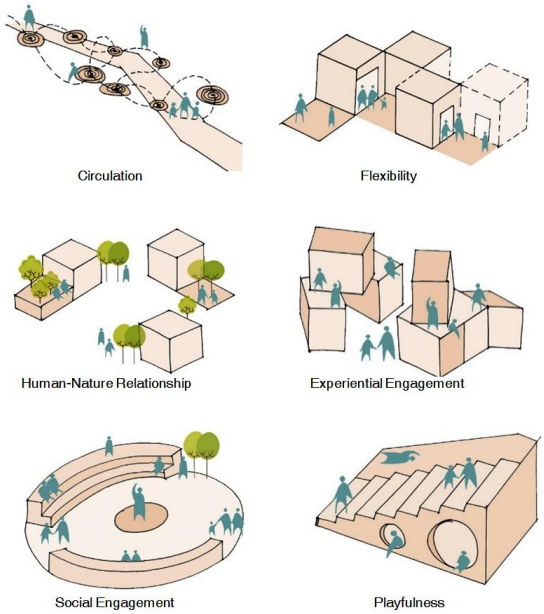


Figure 2: Features Essential for Learning Environments (By author)

4.2 Flexibility

Flexibility within a structure refers to its ability to adapt to various functions according to its evolving needs. It can include movable partitions to provide active flexibility as well as include provisions of open plans and large volumes. Such spaces that support collaboration and play, help improve the creative abilities of children. Strategic space planning can help students achieve their full potential through motivation and engagement.

4.3 Human—Nature Relationship

The built environment affects the physical relationship between humans and nature. This has proved to further affect the health and happiness of humans. The awareness of natural systems can be revived by designing places grounded in their unique natural environments and thus assist in activating students' senses. The integration of nature with the built form will create dynamic learning spaces and stimulate both, the mind and body.

4.4 Experiential Engagement

Human occupancy and wellness are the core principles for the foundation of experiential design which gives priority to the interactions of humans with the built structure. Experiential architecture is based on the concept of a holistic approach to design, for users to connect emotionally with spaces resulting in a lasting impression on human minds. The engagement of sensory elements with the school design is essential to shape stimulating experiences for the children.

5.5 Social Engagement

Purposeful spaces that include the needs and values of the society are more user-centric and help in creating a social engagement between the structure and the people. The social, environmental and economic factors of the community must be addressed through sensitive design. Community inclusive spaces in schools like libraries, workshops and amphitheaters will help generate social engagement and develop a sense of belonging within the community.

4.6 Playfulness

Play-oriented design has the potential to elevate the human thought-process and problem-solving abilities. It helps the development of curiosity and imagination in children. Playful learning spaces present connectors between theory and fun. Vibrant and explorative design enhances the mind, movement and cognitive skills while energizing the entire learning process.

5. CONCLUSION

Architecture, psychology and sociology are all deeply interconnected. The relationship between design and education is crucial, particularly when it comes to children's learning spaces.

Each child is different. When given an opportunity, children develop in multiple domains. These different ways of development must be nurtured through the learning environment. Multi-functional and flexible spaces for educational institutions that are congenial with the exploratory spirit of children are the need of the hour.

When designing learning spaces, it is essential to go beyond mere ergonomics and reflect upon architecture as a tool to enhance the quality of education. The architecture of a space and its physiological impact collectively affect the quality of learning and well-being of the users. Inclusive teaching methods rely on hands-on learning and sensorial experiences to think beyond the four walls of the classroom and blur the boundaries between indoors and outdoors.

Schools, where children spend a predominant part of their childhood is crucial to their emotional, physical and social well-being. The learning environment of schools needs to be revamped to suit the needs of the present generation. However, the authenticity and diversity of Indian culture should not be lost in the process. Society responds to the built environment better, when they can emotionally connect with it. The core values of these learning spaces shape the behaviour and understanding of children. This can be used as an advantage to inculcate values of humanity, sustainability and collaborations, which are globally vital in today's time. This can be achieved by designing learning spaces rooted in the fabric of their region, to promote sustainability and community relations. Multidisciplinary learning spaces that promote play-based learning,

interactions, culture, flexibility and opportunities to explore various themes, will motive and inspire children to learn and grow, eventually becoming responsible citizens of the future.

This approach also looks at changing the common perception towards education and bridging the gap between the conventional systems, community, geography and the real world experiences.

With the upcoming National Education Policy 2020, it is the best time to re-imagine learning environments and consciously design them for holistic development and lifelong knowledge.

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Cognition Through Space: In an Architecture Institute

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ABSTRACT: Young minds spend their formative years in college, and their cognitive bias is formed on the interactions they have, on concepts they learn and the creative choices they make in college. The purpose of architecture is to generate spaces that encourage positive interactions and help students to nurture their social skills. An institution meant to facilitate deep engagement between the people and their surroundings at the moment of encounter appears to be an appropriate topic for investigating the way architecture fosters this experience. Architecture institutes are not only valued for their academic and spatial quality they provide for the construction and design projects, but also serve as living examples and working models of how buildings function. The paper aims at proposing an engaging and provocative institute for the students to live, learn and practice architecture.

Keywords: *Cognition, Engagement, Sociability, Architectural Institute.*

1. INTRODUCTION

Space is more than a simple vacuum that surrounds us. Along with its physical characteristics such as geometry, color etc., it has other abstract qualities that make it meaningful. Human experience and psyche play a significant role in what we perceive as a successful design. The success of a design can be measured by the quality and frequency of the use of its spaces. The openness of a space gives people the freedom to use it according to their needs but creating built and un-built spaces that encourage activities can inject vitality in the spatial experience.

Cognition is the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses. Architecture influences human cognition, experience and behavior. Since cognition is linked with the emotional capabilities of a person, social connections are a necessity for learning. It enhances the mental as well as the social aspects of a student. The relationships that are created as a result of social interaction are crucial for provoking engagement. The pandemic has shown why learning is difficult when people are confined within their homes; the mind needs to connect with people, nature and the surroundings to learn and express truly and freely.

Throughout a student's educational journey, the foundation of for life is established, both in terms of knowledge-building and social skills. Friendships are forged that often last for life, and architecture can play a big part in creating opportunities for students to interact with their peers. The college building is the place where students will learn, read and understand architecture, thus the design of these college buildings become tools of learning that can help the budding designers to understand building systems, structures, materials and their interaction with their surroundings.

Design learning is a social affair. Architecture is not akin to solving a mathematical equation that requires a defined process and a predicable outcome. It is the beauty of the design profession that allows us to think about new ideas every day. Design learning is a collaborative; inter disciplinary and socially engaging process which requires the professionals to engage with the physical as well as physiological needs of the users. Academic spaces are important to foster creativity and problem-solving. The aim of this paper is to design spaces that stimulate social engagement within an architectural institute, and encouraging collaborative and experiential learning which can foster cognitive skills in students.

2. MATERIAL AND METHODOLOGY

The research started with the question of what is spatial engagement. The book *Space for Engagement: The Indian Art place and a Habitation Approach to Architecture* by Himanshu Burte (2008) was pivotal in the research process. Through initial reading, the case for designing an Architecture institute was chosen.

A questionnaire was circulated via Google forms, and the responses paved way for further research of the topic. The study was divided into data collection and case studies. Case studies were part of qualitative and quantitative research, as the nature of spaces and their impact on students was studied, along with requirements for planning of the institutes. These

were carried out through primary and secondary data collection and subsequent analysis. Books, research papers, articles and photographs were reviewed for different parameters of the research, to satisfy the research question and the research objectives.

3. LITERATURE REVIEW

Cognition refers to the action of acquiring knowledge and understanding via thought, experiences, and senses. Cognitive processes have some specific uses like learning, forming memories and decision making. How one will perceive the world, will form impressions and interact with the environment is impacted by the cognitive abilities. One must forever continue to exercise and develop these cognitive functions. To continue learning new things, one should keep consuming latest information. To quote Rene Descartes; *I think, therefore I am.* One of the foremost ways cognition allows us to function is by forming concepts and mental groupings of comparable objects, people, ideas or events. It can simplify one's thinking so easily that he/she does not have to stop and think about it, it becomes part of the subconscious mind. It is important to actively keep the mind open to create room for evolving concepts. The ability to solve problems is governed by cognition.

Cognitive learning theory integrates cognition and learning for the various processes involved in learning effectively. This learning process aims to chart the training process for optimal thinking, understanding and retention of what we learn. Here are three important aspects of cognitive learning:

1. Collaborative learning
2. Experiential Learning
3. Observation Learning

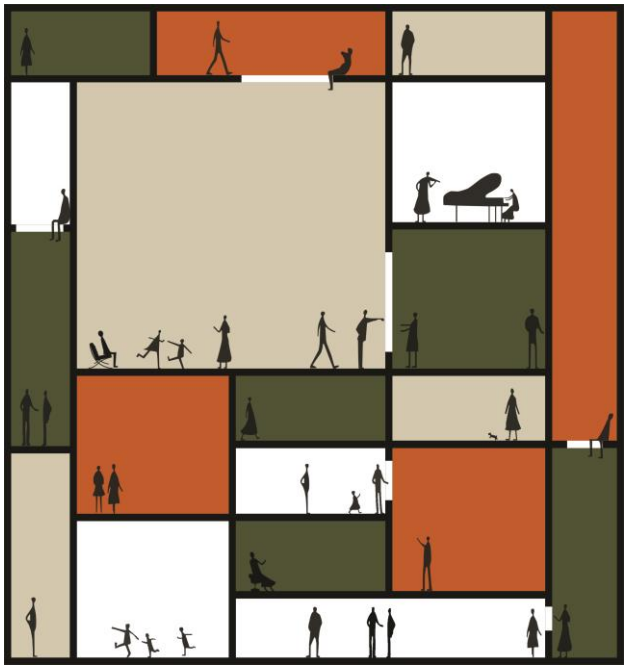

Figure 1: A Spatial Collage; by Author, Inspired by Piet Mondrian's Painting

3.1 Spatial Cognition

Like other physical environments, architecture influences human cognition, experience and behavior by allowing, facilitating, requiring, impeding or preventing various perceptions, thoughts, emotions and acts.

—Ar. Daniel R Montello

A spatial experience is a simultaneous multisensory experience that incorporates built environments, people, context and purposes and is capable of enhancing the emotional connection in the room. The visual nature of a space or object can be deceiving. It is our sense that gives meaning to the space. Our cognitive bias of a space is determined by our experience. The sensorial experience determines the emotion we feel in a place. Cognitive structures and processes are deeply relevant to

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how people perceive and picture architectural spaces, how they remember them, speak about and make pictorial representations of them, make behavioral decisions about and within them, and acknowledge aesthetics and other emotional responses to them. Architecture can do this physically, for example by walls that block movement, sight or sound.

3.2 Engagement

People's behavior in built space, particularly the nature of interaction, are governed by communication systems—and these are influenced by the physical setting, by the social expectations one has in the setting, and by the attempts to define his/her roles in respect to others. Places provide the physical and social common ground in which a shared project may be forged. What makes a conscious focus on engagement particularly necessary in a discussion about space is the fact that an engagement between people or between a created place and people does not always depend automatically; often it has to be fostered by intention and design.

Catalyzing the engagement between people and the designed inhabited space is a critical part of this task of place making. It is important to approach architecture through the consideration of the engagements that it is meant to facilitate between a design space and the people and the institution it is tied to. A place acquires its essential affordance through the medium of the engagement it builds with and among the people involved in it. The interpersonal and mutual closeness between people, which evokes a feeling of togetherness, is defined as a social connection. Social connection is the positive and close feeling one perceives while interacting with others. Social connection is a feeling of trust and belonging to the community, a feeling of being accepted and valued for one's best qualities. Since cognitive activities are linked with emotional ones, social connections are a necessity for learning. Neuroscientific research has proven that a sense of belonging has a profound impact on the knowledge and skills that students learn retain and apply.

3.3 The Engaging Institute

The institute is a physical area where the world of practice comes into symmetric contact with the students. It is also the only formalized physical place that the students will truly and continuously encounter with each other, exchanging ideas and evolving their knowledge. Building a meaningful and lasting engagement with their peers is an important task and therefore institution design becomes vital.

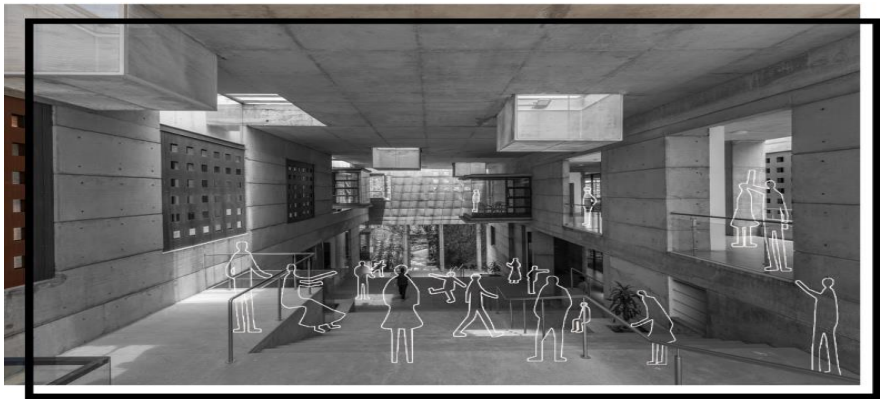

Figure 2: By Author, IIM Bangalore

For instance, The IIM campus in Bangalore, by Vastu Shilpa Consultants, aimed to encourage secure and open-ended discussions between students and teachers through a network of corridors, courtyards and external spaces. The connection with nature through gardens, at different levels and heights, encouraged an intellectual exchange outside the classroom in these pause points. The landscape areas intersecting with the built form created soft edges. The new IIM classroom complex in Bangalore, by Mindspace Architects, was planned perpendicular to the main axis of the old campus, providing a circulation space for the users as well as a space where many novel ideas would be formed and discussed amongst the students.

"We do learn from our seniors and juniors outside the classroom or hostel room as a 'THIRD PLACE'."

—Ray Oldenburg's
"The Great Good Place'

3.4 The Shared Space

"Architecture can't force people to connect; it can only plan the crossing points, remove barriers, and make the meeting places useful and attractive."

—Ar. Denise Scott Brown

A space that offers great amounts of encounter opportunities of longer duration could be considered to have a social texture. The use of spatial anchors, seats, shelters etc. can be used to hold people together. For an engaging institute, a large part of the public space could be very beneficial with the concentration of encounter opportunities. If there is a perceptible core in the structure of the public space that could be conceived as an important site for sociability. In the case of the institute's interface facilities like cafes and book shops, they are great retainers of people and zones with a potentially referential social texture.

The IIM campus in Ahmadabad, by Ar. Louis Kahn was designed as an institute where classrooms were only a part of the formal learning environments, with corridors, plazas and hallways all becoming spaces which could all become centers for interactions and learning. The porosity of facades allows light and air into the spaces, which in turn creates new spaces for engagement. The design has stimulated an interactive and cross disciplinary learning practice in-and-out of the traditional classrooms. From the perspective of choice in sociability, it is useful to break spaces into two subparts. Interestingly, the process of breaking up spaces involves the introduction of barriers to site and physical access.

In learning, social interaction is crucial as it enhances the mental as well as the social aspects of a student. The main reason as to why people interact socially is to pursue common objectives. The relationships that are created as a result of social interactions are crucial as far as learning is concerned. The desire to go to a public place where friends hang out is a desire for more direct social contact. It is useful to remember that encounters can be planned by accident. The sociability of a given place can usually be gauged by the way it catalyzes informal accidental encounters. Experience-based and practice-oriented learning plays a central role in training the planners and architects of the future. Experiential learning appears to have significant potential in basic architectural design education to increase spatial awareness in untrained individuals. Experimental and experiential learning can involve all the aspects of student learning; their cognitive, affective and physical domain. This results in students being completely engaged with the education.

3.5 Elements of Engagement

"Do we remember the places we have been to, the cities we have visited only because of the sights we have seen? Or are our experiences of spaces enriched by a certain smell or feeling that become so strongly etched in memory that they have the power to transport us back?"

—The Eyes of the Skin
by Ar. Juhani Pallasmaa

Figure 3: Engaging terraces by Author, Inspired by Kanchenjunga Apartments

Legibility determines the imageability of an area—how readily it evokes clear mental images—which successively influences how easily people can maintain orientation while travelling through an area. They influence the benefit of learning the layout of an area, how accurately it's remembered, one's sense of privacy and territorial control within the space, and aesthetic and emotional responses to spaces, including feelings of beauty, fear or boredom. The concept of 'legibility' comes from Kevin Lynch's seminal work 'The Image of the city (1960) that refers to the convenience with which parts of an urban landscape are often recognized and arranged into a coherent pattern. Lynch's urban principles are applied to individual buildings, wilderness environments, sites and more. The five elements of urban form have the potential to influence design practice and contribute to these experiences. They are streets, nodes, landmarks, districts, and edges.

1. **Paths:** The arrangement and movement between spaces is made possible by paths. In a building, corridors are the pathways that able movement between spaces. These become spaces of transition for the users.
2. **Nodes:** These are converging points of different pathways that create social spaces, due to multiple functions meeting as these points. Accidental interactions are possible at these nodes, encouraging engagement between users. Lift and staircase cores are nodes where multiple corridors converge.
3. **Edges:** Boundaries, they can be either real or perceived. Social and occupiable edges connect the users from the inside to the outside. These edges define functions, and are points of meeting of two spaces.
4. **Landmarks:** They are points of reference. At least one aspect of them is unique or memorable in the context they exist. These can be places that are identified for their characteristics, or function. Landmarks are places that attract people, encouraging meetings and informal events.
5. **Districts:** Districts can be classified as group of similar functions that are placed together. For example, in the city of an institution, a hostel becomes a district for the students. The academic block is another district. Thus a sense of ownership is achieved.

A creative space is one that encourages the people who work and live there to change the way they work and collaborate. Context creates content; In other words, different environments can foster different mindsets and different behaviors. Context is a very powerful lever because people don't usually see its influence. We are so focused on the task at hand and our next outcome that often we don't realize how something as simple as sitting on a sofa or sitting on a stool affects the variety and quantity of ideas we generate. These spatial characteristics that are designed to deliver togetherness can change a person forever, a person starts to socialize, exchange ideas and improves his/her knowledge. One starts interacting and making friends for life. If we can see past the socio-economics, the place can deliver intellectual sessions. When a student learns these things early in his/her formative years, they will always create environments that encourage interaction, create engagement and create community.

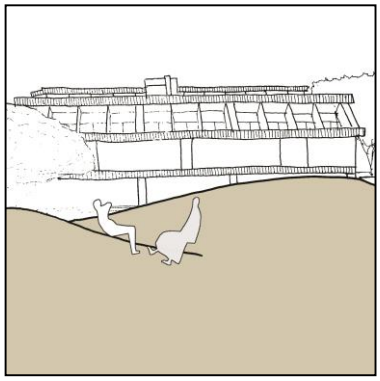

Figure 4: CEPT University Campus

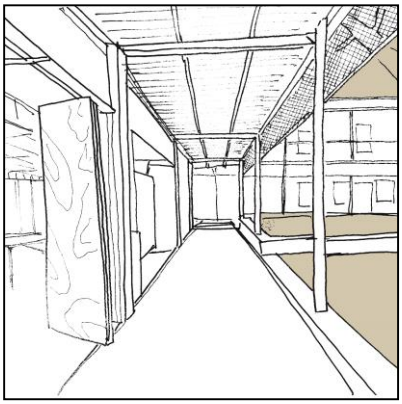

Figure 5: Wadiyar Center for Architecture by Author

4. RESULTS AND DISCUSSION

Flexibility in space is a major factor in designing a successful architectural school. They are different from typical educational facilities, with large open studio spaces, spaces for critique and discussions, resourceful spaces for workshops and digital workstations becoming important functions for learning. Along with workspaces that support both individual and collective

needs, the quality of natural light into the space plays a pivotal role in inspiring students. Connection with nature, both visually and physically through architecture design not only engages the students with the outside but also provides mental and physical peace.

Larger areas for the students to connect with their college seniors, juniors, teachers and/or classmates, along with areas that allow relaxation encourages the students to stay in the college campus and work together, thus encouraging discussions. The success of an institutional building should be measured by the balance it creates between academic productivity and social bonds. Socialization is very important for students. If the spaces in the institute fail to offer comfortable areas for the students to socialize, make friends and relax, there is the possibility of mental burnouts. Educational environments should aim to engage learners, make participants feel welcome, and give everyone an equal opportunity to participate, that is it must be inclusive.

5. CONCLUSION

The impact of Architecture on cognition and learning is immense, and the paper aims at proposing an engaging and provocative institute for the students to practice, live and learn architecture. The students will live amongst similar minds, and this will result in positive interactions.

There are three important aspects of cognitive learning: Collaborative learning, experiential learning and observation learning. The paper aims to propose and design spaces that can support these through architecture and functions. The proposed Architecture institute shall benefit from hostels for in-campus residence. Likeminded people will synergize and this will contribute to the growth of individuals as well as the institution. Intentional and accidental pause points shall be designed with the five principles of urban form in the building, through design elements that will increase the engagement opportunities. Collaborative learning will be fostered through spaces that not only encourage interactions but also cater to the individual needs of the students. Experiential learning will happen through workshop spaces, laboratories, and interactions with artists, artisans and architects. The students will engage one-on-one with professionals and this will help their growth. Observational learning will happen not only in classrooms but outside the conventional teaching patterns. The project shall impart social skills to students through architecture. Students shall become aware of the importance of interactive spaces and the psychological connection with Architecture, thus setting a base for their future projects.

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I would like to mention my thesis guide, Ar. Sunanda Satwah for her guidance and support through the development and research for my topic. I thank Ar. Tanvee Joshi, for being a mentor throughout my college life. I thank my friends and family for their constant support and motivation.

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Sensism: A Space for Specially Sensed Children

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ABSTRACT: Architecture is not only about designing a visually appealing space but is able to deliver the feeling and emotional development with respect to space. Thus, Architectural elements focuses on Usage and function of space where interaction of the user is mainly towards activity and the study says it can be achieve through multisensory Architecture. The Research study revolves around to create the suitable and comfortable environment for partially impaired and blind people. And to understand works and different typologies of architects working with these spaces. This Study is employed by collection of descriptive data through articles and research papers. Also Case Studies were studied from different regions of world. This review therefore provide a summary of how five senses can be considered into the usage of multisensory Architecture (Sight, Smell, Taste, Hearing and Touch). The challenge is to establish deeper connection between user and space. As a result, the final outcome of study contributes towards creating a ideal environment to enhance their activity using appropriate architectural techniques, Colors, Materials.

Keywords: *Multisensory, Emotional Development, Interaction.*

1. INTRODUCTION

The Build environment and spaces created by human has its barrier towards certain community and disables. While Architecture is a phenomenon where imagination is converted into eye—appealing reality. Beyond that it is also crucial to consider other senses which plays an important role with respect to space, connectivity (physical as well as emotional). Since, spaces reflects human activity most of the time, the issue of disability has been much affected by the accessibility into the space itself. Hence, people experience build environment differently according to who they are, these environment can contribute to be more equal, inclusive, if the place where we live, the facilities we use and neighborhood are designed to be accessible and approachable. Focusing more on visually impaired and blind people, they suffers the challenge because the built spaces are designed with focus on visual feature which can be called as architectural visual bias. According to WHO 285 million people are estimated to be visually impaired worldwide and 39 million to be blind. In view of all this, it is important to investigate what happens to the persons overall sensorial experience when visual sense is lacking. The aim is to develop multisensory environment that promotes health and well-being. To appreciate this to the fullest, all five senses are indispensable. Which enhances qualities of space that accommodate their needs, and show the importance of multi-sensory, holistic designs for the blind. Also study has been done on sensorial architecture within the isolation of space for persons with a visual impairment and blindness. This paper tends to study the phenomenon involved to create spatial designed space and understand the need and environment needed by visually impaired and blind people. Hence, to understand the involvement of human senses with space in attribution of material and planning. The information produced by the study and data collection is hence beneficial for designers on the consideration that need to be made in order to contribute to design inclusive spaces for visually lacking people and consider in achieving a suitable and user-friendly built environment which will promote quality of life, health and well-being. Indeed will lead to increase in development of building and urban spaces that do a better job of promoting our socio-cultural, cognitive and emotional development.

2. LITERATURE REVIEW

The word blind or visually impaired creates a negative sense, a sense of loss. Visually impaired people lack the visual perception of the world around them but on the other side their other senses are heightened, making them special in a different way. Understanding Blinds and visually impaired inculpates that they compensate for their lack of sight by relying more heavily on other senses like with the absence of sight, sound can become an invaluable resource. Smell can be used to let the blind know where they are in a given environment. The sense of touch can be used to gather information about specific objects. Common language for blinds include braille language and special writing and reading system. To incorporate

this senses it is important to understand the classification of the senses based on receptor and organ and the stimulus location because in architecture, design element very much depends on how and what level of contact it has to be perceived. Based on senses are classified in 5 categories:

2.1 Designing for Senses

Design for senses plays an important role for the perception and cognition of activity.

2.1.1 *The Role of Eyes*

Architecture is regarded primarily as a visual phenomenon. Thus, we have many buildings that are designed to please the eye but fail to delight the body as a whole. Eyes absorb the visual qualities of a space. Vision is capable of stimulating other senses in our body.

2.1.2 *The Auditory Experience*

Vision is directional while sound is omnidirectional. Thus, sight isolates while sound integrates. The loss of senses in contemporary architecture can be attributed to the ignorance of acoustic intimacy. Sound can lend characters to a space: intimacy or monumentality, invitation or rejection, hospitality or hostility. For instance, an echo created in a narrow street or inside an empty cathedral not only yields the spaces their own identity but also connects you to them the form and the volumes of a building and the materials, with which it has been built, contribute to the sound generated in its interior and exterior spaces.

2.1.3 *The Olfactory Imagery of Spaces*

The memory of a space that lingers around in us is fostered by smell. Every space has its own characteristic smell. The scent can either hang heavily in the air or pass by us in a gush of air. This can either be enhanced or subdued depending on the chosen finish; wax, varnish or polish. Likewise, every city has its own collection of scents and odors, which are powerful tools of identity.

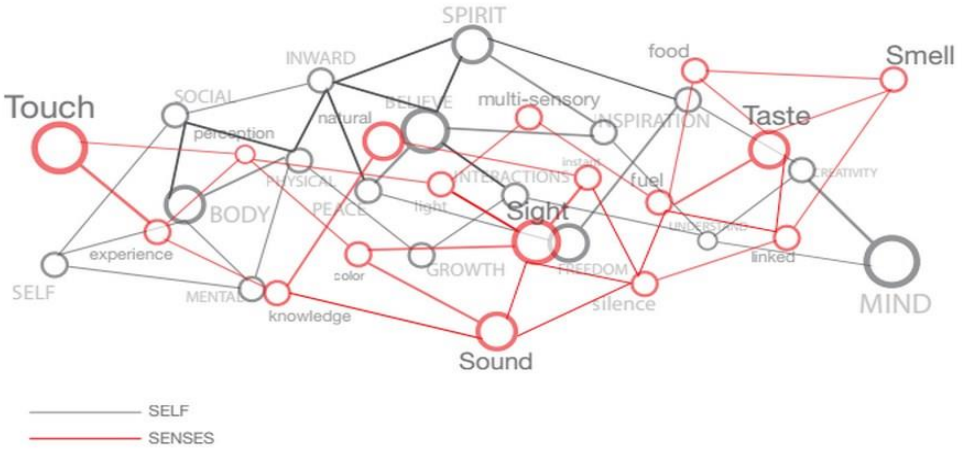

Figure 1: Co-Relation between Self and Senses

2.1.4 *Induction of Oral Sensation*

There is a delicate transference between tactile and taste experiences. Also, taste is generated by the combined action of nose and tongue. Eyes collaborate with tongue as well. It has been found that certain colors and delicate details generate oral sensations.

2.1.5 *The Tactile Experience*

The skin is capable of reading the texture, weight, density and temperature of an object. The tactile sense is the one that actually establishes a connection between our body and the world. It is not just about physically touching an object but

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about accepting the volume and temperature of space. Architects, such as Carlo Scarpa and Alvar Aalto created designs that appealed to the eye and also invited one to touch and explore.

2.2 Design Installation

1. **Textured Pathway:** Helps in indicating reach of space, nearby seating's, interaction points, etc.
2. **Braille Handrail**: Gives information about condition of space.
3. **Bright Colored Paints:** Painted in space where this helps B3 Category visually impaired students to notify obstacles and location easily.
4. **Audible Signals:** Proposed at open areas in building. Indicates time, space in a low tone.
5. **Sensory Gardens:** Helps to stimulate all senses possessed by human. Sense of smell will help identifying the space.
6. **Interactive spaces:** Spaces helps user to make it multifunctional.

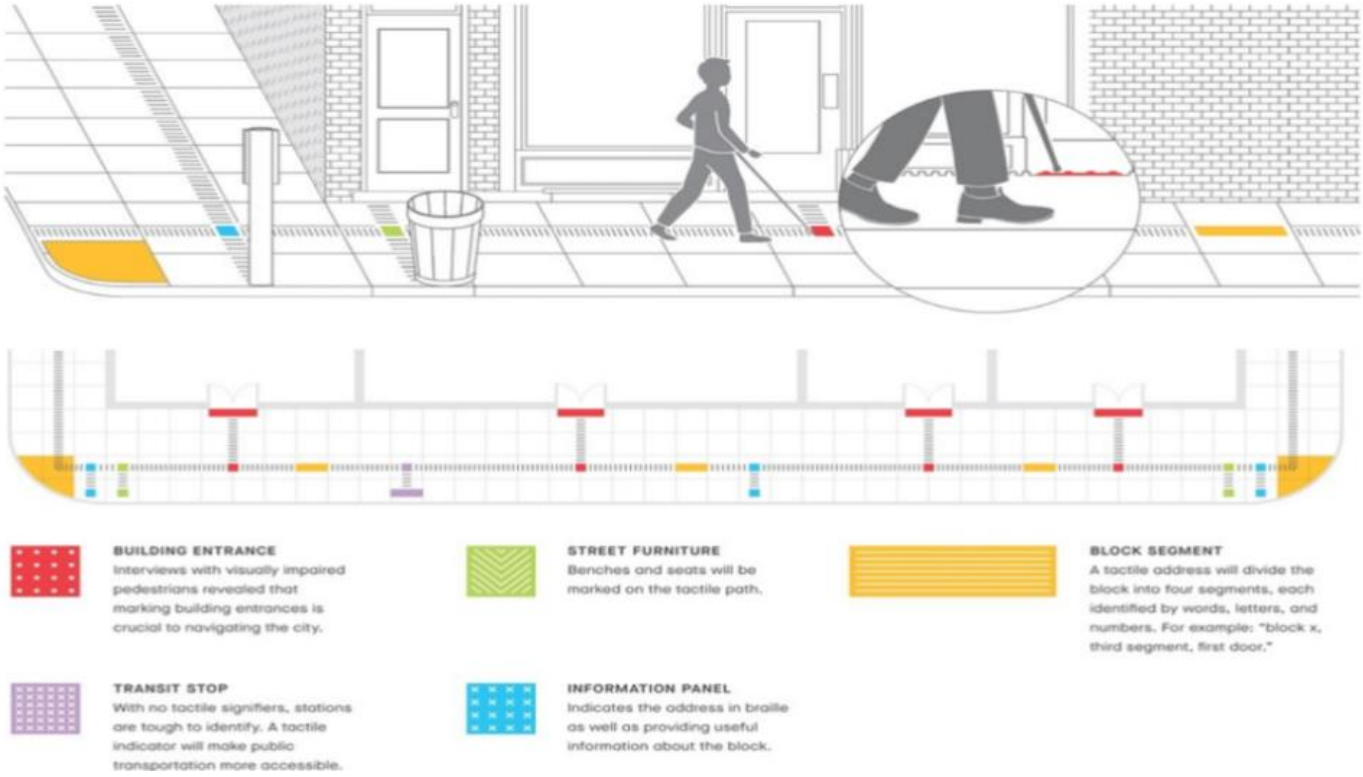

Figure 2: Design Strategy Incorporated for Blinds and Visually Impaired People

3. RESEARCH METHODOLOGY

In this study, all the data is collected with descriptive research method with an aim to describing, exploring how this reliance can be employed into build environment. Research procedure includes:

1. **Archival Method:** Involving the study of literature that is readily available such as documented thesis, published research papers.
2. **Survey Research:** interaction with visually impaired and blind children's in school.
3. **Case Studies:** International case studies obtained from books and websites (used as secondary source of information).

3.1 Case Study 1: The House of disabled people's organization, Denmark

Located in Copenhagen, Denmark is dubbed "The World's most Accessible Office Building" due to its accessibility for variety of health and sensory impairments that include: mobility challenges, Psychological disabilities, visual and hearing impairments.

Figure 3: Section of Office Building

The design strategy around universal design the main focus is on the principle of "equal access". Solution that supports and encourage all users to be self-reliant as possible have been incorporated. The building is the result of a process in which accessibility is not based on building regulations, but detailed information about the users. Hence, this is incorporated by using simple methods and clear routes that naturally lead the body on its way, it is possible to help majority of users to navigate. Signs that can be touched or corridors with light, shadow and form define direction. Blind person here will be able to navigate using corners in the atrium's five cornered shape and easily find way. Had the atrium designed in round shape, navigating in it would seem like being in a perpetual motion machine. This shows that general design and inclusive design are closely linked.

3.2 Case Study 2: Perkin's School for Blind, Watertown, USA

Designed by Architect R.J. Clipston Surgis. In this school's overall design, several elements are enhanced to provide user friendly built environment for visually impaired and blinds. The use of equidistant corridors is used so one can easily identify difference between spaces. The entire blocks are well equipped with tactile pavements, auditory and signals. It also has multiple uses of different floor textured surfaces. Also, the use of light is based on sensors, the use of lightening has been carefully considered.

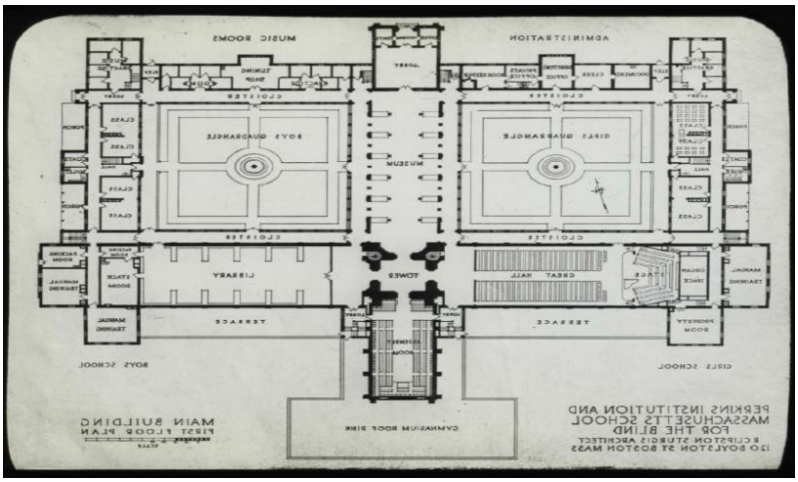

Figure 4: Plan of School

4. CONCLUSION

Understanding the required environment for visually impaired people was the crucial part of study. Shedding light on the role that sensory cues play in the experience with association between visually impaired people and spaces. If these sensory signals are effectively comprehended, they will allow the user to understand and use that space to promote participation and

activity. Throughout the study, the main and the most sensory used by visually impaired and blind person is the touch sensory. Hence, it helps the most identifying, learning and mobilizing. Ultimately, the key is to generate a balance of human sensory cues in built environment.

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Pop-Up Environments [PUE] and the City Space

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ABSTRACT: The ephemeral exhibits and Pop-Up Environments[1] (PUEs) (Bertino, 2019) are advanced urban tools that devised a vehicle to advocate initial recognition for the city's evolution as an emerging need for new infrastructures, new land uses, and new space availability. Led by migration and demographic change the PUEs manifest as an intersection between new city space's customs and their habits. Cities that are widely congested are prone to lengthy bureaucratic and implementation procedures where the scope of upcoming developments can be tested by adaptation through PUEs. Thus, offering an opportunity to operationalize and mobilize imaginations of an expanded city space through temporal mechanisms and frameworks of pop-up environments, to facilitate both a healthy public space and short-term infrastructure. The idea of temporary urban space which is guided by the recent studies in the domain of pop-up environments (PUEs) and the framework (Bertino, 2019); examined for certain select projects such as the 'add on. 20 Höhenmeter, 2005, Vienna, Austria', propelled for an inquiry in the urban context of Mumbai.

Keywords: *Pop-up Environment (PUE), Cityspace, Public Infrastructure, Informal Interventions, Inclusivity, Framework Conditions, City Space.*

1. INTRODUCTION

1.1 City Space and Experiments in Temporal Mechanism and Spatial Typological Discharges

The choice or the presence of ephemeral and temporal architecture itself, in the realm of spatial assemblage, has leaned toward or manifested to resolve issues of the city space than ever before. City spaces have a fundamental role in shaping city life. Research initiated by urban practitioners have directed towards the ambition of looking at city space as an environment of meeting space, and all activities that people dispose-off in this realm are a progression of necessary, optional and social activities. Today's ephemeral exhibits have attempted to create space of engagement and formulated a tissue of a fertile city space and improved the overall spatial assemblage. For example: Projects like Bogota and Austria, where, City space and ephemeral exhibits attempt to create spaces of engagement.

Exhibit A: Add-On 20 Höhenmeter

Underlying objective: Pop-Up Environments in Urban Central Areas.

Time line: 6 weeks
Lace: Austria

Figure 1: For Six Weeks "Add on. 20 Höhenmeter" Transforms Wallensteinplatz into a Centre of Artistic Interaction
Source: https://www.mvd.org/prj/add-on-20-hoehenmeter

[1] Pop-Up Environment is a combination of two words, Pop-up and environment.(used individually and in combination with "environments," "architecture," "housing," and "living system") (Bertino, 2019)

Outlook: In the context of urban city centres, where the location, planning and functioning of the social, healthcare and public infrastructure and the buildings are well defined, there are set rules and practical or legal limitations, such as the concern over preserving heritage and the reserved allocations in the urban plans. It becomes difficult to have investment opportunities and in these places, for both the public and private (Bertino, 2019). *A social space full of relief activities*: Usually separated spheres like dwelling, work, consumerism, entertainment and recreation were combined in a cluster-like arrangement where a living room, a caravan with a front garden, a whirlpool feat. An installation, a factory canteen, a music room, a sun patio and a panorama café were juxtaposed to each other. With its integrated toilets, a telescope to enjoy the vista and soccer table, the project add-on might have appeared like an ironical commentary to the division of functions in the urban architecture surrounding it.

Exhibit B: Called, La Concordia:

Underlying objective: Amphitheatre, the structure can be used to host everything from outdoor dining to film screenings and socially distanced theatre in the Colombian capital.

Place: Bogota

Figure 2: The Environment Enabling Fresher Experience of Dining in the City of Bogota, Reflecting the Pent-Up Demand for the Public Space Quality

Source: https://www.dezeen.com/2021/01/19/la-concordia-amphitheatre-colab-19-bogota-architecture

The Project: This environment presented itself as a solution where it quickly adapted to the new setting of spaced seating and conducting the culinary business. It is necessary to compare this plastic quality which juxtaposes the permanent state of certain places. The pandemic affected the physical attendance to the places and this new venture helped provide an opportunity to attempt at the challenge of attracting and re-familiarizing city dwellers into the relief activities of city space. *"Colab-19, however, hopes it could be kept in place long after the pandemic is over, and that interventions such as this will permanently change public opinion. It's a process they have termed "tactical architecture".*[2]

1.2 City Space Mechanism and Public Life in Mumbai

Planned public space and unplanned public spaces, one city, two city lives.

Why do we always focus on parks and plazas? (Shroff, 2015). When we examine the city space mechanism and public life in a typical congested Indian city like Mumbai, we find that it is actually a strange modus operando between two types of public spaces, one which is planned (operated, restricted and regulated) other is unplanned (unregulated and unrestricted). This balancing and maintaining social quotient in the city space of Mumbai, can have a chance to be mutated and resolve the lack of quality in public space realm. Besides, the recognition for such curbed demand or excuse to be out of one's private life doesn't need a back testing, since many episodes of pop-up public life have been overwhelmingly successful,

[2] Quoted description from: https://www.archdaily.com/955927/la-concordia-amphitheater-colab-19-plus-taller-architects-plus-sca

for example, the happy street initiative or the flea bazaar at BKC, etc. ***Mumbai's planned public spaces*** *predominantly consists of Plazas like Gateway Of India, Maidans like Cross Maidan, Oval Maidan, Water Fronts like Marine Drive and Worli Sea Face and gardens like the Hanging Gardens, Bandstand Parks etc.* (Shroff, 2015)**.**

Figure 3: Situation at Every Public Park, More or Less following all the Listed Restrictions

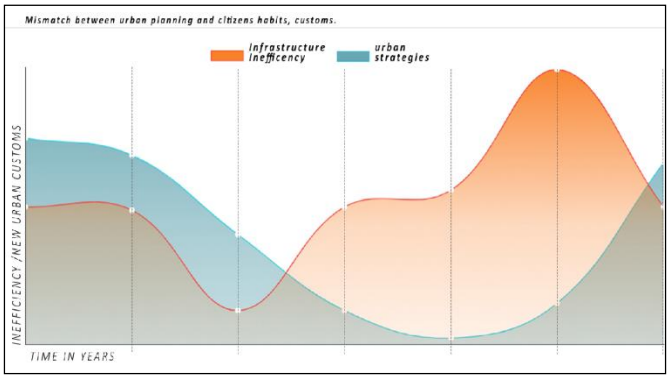
Source: Author.

1. ***Planned public spaces*** do not allow a fertile environment for a range of relief activities, like eating, talking in a certain manner, music, freedom of expression on a political interest, and many other things. Sometimes a control over the freedom and fashion of behaviour is shadowed in public spaces by the maintaining body of the particular public space.
2. **Unplanned public spaces** (Shroff, 2015) are a host of relief activities where one experiences a breath of freedom to get involved in an activity in a fashion that is not governed by anybody other than the law of the land**.** Also, a majority of activities that provide the relief are under influence of informal vendors, where they provide a special momentary relief for the commuters.

1.3 PUE's Adaptation in the City Spaces of Today

Significance of PUE: Urban strategies and the way cities are planned have changed throughout history like adapting to the needs of the inhabitants, infrastructure requirements, and advances in technology. Uses and customs of people and cities are changing and can evolve much faster than in the past, with the result that urban planning is often too slow to adequately meet the current needs of society. (Bertino, 2019)

Table 1: Urban Strategies Always Trying to Catchup to Changing Infrastructure Modifications



Source: Author.

In this context, the development of pop-up environments for temporary developments could be a solution to meet the needs of flexibility, adaptation, and resilience of a city. This allows the urban planner to consider systems from a short-term perspective, fulfilling current needs without compromising the development of potentially different activities in the future. To shortly introduce PUE, they try to address the mismatch between evolving urban practices and inefficient urban planning (Bertino, 2019). The research article published under the title 'Framework Conditions and Strategies for Pop-Up Environments in Urban Planning', puts light to and reveals precedencies that have temporal qualities to adapt to various morphological and geographical contexts.

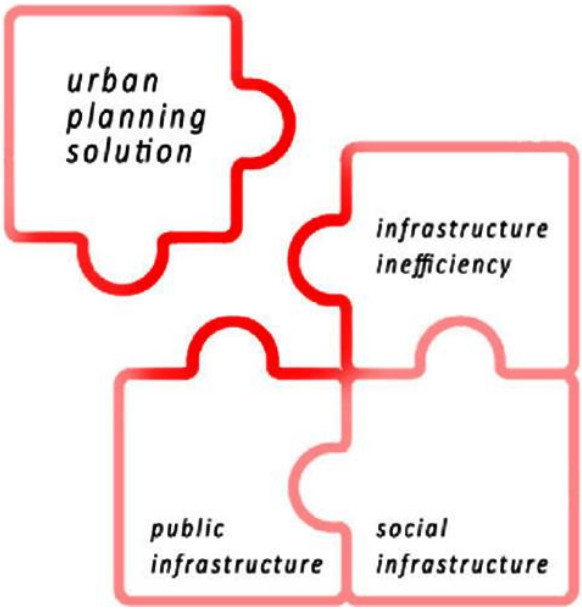


Figure 4: Urban Planning Solution as Misfit to New Traditions in Social and Public Infrastructure

Source: Author.

Research Aim: To emphasizes on the use of temporal mechanisms to be a part in the change, for democratizing the use of city space in Mumbai, where the anticipated outlook is a representation of urban planning problems in an unbuilt manner.

2. LITERATURE REVIEW

Literature from select publications reflect upon understanding of city spaces, changed habits and customs of people using the city space of Mumbai and parameters of deploying PUEs. Research cavity of formulating a framework condition of PUE for such given setting requires a methodological analysis.

2.1 Cities for People

Cities are where people meet, trade and exchange ideas, spaces that people relax and simply enjoy themselves. A city's public domain streets, squares and public parks are catalysts for such activities. Jan Gehl's research into public space and public life as an interaction, counting, mapping, tracking and other tools that materialize and numerate, what is the quantum, and lets us understand the grammar of urban space.

2.2 City Timeline

The study conducted under the research paper titled, 'Spaces for Engagement in The City of Mumbai-Rethinking Parks and Public Spaces in Congested Cities' highlights a key character of cities with usage patterns of city space, throughout the day and thus, guiding through data of new customs and habits of people and their social activities in city space of Mumbai.

Afternoon: Below Commercial Areas - 11:00 am to 3:00 pm: The city space gets utilizes mostly around the commercial buildings. Small informal interventions such as tea stalls, photocopying/printing shops, food carts, cigarette stalls, newspaper kiosks, etc. activate the space by providing an opportunity to pause. (Shroff, 2015)

Evening: Formal Public Space - 3:00 pm to 7:00 pm: During this time people utilize more formal public spaces, for example, Parks are visited by children and their parents. The demographic of people utilizing the city space also changes to groups of friends and families. Common examples of activities found are: Groups of people sitting or walking along the promenade. (Shroff, 2015)

Night: Large Isolated Spots - 7:00 pm to 12:00 am: These spots attract people because of the quality program that they offer and they can be either indoors or outdoors. Indoor spaces such as restaurants, clubs, theatres, malls start getting a lot of crowd. Outdoor spaces such as Bade Miya, Ayyub's, the fair at Nariman point, etc. also attract a lot people (Shroff, 2015).

2.3 Pattern of Growth for Informal Intervention

Identified how informal spaces setup and the mapping of how the informality existed:

1. **High Pedestrian Accessibility:** Generally, the interventions tap into the continuous flow of people, like routes leading to train stations and major highway routes towards the suburban parts of the city. They setup just outside retail edges on the ground (Shroff, 2015).
2. **Neutral Space:** The bulk of informal interventions are set up around these neutral spaces such as transport stations, government buildings, social structures and commercial areas. Residential areas have the bare minimum number of informal interventions because the residents feel more personally about the space below their house (Shroff, 2015).
3. **Avoid High Security Zones:** Spaces such as consulates, luxury hotels and other image conscious spaces are always avoided where they can become a security threat (Shroff, 2015).
4. **Least Conflict Space:** It generally is the space along a dead facade of the structure usually along the side, the back or the space between two structures (Shroff, 2015).

2.4 PUE Parameters

Pop-Up Environments—Criteria and Requirements

When we look at manifestation of ephemeral built spaces they usually are distinct applications than their permanent counterparts.

Requirement	Definition	Relevance
Modularity	Degree to which system's components may be separated and recombined	Minimizing costs
		Minimizing production time
		Minimizing consumption of space
Flexibility	Ability to produce environments that can evolve and change	Rapid implementation
		Respect for users' uses and customs
		Easy change of intended use Adaptability to everyone's needs
Speed	Ability to transport and install environments quickly	Easy transportation on site
		Reducing construction time
		Adaptability to di erent contexts
Simplicity	Ability to install environments easily in di erent conditions	Low structural complexity
		Easy assemble of elements
Affordability	Economic possibility of exploiting a specific resource	Guarantee of adequate housing
		Minimizing cost of use
		Minimizing manutention
Reversibility	Ability to return to the starting point without leaving traces	Reducing environmental impact
		Reducing complexity in disassembly operations
Second-life management	Ability to have sustainable solutions for the end-of-life	High quality control for products
		Reuse/recyclability for new life cycles
		Reducing energy consumption and related CO2 emissions

Flow Chart 1: Requirements of Temporary Pop-up Environments and their Relevance for Urban Planning

Source: Bertino, 2019.

3. METHODOLOGY/FRAMEWORK OF PUE IN MUMBAI

Research methodology: Following the Framework, Context and Case studies, Research and back tested parameters establish a successful deployment of such architecture. A set of variables were decided for the evaluation of the site location and programmatic combination. These variables were based upon the understandings from Introduction and Literature review.

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3.1 Framework Conditions

Parameter	Definition
Location	Place where the PUE is located
Plot	Original Function Area in which the PUE is located
Temporary Use	Intended use of the PUE
Project Time	Duration Intended time of the PUE
Background Purpose	Planification of the PUE
Criteria for Realization	Objectives and aims of the PUE in its context
Design and Materials	Physical description of the PUE and its elements
User Groups	Type of user for which the PUE is intended
Neighborhood Characteristics	Spatial context in which the PUE is located
Neighborhood Density	Number of users expected to use the PUE
Lifecycle of the PUE	Considerations on reuse or recycling
Economic Aspects	Costs and economic benefits

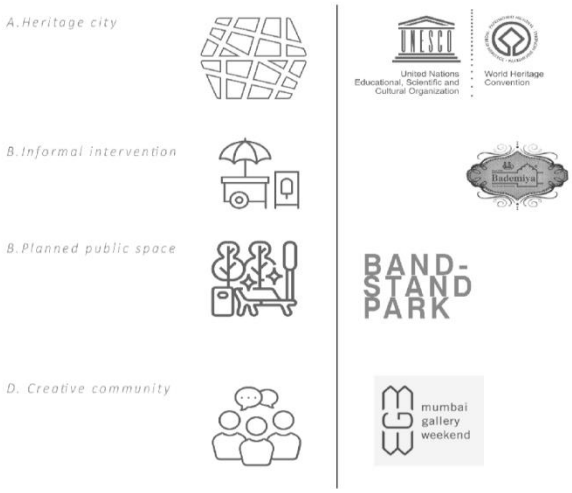
Flow Chart 2: Parameters Considered for Analysis

Source: Bertino, 2019.

The parameter of various ephemeral exhibits has been studied and some of the most peculiar traits in the context and their existence have been directed out. Key parameters like temporary use, intension, background purpose and criteria of realisation premise of the project are considered.

3.2 Site Selection Criteria

Table 2: Criteria's Highlighting the Promising Agents that Influence the Locality in Forming Better Social Place Construct [3]



1. Well defined urban city centre where the location, planning and functioning of the social, healthcare and public infrastructure and the buildings are well defined. There are set rules and practical or legal limitations, such as the concern over preserving heritage and the reserved allocations in the urban plans.
2. Mix of formal public space and informal place, and a recognised unplanned public space.
3. In this context, pop-up environments should be able to provide an opportunity for the construction of new social & public infrastructures, so as to generate interest among citizens through short-term intensification or multiplication of use.
4. Creative and responsible community for empowering social agenda.
5. Established attraction to a diverse group of people to the Area (locality/neighbourhood) every day.

[3] *Table 02. Source: Author.*

3.2 Case Selections

When examined temporal projects we come across exhibits in vacant plots, empty buildings and urban central areas. Considering Indian context, bringing Civic & Social Infrastructure efficiency becomes foremost concerns in the city space realm.

4. RESULTS AND DISCUSSION

4.1 Framework Conditions Involving Different Spheres of Built Environments

4.1.1 *List of Background Purposes*

Activities of social engagement that create quality city spaces range from optional activities like taking a walk, standing or sitting that engages into necessary activities like walking to work or school, getting the mail or walking a dog, etc. In conclusion ***satisfying a Program scheme*** bringing Civic & Social Infrastructure efficiency, introducing spaces like plenary halls, community halls, food markets, schools, creches, toilets, etc. to prime social places like playing fields for different sports, theatres, spaces of fair, exhibitions, restaurants.

4.1.2 *Criteria of Realisation*

Socio-spatial assemblage or informal assemblage strategies like territorialization, deterritorialization, setting-up process and withdrawal are necessary to manifest an informal place and characters like flexibility, simplicity, speed, reversibility in the program scheme include a temporal definition.

4.1.3 *User Group*

When we look at a composition of everyday users of city space in the neighbourhood or localities near the city centre of Mumbai, it is not hard to notice that actors within the space are commuters, nearby residents, students, visitors, hawkers, etc.

4.2 Site

While searching for a *type of context in which the PUE can be inserted*, specifically for the city of Mumbai where the social phenomenon in city space was more significant in the unplanned areas and was driven & influenced by the participation of informal vendors, a diverse range of agents, and spatial environments were needed as ingredients that support a comprehensive outlook for a PUE in the area.

4.2.1 *Land Use Mapping*

The city centre of Mumbai and the localities near it was found to be a promising atmosphere for reception of a Pop-up Environment because of the diverse contexts and history of buildings, public spaces, social communities, green and open areas, museum, and cultural events, informal vendors and their growth pattern.

4.2.2 *Informal intervention Mapping*

Time based optimization of space: For an urban designer the most important characteristic of these interventions is the time based optimization of space. Based on this, they manage to optimize the limited space in the city through dynamic transformations. Since these transformations are temporary they do not leave anything behind and the space returns to its initial condition once the activity is over.

One such example is the parking lot at Nariman Point:

- During the day the parking lot is used to park cars of the large number of office employees employed in the area.
- After office hours the parking lot transforms into a fair and is visited by families with children to seek relief.

Transaction interventions like stationery or cloth stalls, consumption interventions like sugarcane stall or sandwich stall, service interventions like cobbler or a typist, are of informal kind and mobilize activities that have become fairly regular customs and habits in the city space of Mumbai.

4.3 Case Study

4.3.1 *Pitch/Pitch, Amanda Levete, football pitch.*

Figure 5: Stackable Football Pitches could be Erected on Disused or Temporarily Empty Plots Across London, According to Amanda Levete and her London-based studio AL_A

Source: https://www.dezeen.com/2016/11/29/amanda-levete-ala-proposal-multi-storey-football-pitches-london

The tower is designed to be quick and easy to install, allowing them to be erected temporarily for events such as World Cup tournaments. The application of carbon fibre is becoming increasingly more viable in architecture, as researchers continue to investigate the lifespan of the lightweight and high-strength material.

4.3.2 *SelgasCano's Louisiana Hamlet Pavilion, Kindergarten School*

The structure, which is in transit to one of the largest slums in the country, will replace a dilapidated shelter which currently houses 600 pupils. The new school, which cost around £25,000, is made of cheap but durable materials including chipboard, polycarbonate plastic and standard scaffolding components. The 150-square-metre building will feature a dozen classrooms for nursery, primary and secondary pupils, plus new offices, toilets and a cooking area.

4.3.3 *St. Carolus Hospital Screening Facility/AT-LARS, Healthcare Facility*

Prefabricated in two weeks and built on-site in four days, the 140 sqm semi-permanent structure comprises a white scaffolding structure, bangkirai wooden flooring and poly-carbonate cladding. The corrugated uPVC roof helps reduce heat and sound coming from outside. It has a substantial overhang to reduce the amount of heat received by the walls.

5. CONCLUSION

The thesis implication of a temporary environment, instant and spontaneous with a multi-role provision for all actors in the city space, migrated or mature dwellers, deployed with a background purpose in a swelling urban context, can always prove to be a valuable tool to understand new customs and grammars of pubic space requirements.

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Reminiscing Architecture: Exploring Neuroarchitectural Concepts in Dementia Palliation

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ABSTRACT: The interdisciplinary approaches of neuroscience and architectural design attempt to explore human perceptions of different environments and experiences. These are determined by spatial sensory engagements that can be choreographed for positive brain stimulation. Thus, forming a design for improved holistic well-being. Although these concepts may seem dissociative on the surface, for centuries, designers have been creating spaces, although intuitively, using the principles of neuroscience. Neuroarchitecture aims to address the concurrence of natural and built environments. As complex biological organisms, this affects us at neurological, emotional, and cognitive levels. The understanding of this correspondence is vital, especially, during the end of life with degenerating neurological capacities of the human mind and body.A therapeutic setting for palliation can benefit people with terminal illnesses like dementia by creating a tranquil and independent living to embody dignity in their twilight years. This research taps into the potentials of neuroarchitecture to yield enriched environments that encourages memory, improves cognitive abilities, stabilizes mental wellbeing and heightens sensorial contentment for pain relief and stress avoidance.

Keywords: *Neuroarchitecture, Enriched Environments, Sensorial Stimulation, Perception, Therapeutic, Palliative Care, Dementia.*

1. INTRODUCTION AND BACKGROUND OF STUDY

Q. What is Palliative Care?

It is an approach that improves the quality of life of people with life limiting illnesses and provides bereavement care to the family members as well.

It involves prevention and relief of suffering through early identification, correct assessment and pain treatments by focusing on providing a life of dignity in the end years. It deals with all physical, psychological, emotional, social and spiritual aspects of care.

Dementia, as an umbrella term, is a syndrome—usually of a chronic or progressive nature—in which there is deterioration in cognitive function (i.e., the ability to process thought) beyond what might be expected from normal ageing. The impairment in cognitive function is commonly accompanied, and occasionally preceded, by deterioration in emotional control, social behaviour, or motivation.

Q. *In what way can the built environment impact us when our mental and physical capabilities deteriorate? Ans. "Architecture has the most impact when the ideas used in building design reflect our understanding of how the brain reacts in different environments. Neuroscience can help architects understand scientifically what have been intuitive observations." – John P. Eberhard (founding director of Academy of Neuroscience for Architecture)*

Neuroscience is a design tool that allows for an evolution in architectural design practices. Its purpose is to answer why an architectural space is able to provoke feelings of awe or calmness. The idea is to understand how the brain interprets stimuli. Then, the reaction and behaviour of the users are mapped which can be translated to inform designs.

Dr. John Zeisel, sociologist and designer, asserts that in the treatment of patients with dementia, environmental modifications are often more effective than pharmacological and behavioural therapies.

1.1 Aims and Objectives

- Explore scope for spatial changes
- Design provisions for wayfinding, place-neuron orientation and pursuing skills

- Community involvement and awareness
- Highlighting the importance of Quality of Death (QOD) as much as the Quality of Life (QOL)
- Right to palliative care for all
- Cater to the needs of families and caregivers.

1.2 Concern

- Availability of morphine (pain relief drug)
- Absence of government policies 1.

2. LITERATURE REVIEW

2.1 Stages in Dementia

- ***First Stage (1–2 years):*** Forgetful, difficulty in communication, getting lost in familiar spaces, lose track of time, difficulty in decision making, mood changes and difficulty in daily tasks.
- ***Second Stage (2–5 years):*** Need help with personal needs, difficulty in everyday chores, cannot live alone without support, hallucinations, disturbed sleep and inappropriate behaviour.
- ***Third Stage (5 years and more):*** Unaware of time and place, cannot recognize anyone, increased dependency, restricted mobility, extreme agitation and screaming.

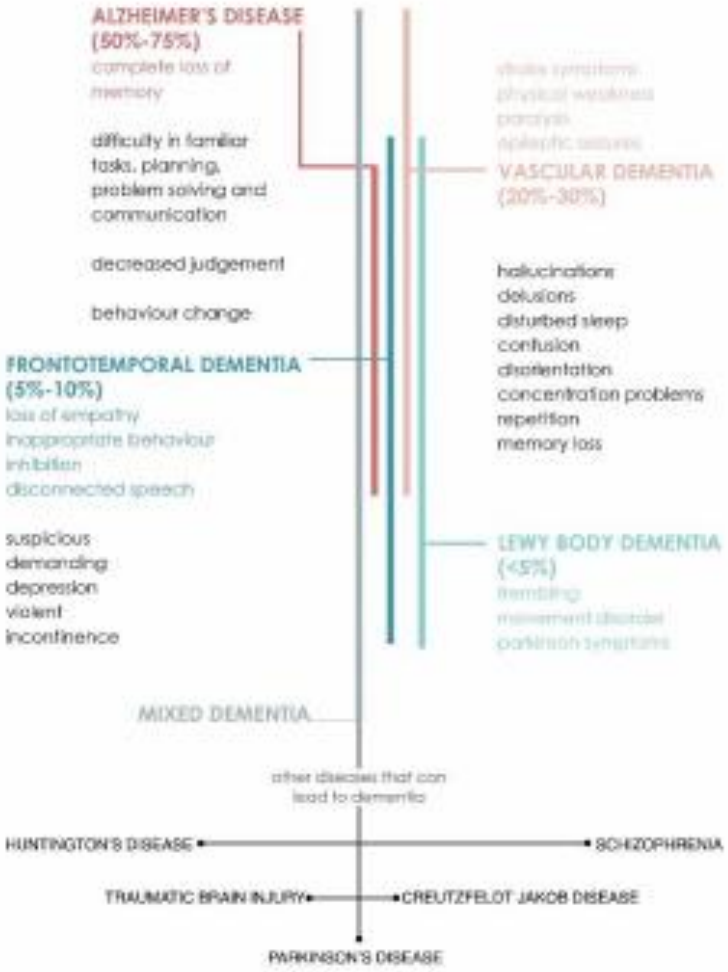


Figure 1: The Dementia Types and Symptoms

Source: Author.

2.2 Care Models

The immediate challenge for India is to develop culturally appropriate services which can be delivered within existing resources.

1. Home care
2. Memory clinics
3. Day care centres
4. Residential care facilities
5. Support groups
6. Dementia help lines
7. Training services

At present, such care services are in the infant stage in this country and the gap between the need for care services and the actual available services is very huge.

In view of the above, seven core strategies were developed in consultation with experts and the evidence available.

Table 1: Seven Core Strategies

WHAT to deliver	HOW to deliver	WHO could deliver	WHERE to deliver
Create awareness and demand for services	effective use of all media platforms and stigma campaigns	government, NGOs, media platforms, publishers	primary healthcare and memory clinics
Capacity building of healthcare teams	training the health professionals in dementia care	doctors, nurses, volunteers, activists and community	hospitals, workshop and training centres
Provide affordable treatment	use cheaper versions of anti-dementia drugs	researchers, healthcare providers	healthcare institutes at all levels
Effective long term care through community based programmes	train carers to form support groups	specially trained staff appointed for community elderly care	community based healthcare model
Residential and Day Care facilities	quality long term care for all dependent elderly	government, NGOs	community
Develop legal services	formulation of policies	government	across the country
Training services	institutes and workshops	colleges, government	across the country

Source: The Dementia India Report.

Relevance Today and Tomorrow

1. *Demographic Analysis:* In middle-income countries like India, life expectancy and populations are increasing, leading to a greater number of people with dementia. It is estimated that in India the total no. of people who need palliative care (PC) is likely to be 5.4 million people a year.

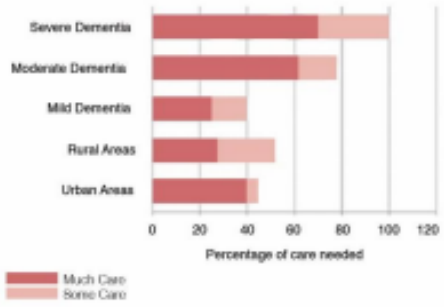


Figure 2: Need for Care

Source: The Dementia India Report.

2. *Quality of Death Index:* India ranks 67th out of 80 countries in the 2015 survey. It is one of the lowest ranking countries.
3. *Issue of Long-Term Care:* Since dementia is a progressive illness, it becomes difficult for family members to take care of the patient over such a long period of time especially, when the condition worsens. There is also lack of palliative knowledge, skills and resources.
4. *Lack of Infrastructure:* Although palliative care was introduced In India 50 years ago, only 1% of the population have access to it. Kerala has 83 service centres while Maharashtra has only 5.
5. *Need for Awareness Propagation*
   - right to quality of life
   - get rid of stigmatization
   - community support and involvement
   - mitigate social and economic impact
   - encourage research and development
   - professional training for PC
   - formulation of PC policies

3. MATERIAL AND METHODOLOGY

"As neuroscientists, we believe that the brain is the organ that controls behavior, that genes control the blueprint, but the environment can modulate the function of the genes, and ultimately the structure of our brain. Changes in the architectural environment change the brain and therefore, they change our behavior.

–Fred 'Rusty' Cage, neuroscientist, Salk Institute.

3.1 Dementia and Brain

The human brain is very complex and powerful; the essential component of the brain is the neuron. We have about 100 billion neurons in the brain with virtually endless number of connections between them. Each neuron is constantly changing, communicating and networking with other neurons to enable thoughts and actions. Neurons connect to one another via electrical impulses or chemical release at the synapse. However, when someone is diagnosed with a specific type of dementia that number of brain neurons starts to decrease causing the brain to shrink. Hence, these connections between the neurons are disrupted because of a build-up of beta amyloid in the brain causing "sticky" deposits that effectively "choke" neurons. Since neurons now can no longer communicate with one another, new thoughts cannot be formed.

Dementia attacks each of the four major lobes in the brain: *1.Frontal lobe:* movement control, encoding new information, recalling knowledge, planning, judging, evaluating, reasoning, socializing, and personality. *2.Parietal lobe*—receiving sensory information from the surface of the skin and processing sensory information from hearing and seeing that are being sent from other areas of the brain. One's eyes and touch are important when dealing with negotiations in understanding the spatial relationships and perceptions of stimuli that the built environment is providing.

1. *Occipital lobe*—visualization and deciphering of colour, depth perception and motion detection.
2. *Temporal lobe*—regulate memory functions, emotions, hearing as well as verbal responses.

The temporal lobe has the hippocampus which is the map of the room. It is the first to get affected. Hence, the most initial symptoms of dementia are disorientation and forgetting routes.

3.2 Dementia and Perception

We see the building, we enter, we perceive the light and shadow, sound and echo, sense the material, see the geometry. For example, we can never make a comment like "This hospital looks like a prison" if we haven't seen a prison. From the functions, planning, materials and orientation of buildings, we build up our own database of perceptions. The next step is that anything we perceive from the built environment, our brain retrieves a memory, and that's one way of how it affects our behaviour.

Here is an example to show how memory connects to architecture:

- Person A is climbing down the staircase and person B is witnessing the situation.

- Person B recalls a previous bad experience on some other staircase.
- Person B tries to caution person A.

In this example, the memory of a similar architectural element i.e., the staircase, acts as a stimulus for the action portrayed by person B.

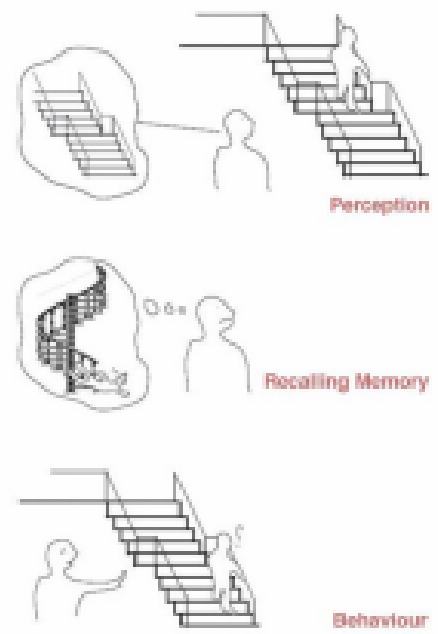


Figure 3: Architecture and Perception
Source: Neuroarchitecture by Cagil Kayan.

3.3 Dementia and Memory

Memories in dementia patients do not completely disappear, it is the process of retrieval that is damaged. We know things not only by using our brains (declarative memory-emotions, events, births, marriages) but also by body movement (non-declarative memory-skills, playing music, sports). New memories are possible to be encoded into the brain by repetitive techniques and cues through sequence of tasks and daily routine.

3.3.1 *The Experiment*

Environment, Brain, Stimuli and Behaviour Three kinds of environments were created and 36 rats were sorted into three experimental conditions using 12 animals in each group:

1. *Impoverished environment:* no food, water and light *2. Standard environment:* adequate food, water and light *3. Enriched environment*—an enriched environment was created with adequate food, water, light and also exploratory objects to play and climb upon. The objects were changed two to three times a week to provide newness and challenge; the frequent replacement of objects is an essential component of the enriched condition.

3.3.2 *The Result*

After 30 days, results clearly indicated that the cortex from the enriched group had increased in thickness compared with that living in standard conditions, whereas, the brains from the impoverished group had decreased.

3.3.3 *The Conclusion*

In response to appropriate stimuli, the brain creates an urge that demands to be satisfied by triggering action. Enriched environments stimulate our brain to perceive, think, understand and write or connect to memories which makes the brain to visualize and develop new neurons.

4. RESULTS AND DISCUSSION

"Environments that are designed for people with dementia will result in well designed environments for all"
—Mary Marshal

As a result of the undertaken research, certain evidence based design concepts are introduced and their implications in the real architectural world is to be explored.

4.1 Deinstitutionalization

Deinstitutionalization is one of the approaches to impart a feeling of normalcy and making the space more home-like. There is a need for an effort towards personalization and relatability.

4.2 Small Clusters Forming a Larger Service Provision

Large-scale long-term care settings illustrated that the noise, confusion and over stimulation was leading to agitation and aggression in its residents.

4.3 Building Configuration

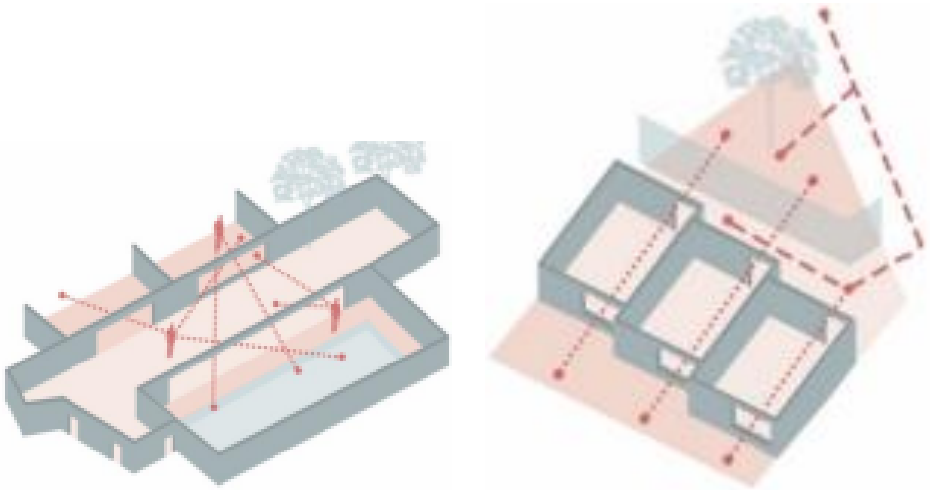
An approach in spatial layout is the open plan design where more than 1/3rd of the bedrooms would be located within a single loaded corridor, and the rest would open onto the social space. This positively results in the residents having greater activity levels, displaying less anxiety and greater interest in their surroundings.

4.4 Transparency

Room to room transparencies highly benefit residents with neuro-disabilities because they are often unable to imagine what is on the other side of a solid wall. Here, the intent is to explore the ideas of transparency from the standpoint of observation. Observing and overseeing activities without engaging in them promotes social and sensory stimuli.

4.5 Encourage Movement

'Social wandering' provides residents with a source of exercise and a way of exploring opportunities for stimulation without feeling lost. For this, it is essential to be able to locate oneself in a naturally mapped physical environment with way finding cues.



(a) Building Configuration (b) Transparency and Movement

Figure 4

Source: Author.

4.6 The Act of Wayfinding

Wayfinding is one of the most common issues faced by people with dementia. Wayfinding is defined as the process or activity of ascertaining one's position and planning and following a route. Feeling of being lost, hesitation, delay in navigation, causes stress which affects their medication and health. A good environmental image gives its possessor an important sense of emotional security. Environments with rich spatial experiences can better support the act of wayfinding. Reduce the need for decision making and increase architectural legibility by making the function of spaces evident and providing cues to lead the way to these area:

- Decision points should be simple and act as spatial reference points
- Avoid changes in direction
- Avoid repetitive elements and symmetry in plan—Efficient use of landmarks

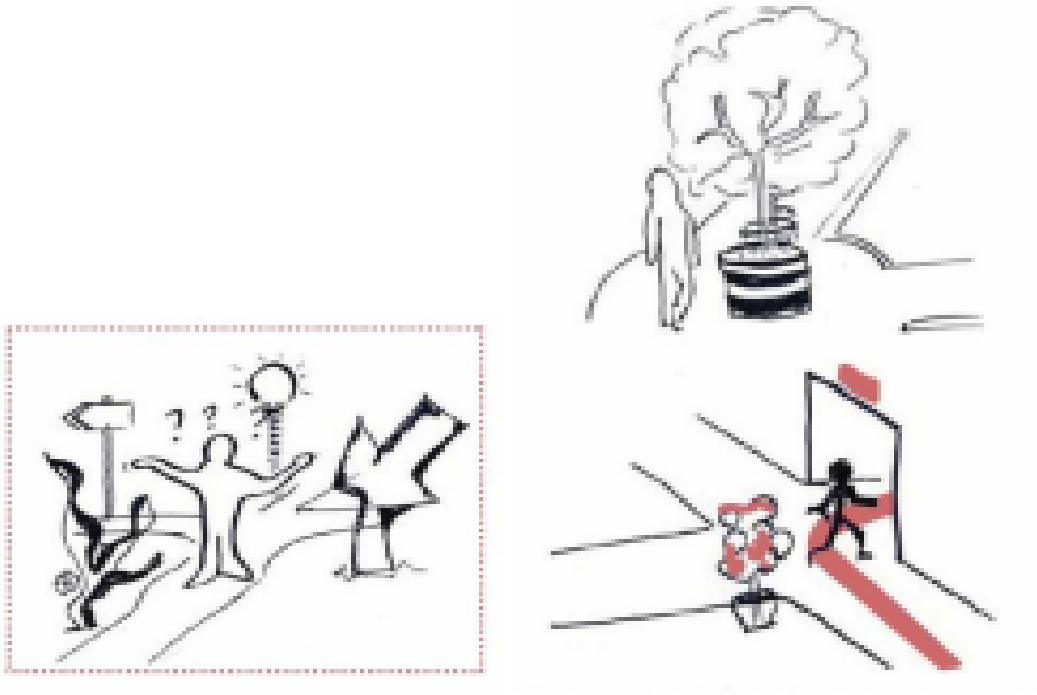


Figure 5: Landmarks for Wayfisnding

Source: Neuroarchitecture by Cagil Kayan.

4.7 Natural Light and Access to Outdoor Spaces

Providing outdoor spaces and visual access to other areas of the building provides residents the ability to be aware of what activities are taking place and encourage them to participate in them. Secured outdoor garden spaces are seen as therapeutically beneficial because they provide natural stimuli that induces 'involuntary attention' by natural positive stimulations.

- Exposure to natural light have been shown to lessen sleep disturbances and lowered the amount of late-night wandering in the corridors.

4.8 Use Pattern of Spaces

The design and consideration of how spaces will be utilized can often impact how well they are occupied and how effective the space is at generating casual encounters and friendships. Each of these spaces should also differ in character to create separate "moods" for each room to distinguish functions. Those with a cognitive decline tend to look at their feet when walking, so floor patterns can be confusing and even restrict movement. Problematic features include dark floor surfaces which are generally not walked upon as they may be perceived as holes in ground.

4.9 Addressing the Urban Context

Urban interventions like active ground floors, optimum walking distances, stand-out landmarks, informal urban open spaces with buffer zones, intergenerational spaces and regular urban activities can help make our cities dementia friendly.

5. CONCLUSION

India has an extremely weak palliative care ecosystem for the terminally ill and the elderly. With an anticipated rise in both those groups, this could be the next big public health challenge. This project is an attempt to go beyond the medical aspects of health and explore architectural means of holistic wellbeing, especially for those in dementia palliation. This research asserts architecture that acknowledges the physical, emotional, social and psychological needs of people with dementia and their families. Creating such a body of information, enables us to identify and analyse how the built environments and those affected by dementia are in dialogue with one another, leading to spatial evolutions within enriched environments.

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Role of Kinetic Architecture in Building Aesthetics

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ABSTRACT: Today we are living on the twenty-first step of the twenty-first century. We know that even today, in the conservation of modern architecture the next most important analysis after overall planning is the 'Building Aesthetics'. Which describes the different aesthetical shapes and elevational treatment of a building. In this research paper in front of your discerning eyes, interconnectedness and interdependence of the building aesthetics by dynamic architecture and the charming building beauty for the same. The presented paper examines the combination of transformational creative architecture and this stream of changing architecture. The process of research shows that the importance of transformability is not only from an architectural point of view but also towards the direction of conceptualism in architecture. As the face of writing is the structural part of the research which includes main goal of kinetic architecture in building aesthetics and some limitations and delimitation as the solution for that. At the stage of research methodology, data is collected by case studies through literature readings. Conducting a survey for gathering information about effectiveness for expected conclusions. Specifically, on the practical basis of the kinetic architecture on building aesthetics and social mindset behind that.

Keywords: *Kinetic Architecture, Building Aesthetics, Transformability, Building Envelopes, Static and Dynamic, Human Psychology.*

1. INTRODUCTION

Architect Louis Sullivan (1856–1924)'s famous axiom, "Form Follows Function" became a touchstone for many architects. For him, the purpose of design is the concept behind design. Wright changed his mentor's teaching phrase "Form and Function are One." After many years of change Brazilian Architect, Oscar Niemeyer who is considereda major figure in the development of modern architecture argues that—My work is not about "Form Follows Function", but "Form Follows Beauty" or, even better, "Form Follows Feminine". In this debate, we get a lesson that in times like modern architecture, one has to take care of the beauty of the building as well as get the form of building by transforming contextual inspirations and responsiveness.

Research Question: Why are the trends and projections of kinetic architecture important in today's contemporary high-tech architecture with new interpretations of architecture?

Aim: To analyze the role of kinetic architectural trends in contemporary architecture.

Objectives

1. To study the origin of kinetic energy will strengthen the foundation of research.
2. Motivated by revolutionary changes in kinetic architecture and accompanying shapes and aesthetics.
3. This study aims to make a change in kinetic architecture by anticipating possible conceptualism in futuristic architecture.
4. To synthesize the importance of building aesthetics in well being of humans.
5. To prove the balanced integration of artistic sensibility and scientific methodology in architecture.

Hypothesis: If we are using kinetic energy in the trenditional modern kinetic architecture, then there is no need to rely on other non-renewable sources of energy use in contemporary architecture.

Lack of resources and a large inclination of the social mindset towards traditional structures lead to discrimination in urban and rural contexts.

Scope: In clarification of interactive architecture- is considered the building as an attachment. A space that supports some activism. The building attached aesthetics such as walls, floors, and ceilings act as interactions spaces. Kinetic architecture in research language—'**This type of architecture doesn`t deal with people as users but as participants.'**

While studying at the stage of practical as well as projective level of this research, there are some limitation:

1. At the stage of data collection, the practicality behind the issue being studied and its effect on the social psyche.
2. When conducting sample selection at the case study level, the dynamic architecture of the BC period had nothing to do with aesthetics. They were limited to occasional needs only. Hence, age of sample is most important.
3. Age of samples is also important in survey sampling. The social ideology of changing architecture and building aesthetics fall into two parts—old ideas (those who do not like change) new ideas (those who agree with the modern era)
4. Also, there are two main types of ideological studies—social thought (those who do not know enough about this issue) and artistic designers—the thoughts of researchers (who are called the founders of this changing architecture).

2. LITERATURE REVIEW

Kinetic is not a new term in recent architectural enhancement. Studies show that kinetic architecture has its roots in prehistoric architecture also. Study as the aesthetical and transformable point of view of the building using the energy gained from the daily movements in the building and the daily routine of nature such as Solar radiations and Wind waves for examples of marriage among Nature and Architecture. While research on all these backgrounds has shown that "Architecture can also be flexible".

A detailed reading of how to use this as an architectural element in various ways reveals some remarkable statements. All those critical readings are summarized and ordered chronologically in the reviewed literature.

Table 1: List of Databases Search along with the Search Terms Used for Each of the Topics Regarding the Study

Splitting Main Aim	***Respective Search Terms***
Architecture as the combination of Art and Physics	Fascinating Architecture
	Architecture in motion
	Convertible structures
	Aesthetical movements
	Dynamic vs Static Facades
	Viability of the technology
	Motion & Mechanics angles
Nature and Kinetic Architecture	Adaptive shading
	Installations and applications
	Cyclone resistant transformation
	air pollution control
	Retractable roof deployment
	Biomimetic inspired
	Natural light and ventilation
Energy utilization and effectiveness	Installations and applications
	Energy transfer
	Fire safety precautions
	Natural disasters precautions
	Maintenance to benefit ratio
	Curtain walls
	Open & close motion analysis
	Movable interior/exterior walls
	physics follows philosophy

Art finds its place in architecture is explored by design, space, or surfaces, and is inspired by nature, literature, engineering, or even philosophy. Roger Guernsey has stated very clearly that **"Architecture: The mother of all Arts"** in Daily Press article. The aesthetics of a building is as much as the outer skin and the face of the architecture; without which it is almost impossible to identify a particular building. Kinetic art is the only art that has movements that are comprehensible to the viewer or rely on a motion for its effect.

Table 2: Some Literatures in That Context

Databases	*Summary of Findings*	*Research Gap*
Source: Nature and Kinetic Architecture: The Development of a New Type of Transformable Structure for Temporary Applications. Author: MaziarAsefi and AysanForuzandeh Year: June 2011 Origin: Iran	Sir Asefi says that, in this changing world of architecture, dynamic architecture should be used to meet the needs of the user. According to him, this structure should be used mainly for temporary buildings. Type of literature: Journal	Emergencies like natural or man-made hazardscan also be handled using sophisticated systems in the user's needs.
Source: Transformation and movement in architecture: the marriage among art, engineering and technology. Author: Dr. MaziarAsefi Year: Aug 2012 Origin: Iran	In this literature Dr.MaziarAsefi stated, Transformation is not just a method of enhancing the aesthetic space of the building through intricate structures. Type of literature: Journal	Will it be possible. If structural change is going to lead to further innovation using the same historical research and wonderful science it is to sustain it in mobile elements?
Source: Kinetic Architecture & Renewable Energy Author-Dr. Azza Gamal Haggag Year: 2018 Origin: Egypt Type of literature: Research paper	Dr. Azza expects to conclude, energy utilization and harvesting affect the user's efficiency of exterior architectural space and the concept of eco-friendly buildings and depletion of energy source.	Considering the aesthetics of the building, the process of changing the envelopes of the building can also be done in the internal movements of the building along with augmenting in energy.
Source: The Role of Kinetic Envelopes to Improve Energy Performance in Buildings Author: Fahad Alotaibi Year: 2015 Origin: Canada Type of literature: Research Article	Sir Fahad A stated based on their contexts, kinetic masks make a casual and best way to cope with harsh weather, especially providing fresh air and sunlight.	By studying the geographical conditions like climate change such as heat, persistent natural disasters, type of building & the air pollution from outside, the material medium required by the element will have to be used.
Source: Cyclone-ResistantFacades Author: Angela Mejorin, Dario Trabucco & Ingo Stelzer Year: 2018 Origin: Italy Type of literature: Research report	A researcher studied a worldwide overview of the cyclone-resistant glazing solutions for building envelopes located in cyclone-prone areas. Stated importance of facades and transformable structure against high wind pressure.	Need to read on application a mechanism that performs with such efficiency and speed in evacuation dealing with natural or manmade disasters and emergencies.

3. RESEARCH METHODOLOGY

This research has majorly been conducted through the data collection as a first-hand experiences along with the foundation of literature review and available resources. Collecting primary data by gathering surveys to analyze the mindset behind interrelations of kinetic architecture and aesthetics in their day-to-day visual experience. Accumulate the data by directing personal interviews, telephonic interviews and online interviews like survey forms and clinical survey method by using several samples like professionals and users. Rack up secondary data chronologically of pre-studied and present researches and works related to aesthetically purposed transformable structures from respective books and literature. Selection criteria for case studies are ordered chronologically from the origin till today's post-modernism. Finding research gap between their expected conclusions and findings. Study their arguments on aesthetics and axioms on kinetics.

Swing Bridge (1487–1489): Milan, Italy.

1st invention of revolving architectural element in the world by Leonardo da Vinci (Italian polymath of the High Renaissance).

- **Working Mechanism:** Single-span wooden bridgeAffixed to a rolling rope & pulley system—Equipped with a rope and wheels.
- **Design Innovation:** Was an origin and inspiration for kinetic architecture. Manual rotational structure.
- **Inference:** Studied the importance of dynamic rotational structure in case of emergency.

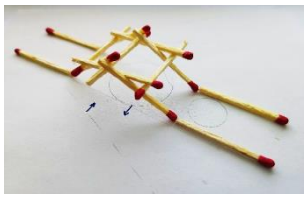

Figure 1: Self-Supported Kinetic Structure

Figure 2: Swing Bridge (The Vinci Bridge)

Arab World Institute (1987): Paris (Institute Building)

Figure 3: Moucharabiehs Screen having Mechanism

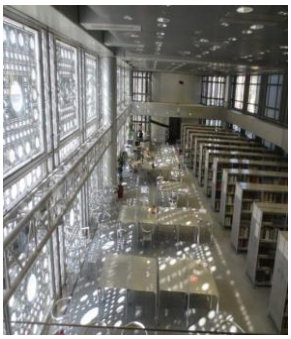

Figure 4: Internal Sun-Pattern Reliance

Figure 5: Pavilion Open Wings

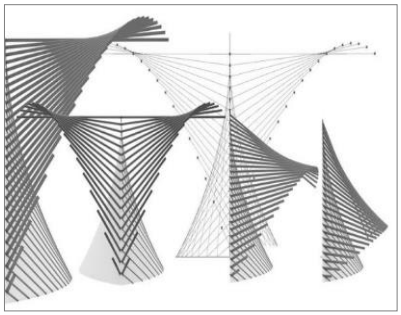

Figure 6: Diagrams of Wings Hourly Movements

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Quadracci Pavilion (2001): Museum at the United States
By Ar. Santiago Calatrava

Working Mechanism: With a wingspan comparable to that of a Boeing 747–400, it consists of 72 steel fins, which vary in length from 7.92 to 32 meters and weigh 90 tons. The brise soleil is made up of 72 steel fins, ranging in length from 26 to 105 feet. Even though hefty, it is in movement.

Design Innovation: The building with its iconic sunscreen in the form of wings and bow and canopy sweeping elements, is a remarkable achievement of engineering and architectural vision.

Inference: Step towards conceptualism by applying bird wing-like roof structure with open-close mechanism.

4. RESULTSAND DISCUSSION

The presented paper is a pilot study to gain insight into social perception about kinetic architecture and its effectiveness on the identity and uniqueness of structures. The studied cases show the future projections of postmodernism in response to the ever-increasing architectural metamorphosis. According to a study on literatures and analyzing case studies, a variety of qualitative data was collected to complement the research. This study shows that kinetic architecture responds to user needs as well as natural factors. The modernization in architecture over the years and the conservation of those changes along adaptive design were examined.

Flowchart 1: Research Methodology (Data interpretation)

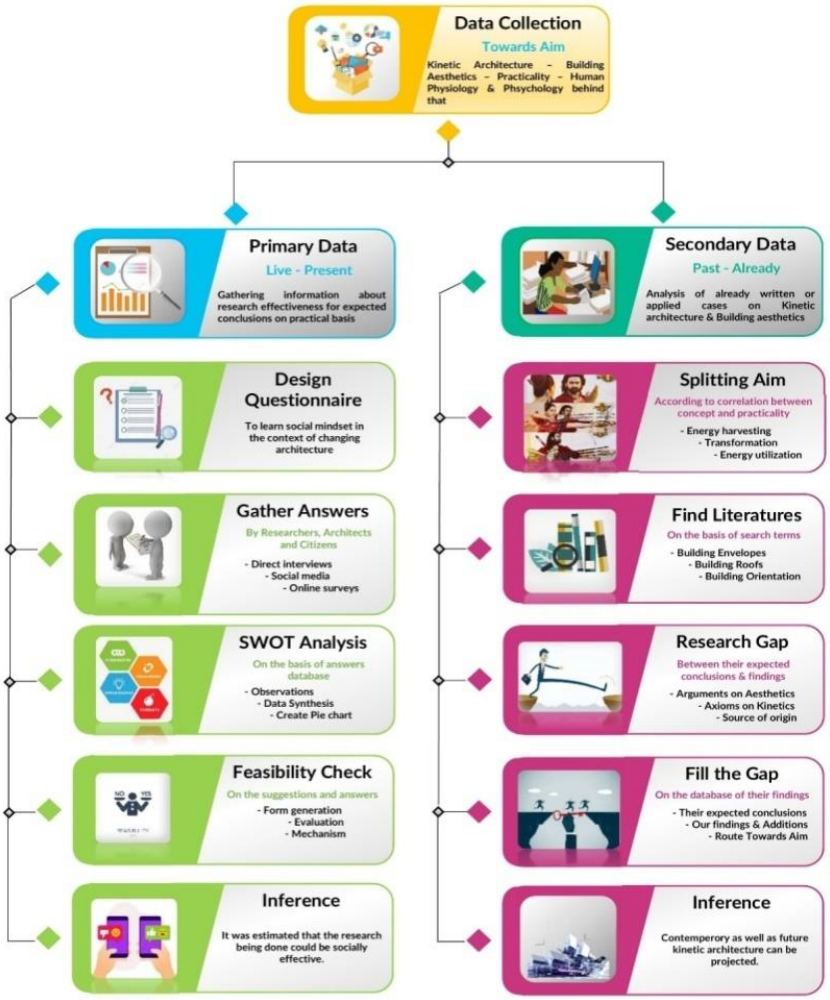

Figure 1: Analysis of Responsive Kinetic Architecture

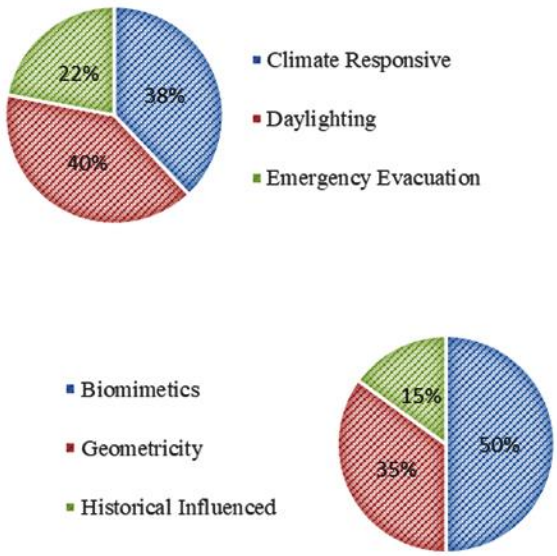

Figure 2: Steps towards Conceptualism

This study survey of samples is split and focused on two main groups—According to subject literacy and according to age mindset. Gathering data by professionals including respective research scholars, Architects, Engineers and all technical group of people versus users. Prepared and disseminated questionnaires to pre-learn the social mentality behind kinetic architecture. It was necessary to give brief information about the subject by providing photographs and animations as the foot of that survey interviews, especially for users and observers.

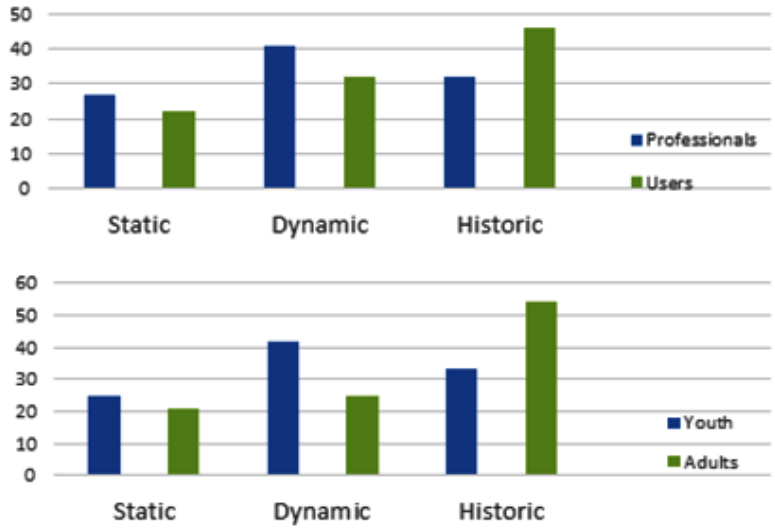

Figure 3: Results According to Statistical Data

5. CONCLUSION

According to research based on the analysis of presented elements reveals an important place in the architectural field in this age of concepts. In today's contemporary architecture, the use of kinetic energy with an aesthetic approach will solve many problems from a single element. From the analysis of the survey conducted, one can understand the social ideology which can be used in the future to take a step in the direction of changing architecture. The forecast for the next few decades was a realization of the perceived global energy shortage. Accordingly, the equipment presented on kinetic energy will be very important not only for the beauty of the building but also as a naturally auspicious and renewable source of energy.

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Human Centered Approach in Architecture Through the Lens of Critical Regionalism

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ABSTRACT: The importance of Human-Centric Design has been immense, right from the traditional neighborhoods of pols of Ahmedabad, old precincts of Jaisalmer, and many more until the present-day environment. While having such a rich and humane architectural approach throughout the history of Indian architecture, most of the contemporary architecture works in line with a modernist style influenced from the west, which results in undue negligence on the users of the space. Such context inappropriate architecture results in its inability to solve local on-ground issues such as social and economic inequality in India; and the physical, psychological and perceptual comfort of the users for which it is built! This poses architects in service to the community to rethink on; "How does architecture put human beings and the environment that supports every life, at the center of all design?" The paper attempts to understand the factors that make a project human-centric through works of Critically Regionalist architects such as Charles Correa, Raj Rewal, Cristopher Benninger, and Shirish Beri so that one can attempt their relevance in today's context. This study is a comparative analysis of five selected critically regionalist projects in a contemporary context that is based on different programs and thus aims to understand the factors that contribute to shaping a human-centric environment.

Keywords: *Human-Centric Design, Critical Regionalism, Traditional Architecture, Modernism, Charles Correa, Shirish Beri, Raj Rewal & Cristopher Benninger.*

1. INTRODUCTION

The journey of evolution of Indian post-colonial architecture began as soon as people experienced it to be inadequate. People realized that British architecture could not cater to the diverse climatic conditions and socio-cultural needs of India, and hence it was certain that British architecture dwindled soon after India's independence. Newly independent India chose modernism as its architectural style and believed that it would solve its problems of social and economic inequality (Sanyam Bahga, 2018). By the 1960s, architects in India started realizing the lack of a multidisciplinary approach to modernist architecture, which could effectively only cater to the function of the building. Prominent Indian architects such as Charles Correa, Raj Rewal, Balkrishna Doshi, and others, sought to overcome this dominance of modernism and started inculcating elements of Critical Regionalism to counter the homogenization of architecture caused by modernism. India being a developing country with its limited and valuable resources, could not afford to waste its resources by imitating the buildings from the west. Hence a new architectural style was followed in the 21st century which sensitized architecture to the local conditions of India, but on grounds, it was limited to a very small number of projects.

"Architecture can be thought of as the human act of highlighting and suppressing elements of the environment to benefit human life" (Viegas, 2019). In the present scenario, due to our commercial pursuits, we achieve this by tearing down various elements of the natural environment and side-lining all the traditional knowledge that regionalist architecture has taught us. "Due to rapidly growing populations coupled with mass migratory patterns and lack of concern by builders most projects do not cater to humane environments" (Gulati, 2020). Architects in service to the community are required to answer a fundamental question; "How does architecture put human beings and the environment that supports every life, at the center of all design?"; Moreover, "How does it shape human psychology?" Architect's responsiveness towards humans serves its community. It is a need of the hour to understand a basic fundamental that architecture is for people and its supporting environment. It is required for the art of the building to be such that it meets the physical, psychological, and perceptual needs of its users to improve their quality of life, to make a project human-centric.

Many projects of key architects have achieved the desired quality of a project to be human-centric in the contemporary context by using principles of Critical Regionalism.

The research aims to understand Human-Centric Design by decoding five such key Critically Regionalist projects of varying scales and functions of various architects in the contemporary Indian context.

2. LITERATURE REVIEW

2.1 Defining Critical Regionalism

The term Critical Regionalism was coined by Alexander Tzonis and Liane Lefaivre within the early 1980s (Sanyam Bahga, 2018). It was later mentioned by Kenneth Frampton in his essay "Towards a Critical Regionalism: Six Points for an Architecture of Resistance", 1983 where he elaborated architecture that has values emerging from the context that is time-driven. Critical regionalism is the uniqueness of blending regional traditions with modern architectural principles (Frampton, 1987; Tzonis and Lefaivre, 1981). It is an approach to sensitize architects towards the tangible elements of a place. The approach necessarily strives to counter the homogeneity present in modernist architecture (Henrique, 2013; Slessor, 2000). The idea of "home-coming", according to a regionalist architect Sanjay Mohe, makes the user feel at home much before he or she enters the home and thus Critical Regionalism gives a sense of context and a particular meaning to architecture (Sanyam Bahga, 2020). A regionalist project is said to be successful when one can synthesize indigenous wisdom from vernacular architecture along with progressive aspects of modernism (Frampton, 2007). Its practitioners seek to integrate the global developments with the regional sensibilities of the place (Yeang, 1987).

Critical Regionalism differs from regionalism in a way that it does not promote merely replicating elements of traditional architecture (Sanyam Bahga, 2020). The principles of traditional architecture must be understood and implemented instead of emphasizing its visual aspects (Sanyam Bahga, 2020). For example, the arrangement of spaces needs to be influenced by vernacular architecture rather than facade elements like arches being merely copied (Sanyam Bahga, 2020). The basic idea is to go deeper into the logic and its principles that produced vernacular architecture in a region.

Typical and homogenous solutions have been incorporated around the world without giving attention to the specificities of a place. The role of an architect has been merely reduced to designing external skins of the buildings (Frampton, 2007). Hence, Critical Regionalism is vital in present times to counter homogeneity and give architecture its sense of place.

2.2 Human-Centric Design

In an architectural design, the needs and requirements of spaces are catered, to give primarily comfort and a sense of identity to its users. According to a study by Lawrence (1987), Untermann and Small (1977), a GLC study (1978) Alexander (1977), Lang (1987) Marcus and Sarkissian (1986), along with Vastu-Shilpa Foundation (1988) among others, have ascertained that a user's satisfaction from a built environment depends on physical, psychological, perceptual, social, and economic aspects.

While physical aspects in buildings fulfill the most basic human needs like shelter and security, architecture also impacts the emotional state of any person who interacts with it. A building can provoke a range of emotions from fear to hope. Architecture creates psychological responses in people that can promote long-term health and well-being benefits or can also cause illness or mental distress (Voegeli, 2020). For instance, exposure to greenery and nature dramatically enhances health, helping people live longer and happier lives (Voegeli, 2020). On the other hand, cramped spaces and uninspiring surroundings are known to do the opposite (Voegeli, 2020). Perceptual needs give people a sense of belonging to the place. Whereas interactions among users and their fellow-mates fulfill one's social needs.

Human-centered architecture puts humans at the center of the design process and seeks to optimize positive interactions as such between humans and buildings (Voegeli, 2020). This topic helps us in consciously choosing a path that places human activity ahead of abstract notions of form and theory in the evolution of project development and serves the community to its fullest requirements.

2.3 Human-Centric Design through Critical Regionalism

From the above studies it can be interpreted that, Critically, Regionalist projects have been developed on the values and principles of vernacular architecture. Vernacular architecture such as pol houses of Ahmedabad, peths of Pune, old precincts of Jaisalmer, etc. have stood the test of time and cater to the physical needs by microclimate, orientation, and mutual shading; psychological needs by visual connections and sense of identity; perceptual needs by traditional forms and

character; and social needs through community interactions. Hence, it is essential to study the relevance of such "Human needs" in the contemporary Critical Regionalist structures and to verify whether such structures can be built further to achieve a human-centric design. This also makes us informed about the presence of factors in such structures that make a human-centric design successful.

2.3.1 *Different Forms of Human-Centric Design*

Apart from these principles and selected projects for Human-Centric Design, there are prevalent works of many architects, throughout the history of different regions of the world, that have practiced architecture "of the people, by the people, and for the people". For example, Shirish Beri believes vernacular architecture holds simplicity, frugality, functionality, cleanliness, and general respect for creation as the basic tenets of the design (Beri, 2000). It is not something that has changed umpteen times to follow different architectural styles, but has been a spontaneous and continuing activity of the people with a common heritage and acting under a community of experience (Beri, 2000). Thus, these architectural expressions changed from one region to another as the available resources, the socio-cultural attributes, the climate, and the site changed (Beri, 2000).

On the other hand, architects such as Laurie Baker known as the 'Gandhi of architecture', the 'master of minimalism' gave India low-cost building design with maximum efficiency and just the right amount of aesthetics. He believed architecture was a medium to blend man and nature. He re-defined the concept of housing itself, aligning it with the local ecology and surroundings. He emphasized local materials and traditional concepts in constructing dwellings, demonstrating a strong commitment to mass, affordable housing. Influenced by Mahatma Gandhi and his own experiences, he promoted the revival of regional building practices and the use of local materials; and combined this with a design philosophy that emphasized a responsible and prudent use of resources and energy (Ponnu, 2020).

Thus, we see that Human-Centric Design was unknowingly being practiced in various forms until we see it as a disconnect through the past century due to change in priority attached with architecture to the economy at the global level. Human-Centered Architecture includes a broad spectrum of works varying from vernacular, traditional, anonymous, timeless, regionalist architectural works, etc. all aiming to achieve various levels of comfort for the users of its space.

3. RESEARCH METHODS

The five selected projects namely, Artist Village at Navi Mumbai by Charles Correa, CIDCO Housing at Navi Mumbai by Raj Rewal, Salvacao Church at Mumbai by Charles Correa, Centre for Development Studies & Activities (CDSA) at Pune by Christopher Benninger, and Muktangan Drug De-addiction Centre at Pune by Shirish Beri are Critically Regionalist projects that were designed by eminent architects according to the humane needs and requirements of its users.

The various projects that were selected for in-depth analysis of the study were based on a variety of building scales and programs and the following principles for a critically regionalist structure.

1. **Context-specific Architecture**: Does the design respect the character of the surroundings in which it is situated? (Yeang, 1987, pp. 12)
2. **Historical Knowledge**: Does the architecture take into account the building traditions of the region? The design should however incorporate historical knowledge only in its essence (Yeang, 1987, pp. 16; Mehrotra, 2011, pp. 122) and should not merely replicate visual elements.
3. **Climate Responsiveness**: Does the architecture of the building respond self-evidently to the climatic conditions at the site where it is situated? The design should benefit from the best climatic conditions and should minimize the dependence on mechanical means such as air-conditioning and artificial lighting for the functioning of the building (Correa, 1983; Yeang, 1987, pp. 57; Henrique, 2013).
4. **Materiality**: Do the project use locally available materials predominantly for the construction? (Henrique, 2013)
5. **Ecology and Landscape**: Does the project minimize the impact of its construction on the ecology of the site and the surroundings? (Yeang, 1987, pp. 29)
6. **Social and Cultural Appropriateness**: Does the architecture of the building respond to the social needs and lifestyle choices of its intended users? (Lefaivre and Tzonis, 2003, pp. 11; Jain, 2000)
7. **Technology**: Does the design sustainably adopt modern technology to benefit the building program? (Lefaivre and Tzonis, 2003, pp. 37; Yeang, 1987, pp. 28)

After reviewing the above scholarships, the systematic mode of qualitative research was adopted and conducted through participant observations, field notes, informal surveys and conversations with the users, photographs, and graphical sketches

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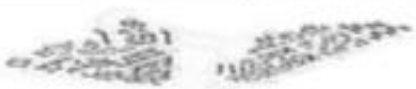
whereby the respondents expressed their deep-seated thoughts. The interaction involved how users experienced and utilized the spaces in their respective projects. The responses varied from the physical comfort of being in a space to the feelings one experiences psychologically within the space, with the satisfaction of being in an interactive community of one's fellow mates that catered to their social needs. The respondents for the surveys were all the users utilizing the spaces of a project with a diverse range of backgrounds, ranging from, doctors, counselors, patients, working staff members, household residents, students, etc.

After the preceding study, it was quite evident that the satisfaction of a user depends on its physical, psychological, perceptual, and social needs. Hence the selected critically regionalist projects are analyzed based on these parameters. An in-depth study of the spaces from macro to micro scale was performed by analyzing extensive project drawings to find suitable co-relationship attributes that respond to the identified factors and are conducive to the activity and usage pattern

4. ANALYSIS, RESULTS AND DISCUSSION

Table 1: Selected Projects

Project Name	Project Details	Site Plan
Belapur Housing		
CIDCO Housing		
Nehrugram Church		
Mukteshwar Temple		
CIDCA		

Source: Author.

4.1 Factors Affecting Human Comfort

4.1.1 *Physical Factors*

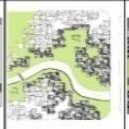
As India predominantly experiences a hot climate, the recurring theme in its architecture is the seeking of space in the shade (Correa, 2012). The physical comfort of a user depends on the climatic comfort of spaces having pleasant indoors and outdoors with the convenience of accessibility to those spaces. Especially in the Indian tropical climate, heat, sunshine, rain, and wind must be managed efficiently according to the region's specific conditions (Gulati, 2020). This includes strategically located water bodies, terrain, landscaping, mutual shading of pathways, etc. Convenience includes gradual transitions from outdoor to indoor spaces and from the largest to the most intimate space of the project. Clear demarcation of vehicular and pedestrian pathways with adequate parking spaces also contributes to the comfort of the users.

Critical regionalism holds value in vernacular architecture where it focuses on built forms organized around courtyards, terraces, and verandahs to offer a microclimate well protected from the sun (Sanyam Bahga, 2020). Unlike in the west, where buildings are akin to closed glass boxes, the transition in traditional Indian buildings between indoors and outdoors has been enormous, where spaces spill out in a variety of open and semi-open areas before making you feel outdoors (Sanyam Bahga, 2020). Another physical and perceptual attribute of traditional architecture was the use of chajjas, chabutras, and other fenestration elements to protect from heat and rain while also giving character to their buildings.

Analysis of the physical attributes of the selected projects (Table 2) reveals that all the five projects are planned considering and to utilize the climatic factors as an asset to the project. The hierarchy and orientation of courtyards in Belapur Housing

are designed to accommodate the winds and give it a desired velocity gradually from the largest courtyard to the smallest by considering the venturi effect of the wind movement. The sizes and proportions of courtyards with the built form are such that they offer micro shading and interaction at various levels within the users. Convenience in this project is demarcated with vehicular access only through the periphery, making the campus completely pedestrianized.

Table 2: Physical Factors

Project Name	Climate	Form	Built Vs Open	Accessibility
Belapur Housing Mumbai Charles Correa				
CIDCO Housing Mumbai Raj Rewal				
Salvacao Church Mumbai Charles Correa				
Muktangan Centre Pune Shirish Beri				
CDSA Pune Cristopher Benninger				

Source: Author.

CIDCO Housing uses various climate control techniques for different clusters. It includes the formation of courtyards with built blocks arranged on its periphery which caters to the light and ventilation requirement. Vehicular access is provided on the periphery of the cluster and pedestrian shaded allies cut across the cluster between various building blocks. This favors safe and interactive pedestrian networks with a hierarchy of open spaces along with the network from overall larger public space to doorstep interaction.

The Salvacao church consists of a series of interlocking courtyards and covered spaces which allows any of the functions to take place indoors or outdoors depending on the weather (Sanyam Bahga, 2018). This favors the inflow of wind and natural light through the openings and their surrounding spaces. The shell roofs are ventilated at the top, thus setting up continuous convection currents of air (Sanyam Bahga, 2018).

Critical regionalism holds the promise of fulfilling one's psychological needs to make one's stay at healthcare facilities less unpleasant at Muktangan Drug de-addiction Centre (Sanyam Bahga, 2018). A balance was struck between the sense of freedom and disciplinary control (Beri, 2000). The design unifying transparency becomes expressive of this freedom and increases the physical and visual interaction, thereby reducing the isolated alienated feeling (Beri, 2000).

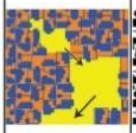
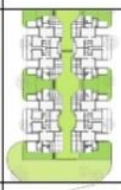
Even the main entrance is transparent. The transparency, the cutouts, the terraced balconies, and the seating, encourage the patients to open up (Beri, 2000). The small-enclosed landscaped amphitheater breathes light and joy in the building; it binds the various functions together, creating a much-needed 'sense of belonging' (Beri, 2000).

CDSA, located on a perched hill terrace, is designed centrally along with the idea of achieving wind movement throughout the campus (Table 2). The dormitories are arranged in a staggered manner to achieve maximum daylighting through roofs and windows. Openings on north and south facades with adequate overhangs take care of the climatic requirement. The campus is held together by a system of courtyards, stone walls, stone stairs, and paved pathways (Beninnger, 1994). The campus is completely pedestrianized with vehicular movement terminating at its entrance itself.

4.1.2 *Psychological Factors*

The psychological needs of the users involve domains of privacy, safety, and territoriality. Privacy involves physical isolation between public and private spaces in neighborhood environments. It involves an important component of emotional and physical well-being despite the social needs of oneself. Hence there emerges a need for well-distinguished public and private realms. Safety in any built environment is a prerequisite. It mainly involves visual connections for watching out for each other, the protection of elders and children from the vehicular networks and other hazards, while simultaneously enjoying the pedestrian movement throughout the campus (Gulati, 2020). A balance between ease of surveillance and maintaining privacy must be achieved in a human-centric design.

Table 3: Psychological Factors

Project Name	Public, Semi-Public & Private	Spatial Hierarchy	Spatial Enclosure
Belapur Housing Mumbai Charles Correa			
CIDCO Housing Mumbai Raj Rewal			
Salvacao Church Mumbai Charles Correa			
Muktangan Centre Pune Shirish Beri			
CDSA Pune Cristopher Benninger			

Source: Author.

Analysis of the psychological attributes of the given projects (Table 3) reveals different results as the psychological layer of any project is defined by the function it carries. Belapur and CIDCO Housing gradually descend from public to private realms in residential environments. The hierarchy of open spaces descends from site to cluster to unit level in Belapur Housing, whereas CIDCO Housing focuses more on human-scaled public spaces from the doorstep, to building, to alley, and finally the cluster level. Both the projects have pedestrianized pathways that make it safe for residents. Salvacao Church being in an open public space has its public realm near the road access and gradually converges into a semi-public area as it moves to its interiors. Whereas, the Muktangan center comes with a set of different requirements. It involves freedom within the campus but disciplinary control with high compound walls and restricted access. Hence, the project utilizes a central open-air amphitheater, that brings in transparency within the hospital environment and gives a sense of freedom within the campus. It gives a much-needed sense of identity by binding various functions together. The most important aspect creating the feeling of intimacy, protection, and security, as well as the definition of the residents' territorial boundary,

is the degree of spatial enclosure and openness. It should neither be completely loose nor rigidly enclosed (Gulati, 2020) An optimum level of intimacy is observed in all the projects where the ratio of most intimate enclosure varies from 0.5 to 2, where the lower ratio is observed in more privatized areas such as housing, and ratios up to 2 are observed in public spaces such as Muktangan Centre.

The following is a survey conducted among the hospital users reveals that the majority of the people enjoy being in an open atmosphere and in a structure that enjoys natural light and ventilation that keeps them happy. It provides a soothing environment to its users. Hence, Critical regionalism holds the promise of fulfilling one's psychological needs to make one's stay at healthcare facilities less unpleasant (Sanyam Bahga, 2018).

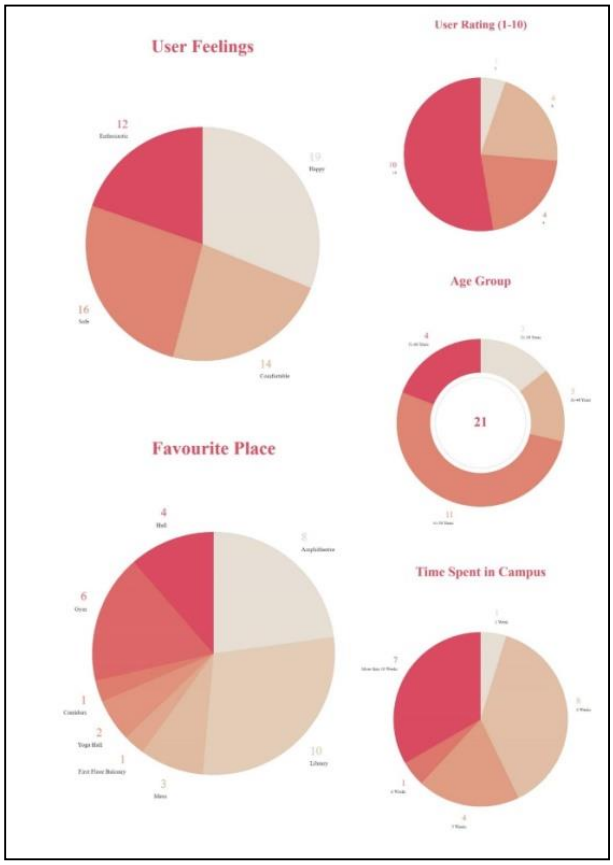


Figure 1: Survey at Muktangan Centre, Pune

Source: Author.

CDSA shows strict demarcation in public and private areas that is, with academic and dormitory spaces. Dorms are also located away from the main access to provide safety to the students. The long transition between the two blocks gives students their required mental and physical space from the academic environment.

4.1.3 *Perceptual Factors*

The prime perceptual need of residents from their living environment is individuality or distinct identity within the prototype mass of dwelling units (Gulati, 2020). Contemporary housing with similarly designed spaces and dwelling units should have a provision for shaping residents' individual and group spaces based on their aspirations and requirements (Gulati, 2020). In this manner, residents can feel satisfaction and pride (Gulati, 2020).

Belapur Incremental housing designed by Correa allows people to expand/customize their houses according to their own needs and requirements. This gives each house a distinct identity and an overall character to the Housing Scheme. This enables users to associate with their homes perceptually, strengthens their idea of homecoming, and also values their aspirations. The following shows the customizations done in Belapur housing.

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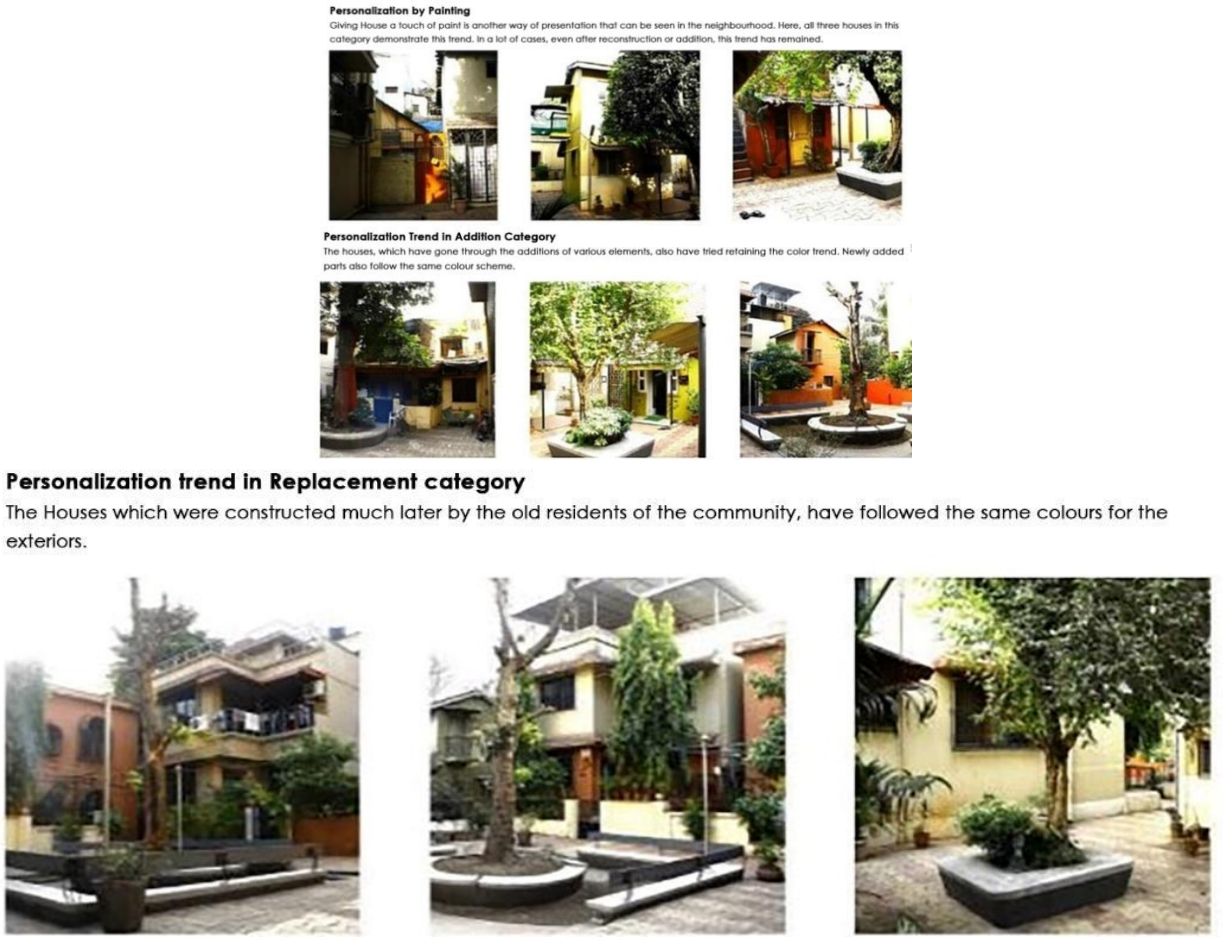

Figure 2: Personalization at Belapur Housing (Modi, 2016)

Additionally, visual stimulation and comfort derived from the physical setting is major contributing factor to the sensory comfort of inhabitants (Gulati, 2020). The need for spaces, which arouse curiosity and a sense of anticipation, can be satisfied by creating interesting volumes, avoiding monotony in building blocks and street facades, negotiating with the sky and ground effects, and varying visual experiences within a residential environment (Gulati, 2020).

At CIDCO Housing, different housing clusters house different area requirements, and hence each has a distinct formation. This gives each cluster a distinct identity, at the same time keeping the overall character of the scheme the same by use of jali walls, gateways, pedestrian allies, etc. In projects involving non-residential environments, overall identity becomes of utmost importance, in comparison to individual identity. Here, the aim is to make the user feel the entire space as its distinctive identity, rather than an individual identity of a particular space. For instance, The Salvacao Church has its visual identity emerging from the shell roofs it has for outflow of hot air; Muktangan Centre has strong and solid compound walls and has a visual sense of feeling natural using stone as the building material; CDSA as a project resembles its context of western ghats by sparsely placing building blocks, unobstructed views, and campus made of stone masonry.

5. INFERENCE/CONCLUSION

The above readings establish the fact that human-centric spaces are significant to cater to the overall comfort of its users. The need for such environments is increasing with growing populations and mass migratory patterns. Although traditional Indian architecture is seen as effective in producing such environments, most of the contemporary works lack these, due to widespread negligence, the pressure of the growing population, and lack of concern by builders and architects. It is evident from the above five analyzed examples that the comfort of users in space requires physical, psychological, and perceptual needs to be catered. This analysis leads to the following Conclusions, Recommendations & Guidelines of a successful human-centric project:

5.1 Overall Factors

- Human-centric environments are not only about functional and habitable built spaces but also their response to transitional and open spaces which play a larger role in the comfort of users.
- Factors affecting the comfort of users in a human-centric environment range from physical, psychological, perceptual & social needs of its users.

5.2 Physical Factors

- The Physical factors that affect human comfort range from macro to micro levels.
- The macro-level factors include overall form and grain of built form that is conducive to natural light and ventilation patterns.
- The availability of well-distributed and integrated open spaces with convenience for discharge of various activities affects physical comfort.
- Planning built forms punctured by open spaces would create active and passive modes of interaction that would meet the social needs of the inhabitants too.
- Micro-level physical comfort includes a smooth transition from one space to another, mutual shading amongst built forms, openings designed for physical and visual comfort, and pedestrian-friendly spaces amongst others.

5.3 Psychological Factors

- Psychological attributes depend on privacy, safety, and territoriality. Strict demarcation of vehicular and pedestrian networks and a balance between ease of surveillance and privacy must be maintained.
- Ratios of the height of built forms to the minimum width of open spaces vary from 0.5 to 2 depending upon the degree of privacy a project requires according to its program.
- Exposure to greens and the hierarchy of open spaces helps in visually watching out for each other and improves the psychological comfort of the users.

5.4 Perceptual Factors

- Perceptual needs revolve around giving a sense of identity and visual pleasure to its users by avoiding monotonous building blocks.
- Creating interesting volumes, street facades, and varying visual experiences which arouse curiosity and a sense of anticipation among users serves their perceptual needs.

5.5 Inference

- Despite being located in varied contexts; all the projects effectively respond to the diverse climates respecting their programs.
- Clear transition from public to private areas is observed according to the function of the project, along with strict demarcation of vehicular and pedestrian pathways to ensure the safety of its users in all the analyzed projects.
- Although all the analyzed projects have different spatial organizations, they have effective unity, connections, transitions, and hierarchies. Hierarchical networks effectively respond to a strong sense of privacy, safety, and territoriality.
- Built mass and character is visually interesting in the projects ranging from the evident shell roofs of Salvacao church to the central enclosed Amphitheatre of the Muktangan Centre with visually strong compound walls.
- This study informs about the tools and strategies used by well-known architects to create habitable human-centered environments in the Indian context.

The above-mentioned recommendations reiterate the fact and emphasize the role of an architect as, not only one who designs the external skins and facades of a building but as a designer who understands the various needs and requirements of its users qualitatively and strives to achieve an overall sense of comfort and satisfaction among its users humanly.

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Louis Kahn's Silence and Light

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ABSTRACT: Louis Isadore Kahn (American Architect) evolved the concept of 'Silence and Light' to articulate and express himself. The concept is born out of Kahn's search for the eternal and the ultimate. The literature review revealed that Silence and Light find expressions in Kahn's works at various layers; physical, psychological, and metaphysical. Every theoretical work on Kahn's Silence and Light dives in each of these layers to various depths. In the works of literature studied, anyone/two of these layers has been touched but the other/s are absent. But none of the theoretical work is exhaustive in understanding this realm of Silence and Light. As a result, getting a complete and holistic view of Kahn's Silence and Light becomes difficult. This Research paper interpreted converging and diverging expressions in the theoretical literature of Kahn's 'Silence and Light' to gain a consistent and holistic understanding.

Keywords: *Louis Kahn, Silence, Light, Measurable, Unmeasurable, Presence.*

1. INTRODUCTION

Louis Isadore Kahn (February 1901 – March 1974) was a celebrated American architect [Figure 1]. He practiced architecture in a way that was beyond any style. His architecture was experienced as timeless. This paper is one of the attempts to tap into the inexhaustive realm which Kahn drew from. The concepts of Kahn and the way he attempted to express it through a very conscious and refined choice of words reached its pinnacle in his concept of 'Silence and Light'. There was a yearning to explore this realm of Kahn's and this research paper became a means to do so. A good way to do so would have been to go and visit Kahn's works like The Indian Institute of Management in Ahmedabad, or The National Assembly Complex in Dhaka, Bangladesh [Figure 2]experience the spaces and witness how these works of architecture traverse the distance from Silence to Light. Though this could not be possible, as in the year 2020–21 the world witnessed the COVID-19 pandemic. This brought in physical restrictions of travel and reaching out to people or resources. Though a first-hand experience of 'Silence and Light' was missing, there has been numerous theoretical literature available that made it possible to access this realm sitting at home. The paper thus investigates how theoretical literature understands Louis Kahn's 'Silence and Light' and how it manifests in his architectural works. The research is desk research that lacks personal exposure and empirical data.

The research process began with finding resources that explored the concept of Silence and Light by Kahn. This was followed by a thorough reading of the literature. The words 'Silence' and 'Light' have found varied expressions by authors. Thus, the literature had to be read critically. One had to understand the context of the literature and also get into the author's mind through the writing to get the meaning behind the words written. The readings revealed that each paper touched the physical, psychological, emotional, and metaphysical layers of the concept of 'Silence and Light' with different intensities. Each literature majorly focused on only one or a couple of these layers and missed the other(s). Thus, a holistic understanding could not be gained, unless all layers are understood in totality. The paper thus attempts to link these various understandings to gain a better insight.

Figure 1: Louis Kahn Explaining Silence at his Lecture at the ETH Zurich

Source: https://www.archdaily.com/362554/Light-matters-louis-kahn-and-the-power-of-shadow/516f12e1b3fc4b8f69000176-Light-matters-louis-kahn-and-the-power-of-shadow-photo

Figure 2: The National Assembly Complex, Bangladesh

Source: https://www.archdaily.com/83071/ad-classics-national-assembly-building-of-bangladesh-louis-kahn/5037e5b928ba0d599b000319-ad-classics-national-assembly-building-of-bangladesh-louis-kahn-photo?next_project=no

2. LITERATURE REVIEW

Authors have various methodologies to understand Louis Kahn and his concepts. John Lobell in his book initially states the concept in Louis Kahn's own words and then attempts to strengthen it by his explanations and discussing some of Louis Kahn's buildings. He draws similarities between what Louis Kahn says when he talks about Silence and when Lao Tzu (Chinese philosopher) talks about the nameless and when Martin Heidegger (contemporary philosopher) talks about the Being. Kahn talked about exploring what lies between Silence and Light which can be related to T.S. Elliot's writing about what lies between the idea and reality.

Frederick W. Esenwein in his paper 'The Organic Imagination and Louis Kahn' tries to investigate such expressions in Europe and America. The author suggested that Kahn's expression evolved out of them. Expressions similar to 'Silence and Light' are found in Romanticism and American Transcendentalism.

In her thesis 'Within the text of Kahn' Annie Pedret rightly states that Kahn's writings are cryptic and difficult to understand. A probable reason may be because Kahn always wrote and lectured not to explain someone something but as a conversation with himself. It was his way of making a deeper inquiry. In this process, as Kahn probed into the emotional and metaphysical layers, he felt that the existing words were not capable of conveying those layers. He redefined words to suit them for his purpose. For example, the word 'form' didn't mean the physical shape but meant the very essence of something. Further on he also invented his own words like lightless and darkless in an attempt to express himself. Pedret's Thesis traced the continuous transformation of a concept. It showed how its meaning had a remarkable consistency through the way they were expressed by him was different.

Similarly, different literature concerning Silence and Light that were studied for this research may seem different or even contradictory at first glance but could be having the same meaning but expressed by authors in their ways. Alexandra Saraiva in her paper 'Between the Shadow and The Geometry of Light' interprets that Silence translates in spaces through the qualities of simplicity and neutrality. Ornamentation and clarity are absent in the spaces. This contradicts her understanding of Silence being something that does not exist.

Noelia Galván Desvaux and Antonio Álvaro Tordesillas in the paper 'Louis Khan, The Beginning of Architecture. Notes on Silence and Light.' explore the concept and its journey through Louis Kahn's notes and his sketches explaining the concept. The paper presents a very pure understanding of the concept as it is derived from primary sources, i.e., notes and sketches of Kahn. But the paper has no mention of the emotional, mental or physical layers, as to how they manifest in his projects.

There was no paper or book studied which explained all the layers to an equal depth. The connections between the layers and how the concept translates into a work of architecture through these layers have also not been holistically explored.

3. METHODOLOGY

The method adopted for this paper was a theoretical review through content analysis. The research attempted to investigate how theoretical literature understands Louis Kahn's 'Silence and Light' and attempted to gain a holistic understanding of it.

The first step in the research process was to select resources that talk about Louis Kahn's Silence and Light. All the resources have been collected through an online platform. Key Resources which give an insight into Kahn's way of thinking, working, and expressing were also included to understand the language of Kahn as his language is often conceived as cryptic initially.

The resources studies included thesis papers, journal articles, reports, books, videos, and documentaries. Out of these resources, 12 of them had a mention of 'Silence and Light' and attempted to explore it. 1 out of these 12 were republished lectures of Kahn and 2 of them just touched the concept and lacked sufficient quantum and quality for further research. Thus finally 9 (5 Research/Thesis papers, 3 books, and 1 Documentary Film) were selected and further studied for this research.

4. RESULTS AND DISCUSSION

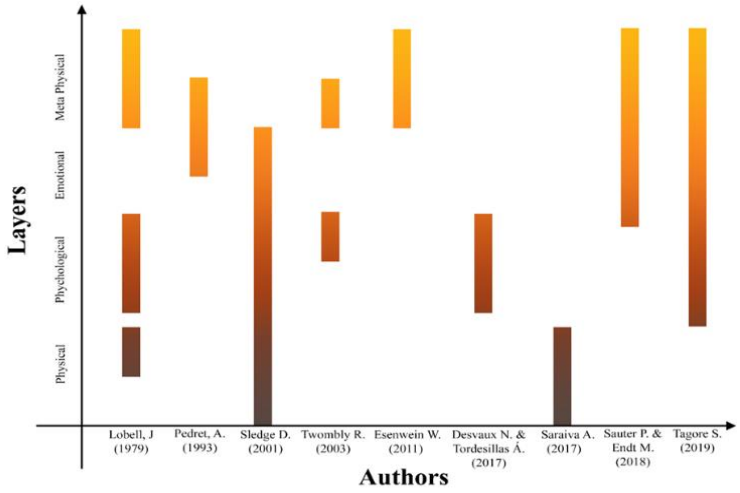

Chart 1: The Extent and the Layers Investigated and Expressed by the Authors

Source: Author.

3.1 Metaphysical

Some words like unmeasurable and measurable are the qualities of the aspect of Silence and Light but are used sometimes in contexts in which they mean Silence and Light. Other such pairs like Law and Rule, Belief and Means, Existence and Presence, White Light and Black Shadow, Lightless and Darkless, Servant and Served, Not being and Being, Intuition and Knowledge, Spirit and Brain can also be found.

Parallelscan be drawn in various cultures belonging to various times. One such parallel of Silence and Light can be drawn in the Hindu and Yogic culture as well. The Indian yogic lores talk elaborately about Shiva and Shakti as the masculine and the feminine dimensions. Shiva means that "which is not", can be seen as Silence, the non-existent, and Shakti, the existent, the expression of the non-existent can be seen as Light. All of these parallels are different in expressions depending on the times, the languages used, and the intent but they seem to talk about the very same thing. One of the expressions of this can be Louis Kahn's Silence and Light.

As seen in Table 1 Silence is often stated as something which does not exist yet. Whereas Kahn used the word Existent for Silence and Presence for Light. This seems like a contradiction. One needs to understand the subtle difference between the Existent and the Presence. Existence means something which exists. You might perceive or might not perceive it, irrespective of that something exists. It is there. When you perceive it, the same thing now has a presence, due to it being perceived. Now it is there and you know that it is there. This is how Kahn expressed the terms.

When Silence is said as something which does not exist, it refers to something not being existent for a singular, or one person. Silence is that which is not perceived yet and so does not exist in the experience of one but in reality, it exists.

When Silence is perceived, it has a presence that is being referred to as Light by Kahn. Thus, Silence is, but is not and Light is not, but is. Silence does not mean physical void or emptiness. Silence is the will to be to express ([Figure 3 and 4). To

express means to bring it to Light. Man is an instrument to take things from Silence to Light. He has access to both Silence and Light. Architecture is bringing spaces to Light. Spaces are already there, they exist, they are in the realm of Silence but when an architect encloses it in a roof and walls, he gives the space a presence and it is now in the realm of Light.

3.2 Emotional, Psychological and Physical

Beyond Silence lies what Kahn called Order. It is the beginning of the will to be to express. If we want to make a wall out of brick. It means we place the brick in a certain pattern, join them with mortar, etc. Looking closely this is an act of bringing a wall from Silence and Light i.e., bringing the wall into existence. But in the process of doing so if an architect doesn't know the order of the brick, what the brick wants to be, why it wants to be, and express; then the wall does not connect back to Silence. It is not in alignment with its *will to be*, its order. Any project Kahn worked on, he tried to feel the order of the project which he called the institutions of man or the form. Any decision taken for that project, he asked it the order of it and thus the decisions were. Everything was answerable to the form.

For example, in the open plaza at the Salk Institute [Figure 5] designed by Kahn, one can observe water emerging from underground and flowing towards the Pacific Ocean. One can feel a scared quality and an ancient complex that alludes both to birth and death and has been called a feeling of Silence by authors. This Silence is a feeling of stillness and calmness and should not be confused with the concept of Silence and Light being discussed. Kahn says that a building must emerge from the immeasurable come to the measurable and go back to the immeasurable.

Thus, when a project draws from Silence, answering the order, the result could be something very vibrant and very active, and full of life. Yet it will have the qualities of Silence. The Silence here is not the absence of sound.

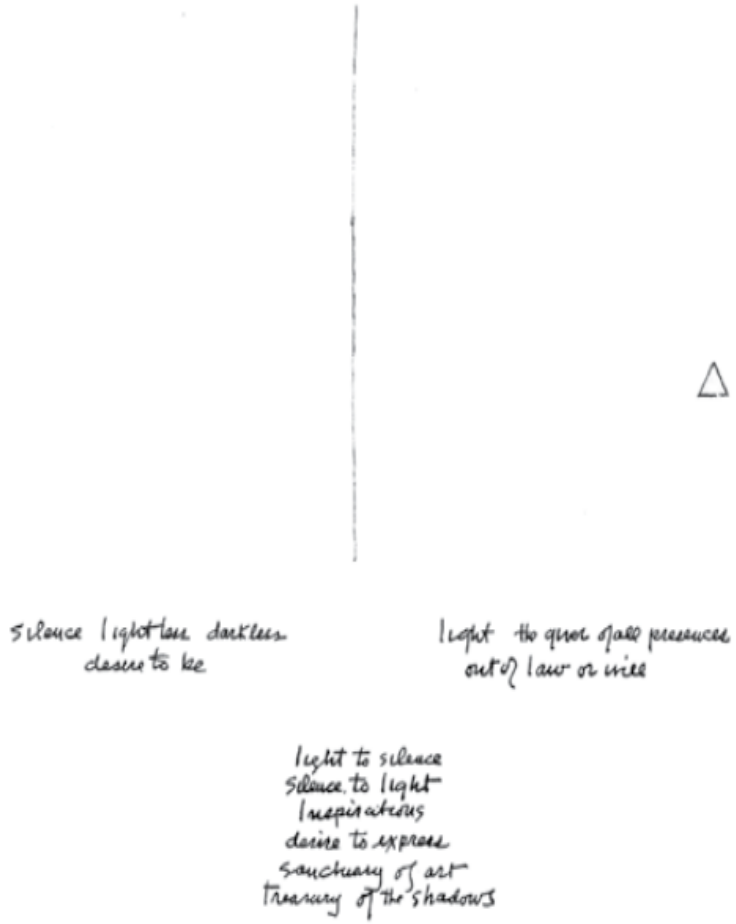

Figure 3: Louis Kahn's Notes on Silence and Light

Source: Noelia Galván Desvaux, A.Á. (n.d.). Louis Kahn, the Beginning of Architecture. Notes on Silence and Light. diségno.

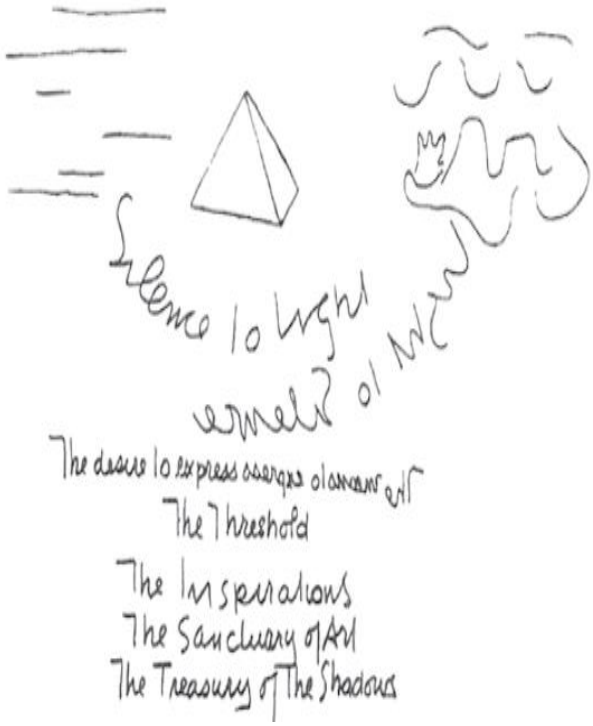

Figure 4: Louis Kahn's Sketch on Silence and Light

Source: Noelia Galván Desvaux, A.Á. (n.d.). Louis Kahn, the Beginning of Architecture. Notes on Silence and Light. diségno.

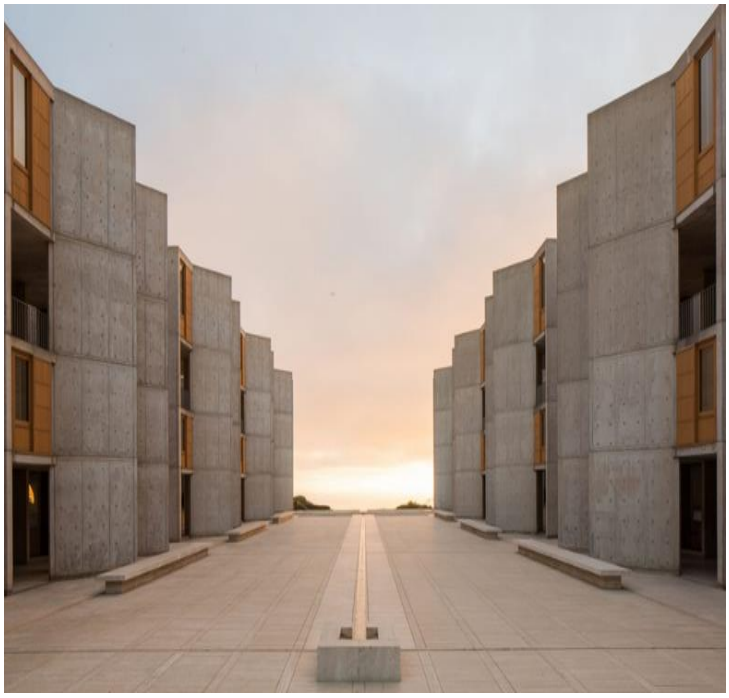

Figure 5: The Salk Institute of Biological Studies

Source: https://www.dezeen.com/2017/07/06/salk-institute-restoration-biological-studies-louis-khan-restoration-wje-getty-conservation-institute/

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Table 1: Various Meanings Associated with Silence

Silence	*Author/s*
The feeling you get when you pass the pyramids and they want to tell you what was the force that caused them to be made	Annie Pedret
Will to be to express, the notion of expression and being. A wish of expression present in the collective unconscious	Annie Pedret, Noelia Desvaux, Antonio Tordesillas, John Lobell
The incredible creative urge that allowed Gingko trees in Hiroshima to bloom forth after total destruction	Florian Sauter
The words which have not yet been spoken and action which has not yet taken place	Annie Pedret
A void, not a place but the desire of every person to create	Robert Twombly
Pure and immaterial will for existence	Florian Sauter
What does not exist/Which is not yet	Alexandra Saraiva, John Lobell
Without weight, it is immaterial.	Annie Pedret
Without a name/nameless	Annie Pedret, John Lobell
Without words/wordless	Annie Pedret, Florian Sauter
The source of new need	John Lobell
Soundless murmur	Florian Sauter
Unluminous Light	Florian Sauter
Commonness	Annie Pedret, Florian Sauter
Joy	Annie Pedret

Source: Author.

Table 2: Various Meanings Associated with Light

Light	*Author/s*
A means of expression by which nature becomes present in architecture	Noelia Desvaux, Antonio Tordesillas
By will, by law, the measure of things already made	John Lobell
What does exist/Which is	Alexandra Saraiva, John Lobell
The source of all being	Florian Sauter
Giver of all presences	Annie Pedret, Robert Twombly, John Lobell
What is possible	Annie Pedret
Light luminous	Florian Sauter
The named	John Lobell

Source: Author.

5. CONCLUSION

The research paper attempted to deepen the understanding of 'Silence and Light' and how it manifests in architecture, through theoretical resources to a certain degree of success. This paper leads to a revelation that the understandings by the authors which might seem to be different or even divergent at first glance are just different expressions of the same understanding. The paper also suggests rectification in some pieces of literature which have misunderstood Kahn's Silence as the mere absence of sound and/or Light as physical illuminance. Silence is something that does not exist yet and has the will to exist to be and to express. The realm of Silence is the source of everything. The job of the architect is to bring the Silence to Light, the non-existent yet, to presence.

The paper acknowledges the contribution of Kahn in interpreting how the intangible (Silence) manifests in the tangible (Light). The framework of physical to metaphysical evolved for the purpose of this paper may be utilized for analyzing other such interpretations.

As Louis Kahn said, a project comes from the unmeasurable, i.e., Silence; is put to measurable means by the architect, i.e., project is brought to Light, presence. An architect draws from the threshold of Silence and Light. The Threshold from Silence to Light is where intuition, realization, and feelings lie. Employing these, an architect brings a project to Light. An architect is a mere instrument to bring it from Silence into Light. Perception of architecture and meaning is contextual, subject to change, and also depends on certain parameters that inform or make the perception of built form. It also means that architecture need not be so straight-jacketed and can incorporate an enormous range of perceptions signifying that the potential of architectural thinking and perception can be more nuanced and profound.

The understanding gained in the paper is not exhaustive but just a drop in the ocean of the in exhaustive realm which Kahn tried to express through his concept of 'Silence and Light'.

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Psychological Influence of Architectural Design

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ABSTRACT: Human psychology is influenced by the built environment in both direct and indirect ways. The human psychological connection to their environment comes from both tangible and intangible elements that stimulate the senses. The purpose of this research is to highlight the significance of the psychological link between the human psyche and the environment. The human mind is always changing due to emotions and feelings that it experiences as a result of interactions or situations in its environment. Architectural features such as form, volume, colours, light, elicit varied emotions. The research aims to use these variables to simulate the human mind for an improved positive response to its surroundings. Urban life can affect mental and physical health in a negative way. The research moves forward by highlighting how wellbeing is important in one's life. Different architectural typologies and types of experiences are analysed to study where this experience can be heightened.

Keywords: *Architectural Psychology, Mental Wellness, Wellbeing, Emotions, Experiences, Therapy.*

1. INTRODUCTION

Architecture is an art and science of building design. It can control the way people live, the way they think, and the way they feel and vice versa. Psychology is the study of human experience and behaviour. Different buildings generate different psychological feelings. When both of these words are combined, the phrase Architectural Psychology is created. The buildings we occupy have a significant impact on us. The impact of our physical surroundings on us is frequently unrecognised and occurs on an unconscious level. However, almost every aspect of our psychology, whether we're happy, whether we're depressed, whether we're productive or lazy, whether we're creative or dull, is massively impacted by the architecture around us (Speck, 2021). Buildings influence one's mood. When a person enters a built environment, they engage with it, which causes a reaction that imprints a certain experience in the individual's mind. Thus, this relationship between the person and the built environment is of great importance. In the past few years, urban architects have not paid as much attention to the potential cognitive effects of their creation on occupants. The urge to design something unique somewhere overrides the consideration of how it might affect the behaviour of the people who will use it. Therefore, it is important to address this subject and understand how different built environments can have a varied psychological influence on the user's mind.

1.1 How living in a busy city can mess with one's mental health?

Studies show that the hustle and bustle of urban life can take a toll on our physical and mental health. According to psychiatrists, urban living gives the brain a workout, which alters how we cope with stress, that can make us more vulnerable to mental health concerns, such as depression, anxiety, and substance use (Fraga, 2019). During the research, it was realised that people in India don't take mental health seriously. These are a few reasons:

(a) **Judgement and Fear**: In a society that does not consider mental health an issue, coming forward and speaking about it takes a lot of courage, as you will be judged, and the fear of being abandoned is always there (Sabharwal, 2019).
(b) **Lack of Empathy**: People do not engage in issues related to mental health, so they lack empathy. To empathise, you need to understand, and to understand, we need to talk and make people aware.
(c) **Stigma**: Statistics show that India might house the highest population of people suffering from depression and anxiety in the world. The government needs to provide better mental healthcare facilities, and remove the stigma associated with it (Sabharwal, 2019).
(d) **Sensitivity and Education:** We must educate and sensitise people to the signs and symptoms of mental illness, as well as normalise the idea of getting help.
(e) **Expensive Treatment**: The therapy process is quite costly for those who are conscious and seeking help. To get treatment, one needs a lot of time and money to buy medication and go to therapy.

1.2 Existing Scenario

The Mental Healthcare Act solely focuses on providing care for people with mental illnesses while they are in hospitals, but it ignores their growth and treatment in the community, as well as their participation in social settings. The Act justifies the treatment of patients by making provisions for their long-term care, but it fails to recognise any rights for patients who are treated on a daily basis in society and other settings such as offices, workplaces, educational institutions, as well as rural and semi-urban areas, without making provisions and taking steps to rectify so that their livelihood is not jeopardised. The study would like to focus on providing therapy to people for their mental health, including community participation. It would function independently but would focus on an integrated approach in achieving the complete wellbeing of its users.

1.3 Architecture for Well Being

This is the practice of architecture that relies on the art and science of designing built environments with socially conscious systems and materials to promote the harmonious balance between physical, emotional, cognitive and spiritual wellbeing while regenerating the natural environment. Human health, wellbeing and comfort are key design considerations that augment a foundation rooted in sustainable and regenerative design practices (DePuy). Architecture and art have always possessed silent therapeutic qualities. Its implications in different art forms, the quality of spaces, aesthetics, and the mere comfort certain spaces provide are proof of its existence. Architectural qualities when used in the right setting, could prove beneficial for physical and spiritual healing. Treating these peculiar qualities to alter the human mind for an improved response through its surroundings is what this research drives to achieve. The aim of the study is to analyze the spatial environment for users according to their needs, for mental and physical wellbeing. The intent is to use a sensory and emotional approach towards designing spaces and use different architectural means to create experiences from the built environment.

2. LITERATURE REVIEW

In an increasingly digital era that has a tendency to create a sense of isolation, Architects are recognizing the intimate relationship an individual has with his or her immediate physical surroundings (Suri, 2017). People differ with respect to their emotional responses towards a given building. We need to explain how we can design architecture that is sensitive to the needs of people. What architectural tools do we need to accomplish this? And, more importantly, how can we build certain environments that trigger specific emotions? The first step is to understand how people perceive architecture through their senses. Following that, stimuli, or architectural atmospheres that influence one's emotional condition are understood. Architectural means like the use of materials, form and light will be discussed further.

(a) **Senses:** Our senses can be suitably modelled by an architect for developing proper effects of stress relief. Sensorial architecture can provide an experience for people. In order to understand this we can take an example of The Jewish Museum in Berlin, where spaces are designed to express feelings of absence, emptiness, and invisibility, the expressions of disappearance of the Jewish Culture.

(b) **Expression of Material:** The surface nature of materials is linked to impressions of hardness and softness, heaviness and lightness. This selection of materials can make a building appear heavier or lighter than it is. For example an exposed concrete surface looks bulkier as compared to a space made of bamboo.

(c) **Expression of Form:** The way a material is treated, arranged, and shaped has an impact on our perception of it, for example the volume of a space.

(d) **Mass or Void:** We mainly work with solids, but we can also work with empty space, such as the void between solids, and consider the formation of those spaces to be the true purpose of architecture.

(e) **Scale and Proportion:** People are naturally drawn to order. Proper scales and proportions make spaces visually appealing to look at. The golden section, for example, is just one of the architectural orders that might be applied.

(f) **Movement:** Architecture can guide movement or stimulate free movement. "The design of buildings, which must be stationary, should be based on the movement that will flow through them." (Rasmussen, 1962)

(g) **Colour:** Colour is a very powerful means in architecture. The surrounding colours, the level of saturation, and the type of light that falls on it all influence how we see colour.

(h) **Light:** Light and shadow reveal form. Light alone can create the effect of an enclosed space.

(i) **Rhythm:** Rhythm can be described as an alteration of elements or movements over time. We enjoy rhythm in a variety of forms, including music, art, architecture, and even nature.

2.1 Mental Health

Mental health is defined by the WHO as a state of wellbeing in which every individual realises their own potential, can cope with the normal stresses of life, can work productively and fruitfully and is able to make a contribution to their community (Mental Health, 2019). Mental illness is different to mental health. Mental illness includes a range of conditions for which there are standard criteria used to diagnose them, such as depression, anxiety and substance use disorders. A mental illness significantly affects how a person feels, thinks, behaves and interacts with other people (Mental Health, 2019). Good mental health is about living life to your full potential. It's about being socially connected and having fulfilling social relationships. Feeling good about your life; setting goals and being able to make decisions. Here are some attributes that have been found to be associated with good mental health (Mental Health, 2019).

(a) **Looking after your mental health:** It is important to look after one's mental health as it is to look after one's physical health. Developing mental self-care can help one avoid mental health concerns, as well as provide ways to deal with minor issues if they emerge.
(b) **Resilience:** The ability to cope well with adversity and bounce back is referred to as resilience. People who lack resilience may linger on problems and be unable to move on or put things behind them.
(c) **Mindfulness:** Mindfulness is a strategy for bringing one's thoughts back to the present moment. Many of our anxieties stem from reflecting on the past or anticipating the future. So, if one can bring consciousness to the present moment and observe rather than criticise the thoughts, one can lessen tension and anxiety.
(d) **Social wellbeing:** Good mental health is aided by healthy relationships, yet being socially isolated or lacking in supporting relationships can have a negative impact on your mental health.
(e) **Meditation:** This is a practised skill that can help one in managing mental health and also mental illnesses such as anxiety and depression.
(f) **Gratitude:** People who practise gratitude by being grateful for the wonderful things in their lives experience more positive feelings and are happier.
(g) **Stress Management:** Managing stress is important for good mental health. One should relax with whatever helps one to unwind—it may be yoga, stretching or a walk in the woods.
(h) **Cognitive Defusion:** This is a strategy for detaching ourselves from the thoughts, which is useful when one's mind is filled with repeated, negative, or harmful thoughts.

2.2 Mental Healthcare Act 2017

The Mental Healthcare Act (MHCA) passed by the Government in 2017 was seen as an appreciated step in the area of catering to the millions of Indians wanting help. It looks to guard, advance and fulfill the rights of people with mental illness and establish the onus on the State to grant affordable mental healthcare to its citizens. The Mental Healthcare Act, 1987 has been extensively criticized for not acknowledging the rights of a mentally ill person (Wadhawankar, 2020).

3. MATERIAL AND METHODOLOGY

The Research undertakes Qualitative as well as Quantitative Research methods to collect, quantify, assess, examine, analyse and infer the data collected through primary and secondary sources. Different architectural typologies like work, live, play, transit, and healthcare and types of experiences such as mental, physical, spiritual, virtual, sensorial, and emotional are understood and analysed. Different criterias in each of these typologies are taken into consideration, to study where the experience can be heightened.

3.1 Identification of Architectural Typology

The Play/Recreate typology (Table 1) is a suitable option for exploring the spatial quality in terms of experiences - as it is a voluntary activity, people get to choose to go to these places and a large number of people will be able to experience it since the user group changes after a certain period of time.

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Table 1: Identification of Architectural Typology

Typology	*Some Built Forms From the Typology*	*Time Duration that an Individual Spends*	*Voluntary/Involuntary*
Work	Schools, Offices	6–9 hrs daily	Involuntary
Live	House, Hostels	8–10 hrs daily	Involuntary
Plan/Recreate	Swimming Pools, Parks, Spas, Resorts	1–3 hrs weekly OR 1–2 weeks yearly	Voluntary
Transit	Airport, Railway stations, Bus Stops, Taxi, Auto	Few mins to an hour daily OR 1–2 hours every few months	Involuntary
Healthcare	Hospitals, Rehabilitation Centers	A few days to weeks once a year	Involuntary

Source: Author.

3.2 Identification of Types of Experiences

The Mental and Physical experience (Table 2) is a suitable option which can be explored in terms of spatial quality in order to achieve a heightened experience.

Table 2: Identification of Experiences

Spiritual	Spirituality is a combination of human psychology and traditional mysticism, aimed at personal well-being and self-development.
Physical	The physical experience depends on a change in the objects we interact with or in the environment where we are interacting.
Mental	Mental experiences involve intellect, awareness, thought, memories, previous experiences, will, and imagination.
Virtual	If you play video games, then you will be intensely familiar with experiences that are not real which can still feel very much real.
Sensorial	Sensory experiences are any activities that help people learn and develop a greater understanding of the world by using their five senses.
Emotional	Emotional experiences are a subgroup of mental experiences. Emotional experiences are complex and can very much shape the way we perceive an event.

Source: Author.

3.3 Project Identification and Relevance

Within the subject of Mental Health, the topic of interest chosen focuses on promoting Mental Wellness by creating varied spatial designs through the lens of healing architecture that focuses on the qualitative elements identified in the research. The proposed solution would involve different facilities to strictly promote wellness.

3.4 Identification of User Groups

A thorough study for the identification of the best suited user groups was done. People from urban cities usually feel the need to step back from the busyness of day to day life and slow down, relax and unwind in solitude. Therefore this was the target user group that was considered. The users are divided into two categories each being permanent and temporary. Permanent users include the people that will manage everything and provide the experience, whereas temporary users include the people who visit here in order to get an experience.

4. RESULTS AND DISCUSSION

A survey was done in order to get an idea as to what people think about a wellness vacation and how and where they would like to spend their time away from the city. Following are the results and conclusions drawn from the same.

The people that were surveyed mostly fall under the 18–40 age group. These people are mostly the ones that need a break from their daily routine and are willing to go for a wellness vacation. Most of these people think that it is important to take a break from city life (Figure 1) and it is important to be close to peace, calmness and nature (Figure 1). When asked how far they will be willing to travel for this wellness vacation, most of them preferred travelling up to four hours. Many of them would like to spend time near a peaceful place closer to nature while some other suggestions given were historic places, trekking etc.

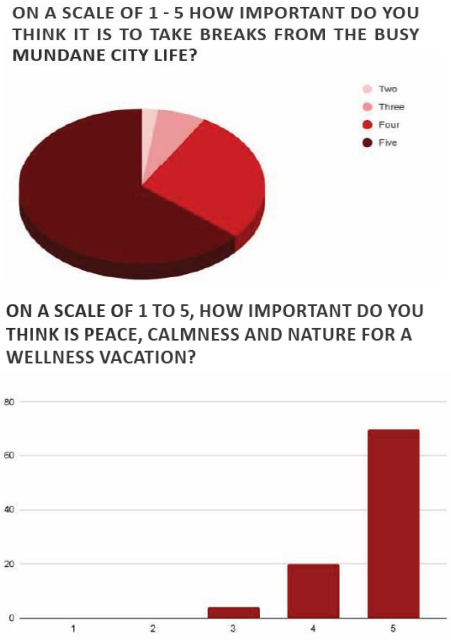

Figure 1: Some Results According to the Survey Conducted

Source: Author.

5. CONCLUSION

The purpose of this research is to highlight the significance of the psychological link between the human psyche and the built environment. We have seen that the emotional response to the built environment is necessary because it creates a psychological relationship between humans and their environment in return, creating a sense of wellbeing. The research reveals the potential for architecture to be used as a major instrument in improving mental health. The work can be further developed by analysing people's response to certain built forms in order to get a clear idea of their experiences.

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I would like to express my sincere gratitude to my thesis guide Ar. Prof. Snehal Gaikwad for her continuous support, patience, motivation, enthusiasm and immense knowledge. Her guidance helped me in all the time of research and writing of this paper. Her constant support and insights shaped my work.

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A Holistic Review Paper on Green Roof as a Step Towards Sustainable Architecture

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ABSTRACT: The planet is experiencing several adverse effects as a result of global warming. These consequences affect not just humans, but also plants and animals. More ideas for sustainable living are required to address these concerns. Adding a green roof to the structures is one of the possibilities.

Green Roof is the solution for up growing urbanism and its various effects, which causes the environment to unhealthy. The green roof provides a sustainable approach to modern cities by providing a healthy environment, amplifying the neighborhood biodiversity and improving the concrete v/s green ratio.

Thus, this research is an attempt to give a holistic overview of Green roof technology that includes the concept of a green roof, benefits and drawbacks for a green roof, ways to construct the green roof, sustainability features and applications of green roof innovations.

Keywords: *Green Roof, Vegetation, Environment, Ecological Balance, Urban Heat Island Effect, Intensive, Extensive.*

1. INTRODUCTION

Global urbanization is increasing at an alarming rate. By 2050 two-thirds of the world will be living in the urban environment where space to people density would be very high and hence ground space is scarce. This all would come in exchange for green space. Therefore 'Green Roof' is one such solution that can overcome insufficient green spaces without taking up more land space. Then why aren't green roof applications mandatory? It seems that people lack awareness of green roofs and its long term benefits or are not confident about its structural applications.

Aim: To give an overview of basic parameters while opting green roof.

Objectives:

- To educate readers on the need and importance of a green roof.
- Clarify the myths and concerns on the green roof. **Scope:** The research covers the types, benefits and applications for green roofs.

Limitations: Analytical research is not part of the article.

2. LITERATURE REVIEW

2.1 What is Green Roof?

A green roof is a layer of vegetation that is planted on top of a waterproofing system on a level or slightly inclined roof. Vegetative or eco-roofs are other names for green roofs. In the city, a green roof acts as a rainwater buffer, filters the air, reduces ambient temperature, regulates interior temperature, saves energy, and encourages biodiversity.

Figure 1: Illustration of Green Roof

Source: ABC, n.d.

2.2 Types of Green Roof

2.2.1 *Extensive Green Roof*

When a lightweight, low-maintenance roof is required, extensive green roofs are used. This is the most common and commonly used variety of green roofs. The extensive roof is not generally accessible to public use. They are mostly given for ecological benefits.

Salient features:

- Low-maintenance ground-cover plants ideal for big flat roof structures and flats.
- 3–6″ of lightweight planting medium
- Appropriate for low-slope residential roofs and retrofits.
- Succulent plants and desert grasses that don't need to be watered after a year.

2.2.2 *Semi-Intensive Green Roof*

In comparison to extensive roofs, semi-intensive roofs have richer, deeper substrate and drainage solutions. This roof requires more water as complex plant mixtures are used as its vegetation. Semi-intensive roofs are generally used within an urban area for aesthetic purposes. It also obviously has economic advantages too. This roof is also accessible to the public. This type requires high maintenance due to the vegetation used.

Salient features:

- Green roofs that are both vast and intense.
- The advantages of a green roof in terms of the environment.
- A varied garden with an affordable upkeep expenditure.

2.2.3 *Intensive Green Roof*

Intensive green roofs are made to duplicate what would be found at ground level in the natural landscape, and in green spaces such as parks or gardens. This system is most hard to maintain. This roof can be accessible for public use as this system is used for that purpose only. Vegetation includes shrubs, trees, grasses it can be native or non-native.

Salient features:

- 8–12 inches of growth medium (or more)
- Rooftop garden with full landscaping.
- Requires constant upkeep, much like an at-grade garden.
- A wide range of plants and trees may be grown (avoid plants with invasive root systems).
- Walkways, fences, and lights are all options, as are parks, playgrounds, and vegetable gardens.

Advantages and Disadvantages

- **Advantages:** Luckett (2009)
- **Insulating Qualities:** Green roofs act as an insulating layer for roofs, it insulates both sound and harsh weather outside.
- **Aesthetic Qualities:** The natural look of the green roof with its ever-changing vegetation gives an aesthetic touch to the structure.
- **Longer Life Span:** The lifespan of the roof increases as the vegetation coat on the roof protects weathering of materials.
- **Air Pollution Control:** CO_2 emissions are reduced when green roofs are used. Furthermore, they filter particulate matter and thus contribute to improved air quality.
- ***Strom Water Attenuation:*** Green roofs reduce the pressure on the sewer systems by absorbing rainwater and letting it drain slowly.
- **Increase Biodiversity:** Green roofs attract birds, insects and provide them with a place for habitation thus increasing the biodiversity of the region.

Disadvantages: Luckett (2009).

- **Cost:** The type of roof, modern techniques, and skilled labour determine the price of a green roof. Green roofs are long-term investments, notwithstanding their high initial cost.
- **Maintenance:** Green roof require regular maintenance and proper care for it to function well.
- **Structural Damage:** As the dead weight on the roof slab grows, stronger structural support is required. It is possible for structural damage to occur because of poor structural stability and maintenance.
- **Leakages:** Leaks are harder to trace and fix.
- **Gardening:** Weed and other unwanted species can grow on the roof can cause damage to the vegetation, thus regular gardening is required.

Construction Requirements

Luckett (2009) refers that while constructing the green roof there and many elements to be taken care of. The Green Roof construction method varies from its type to location it also depends upon the structural framework as well as available technologies. Many other parameters drive the selection of the green roof for a particular structure. Thus for the proper functioning of a green roof, all the factors are to be considered such as Type of Green roof, Roof slope, Location of insulation, Drainage, Detailing accessories, Preparing for the plants, Irrigation etc.

Modular or Built-in Place

Built-in-Place Green Roof: This is a more traditional method of building a green roof assembly, in which components are layered in place over the roof surface.

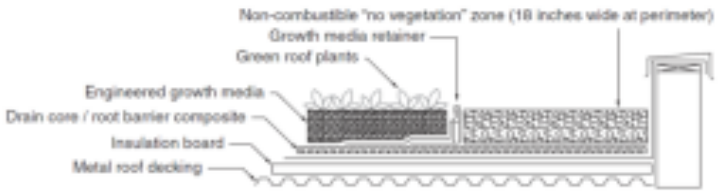

Figure 7: Typical Cross Section Built-in-Place Green Roof

Source: Luckett, K. 2009.

Modular Green Roof: Green roof systems made up of planters that are positioned on the rooftop are known as modular green roofs. The majority of these products comprise engineered soil blends and plants that are suited to the climate of the project. This approach simplifies the design and installation of the green roof because the modules are self-contained and arrive to the project ready to be put on the rooftop.

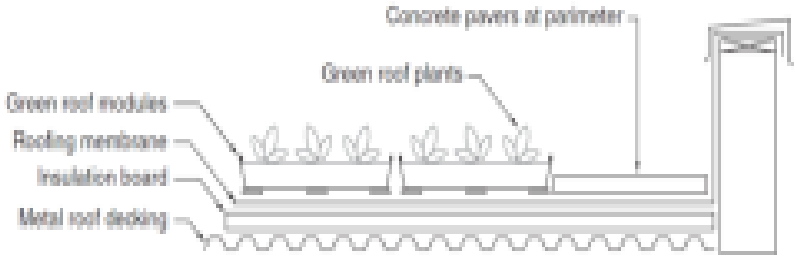

Figure 8: Typical Cross Section Modular Green Roof

Source: Luckett, K. 2009.

Roof Slope

When building a green roof, a slight slope—less than a 1:12 pitch—is advantageous. Because of enhanced drainage, water does not pool and leaks are reduced. The challenges, however, increase as the pitch increases. As rain runs off the roof rather than remaining in the growth media, sufficient moisture for plant development becomes a challenge.

The International Green Roof Association (IGRA) has developed recommendations for sloping surfaces to assist determine how much additional engineering is necessary. According to IGRA, "traditional green roof components may typically be used safely and efficiently on roof slopes up to 10 degrees [about 2:12]." Aside from that, the installation will be very different from a typical green roof and will necessitate a distinct strategy.

Construction Methodology

A green roof generally consists of several components, including, from bottom to top. A waterproofing membrane, an anti-root barrier, a protective layer, a water storage and drainage layer, a filter layer, a substrate (growth medium or soil), and vegetation are all necessary components (plants).

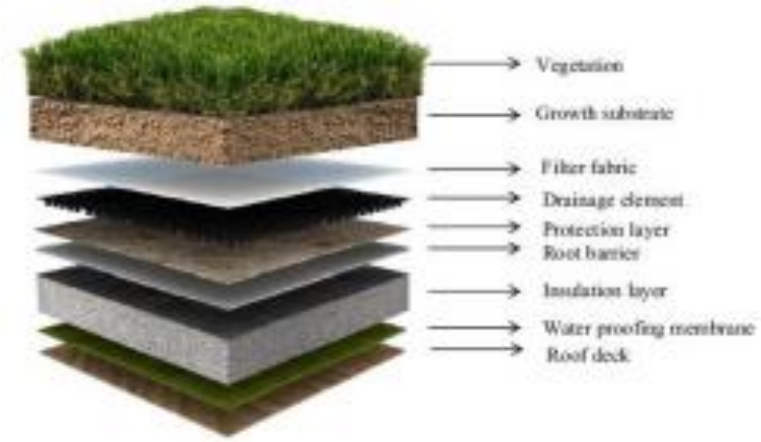

Figure 11: Layers of Green Roof

Source: Vijayaraghavan, K., 2016.

Waterproof Membrane

One of the most crucial components of green roof technology is the waterproof membrane. It protects the structure from infiltration caused by the high water content of the higher layers. The vegetative roof, in turn, protects it from temperature changes and solar radiation, which can cause the membrane's performance to degrade quickly. Water tightness is the most important criteria for this layer. The most prevalent type of flexible membrane is bituminous.

Anti-Root Membrane

The aggressive potential of the root system should not be disregarded when developing a green roof. A root-purpose barrier is to protect the waterproof membrane and roof structure from vegetative roots penetrating from the higher layers, which could mechanically disturb and chemically modify the waterproofing membrane. The drilling of the waterproofing membrane and penetration into the underlying layers because of these two processes results in water infiltration into the building. As a result, in virtually all circumstances, the anti-root layer must be spread out on a green roof and is integrated into the waterproofing membrane.

Protection Layer

An excellent technique is to offer separation and a protective layer between the green roof layers to safeguard the waterproofing and anti-root membrane. This layer must be able to withstand loads and strains throughout both the construction and operational periods. As a result, it must be placed after the anti-root membrane. The weight of the layers above the anti-root membrane normally causes the loads it must endure. Geogrids and geotextiles, as well as polystyrene with a minimum thickness of 3 mm and a compression resistance of >150 kPa, is employed.

Water Storage and Drainage Layer

For a green roof to develop properly, it must have a drainage layer. This layer aims to drain excess water from the substrate, allowing a suitable balance between air and water and providing appropriate ventilation for the roots, as most plant requires a ventilated and non-waterlogged substrate. Furthermore, by removing excess water, it lessens the load on the building structure and the likelihood of a mechanical failure. The drainage layer also protects the waterproof membrane and improves thermal performance. There are two main materials used for the drainage layer:

Granular materials: These have a minimum thickness of 6 cm and a minimum density of 150 kg/m3. If porous, they are also used as water storage. Pozzolana, pumice, lapilli, expanded clay, expanded pearlite, expanded slate, and broken bricks are the most common aggregates used in green roofs.

Modular panels: These have a thickness between 2.5–12 cm and a weight of about 20 kg/m2. These panels are made of high-strength synthetic or plastic materials (polyethene or polystyrene) with cavities that hold water while allowing excess water to be removed.

Filter Layer

This layer's primary function is to divide the substrate from the drainage layer, preventing smaller particles (such as fine soils and vegetation debris) from entering and clogging the drainage layer, lowering its performance over time. Once penetrated, this substance could either encourage the growth of plants within the drainage layer or clog the drains, creating infiltrations and stopping the entire greening system. Small holes in the filter layer should allow for high water permeability, at least 10 times that of the substrate. As a result, the water permeability is the performance to be checked.

Substrate

The substrate is essential to plant growth because it ensures establishment and stability while also allowing for the regulation of agronomic capacity, or the ability to sustain the physical, chemical, and biological conditions necessary for proper vegetative development. The vegetation, roof shape, climatic conditions, and irrigation system all influence the thickness and weight of the substrate.

The substrate is characterized by two main sets of parameters:

- Physical parameters, such as density, particle size, water permeability, maximum water volume, and maximum air volume in saturated conditions.
- Chemical parameters, such as pH index, electrical conductivity, and quantity of organic matter.

Vegetation

The health of the plants determines the majority of a green roof's success, especially in terms of achieving long-term client expectations. The advantages are largely dependent on the plant type, as they improve water and air quality as well as thermal

performance. Climate factors such as rainfall intensity, humidity, wind, and solar radiation should all be taken into account while selecting plants. The location of the roof installation is crucial in maximizing plant species selection, as hot/cold air emissions and chemical components in the air must be taken into account. Suitable plant species based on the soil depth,
• 0–5 cm: Sedum, mosses, and lichens.

• 5–10 cm: Short wildflower meadows, long-growing, drought-tolerance, perennials, grasses and small bulbs; •10–20 cm: A mixture of low or medium perennials, grasses, bulbs and annuals from dry habitats, wildflowers, and hardy sub-shrubs. (Cascone, 2019)

3. MATERIAL AND METHODOLOGY

Green roofs being an urban concept is undervalued in comparison to their benefits. In today's context where global warming is a major concern, it is necessary to build the cities in a sustainable approach. Therefore, it is necessary to aware people of the importance and benefits of a sustainable approach. However, lack of resources and difficult to understand information makes it less attractive. After identifying the problem, it was important to understand the worldwide relevance of the problem and the data available. So the methodology for the research was to first collect and analyze the research papers, books, government standards and web searches. The next step was filtering all the necessary data for one to understand the green roof as a whole. Therefore, this research will guide the readers to prepare a quick reference to be considered while opting for a green roof.

4. RESULTS AND DISCUSSION

Often when we talk about the green roof, concerns like a structural failure, the dead load of the roof, retrofitting, accessibility, leakages but these issues can be overcome with the right strategies.

4.1 Dead Load

A dead load of green roof assembly depends upon the project typology. Also the factors like skills, medium components, water retention quality. Since composition differs according to the type of structure, standard procedures are determined from ASTM-E2397 (Standard Practice for Determination of Dead Loads and Live Loads Associated with Vegetative (Green) Roof Systems).

Normal changes in material thickness and density, variance in the finished growth medium product, human error in the distribution and grading of the growth medium, and differences in plant biomass all contribute to variations in green roof dead loads.

4.2 Impose Load

Other loads such as snowdrifts, seismic loads, and ponding from rain accumulation. Engineers should analyze the likelihood that the addition of a green roof will have a meaningful impact on other loading based on the kind of construction, the climate, and the planned system.

4.3 Retrofitting

Retrofitting can be possible by determining the present structure's type, such as steel frame, concrete flat slab, masonry, or light wood. To establish the design loads, examine the current structural and architectural drawings. If the roof's reserve capacity is insufficient to handle the increased weight, the architect and engineer may shift the imposed loads. Supplemental reinforcing measures may be necessary depending on the kind of structure; however, they are generally prohibitively expensive.

4.4 Roof Access

The occupancy of the roof will play a role in determining the live load and safety standards. When it comes to determining live load, the kind of occupancy is crucial. Safety can be ensured by installing a parapet wall or a handrail, and structural improvements must be made as needed.

Table 1: Comparison between Types of Green Roofs

Criteria	Types of green roofs		
	Intensive	Semi-intensive	Extensive
Maintenance	High	Moderate	Low
Substrate layer	> 25 cm	15–25 cm	8–15 cm
Weight of the system.	>350 kg/m^2	150–350 kg/m^2	80–180 kg/m^2
Accessibility	In general	Limited stepping	No stepping

Source: https://www.researchgate.net.

5. CONCLUSION

Green roofs are strategic tools that have an important role in the creation of sustainable and resilient cities. Green roofs are a part of climate-proof construction helping to reduce heat island effects. Green roof temperatures can be 1–4°C lower than those of conventional roofs and can reduce city-wide ambient temperatures.

Although green roofs are more expensive than conventional roofs, they provide significantly higher relative benefits per square foot over a 50-year lifecycle (e.g., energy cost savings, avoided emissions, reduced stormwater fees).

Considering the urban development, it may not be possible to always have green open spaces within the building premises or even in the surrounding areas. In such cases, a green roof could be a solution to it. They can contribute to restoring vegetation in the urban environment, where it may be difficult to have it on the ground, we can have it on terraces thus increasing the biodiversity and adding aesthetic value to the city.

Green roofs have environmental and health benefits attached to them having an impact on an individual's mood, where people are seen happier in a green environment than grey and empty surrounding.

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Rethinking Synergy of Liveability and Identity: A Case of the Religious Town of Dakor, Gujarat

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ABSTRACT: Change is inevitable and the cities around us are constantly transforming. Dakor imbibes a predominant religious character that gives the town its identity. The image of Dakor is visualized through the Ranchhodraiji Temple complex and surrounding Gomti Lake Precinct with adjoining Ghats. It's significance, however, is gradually being blanketed by various factors that touch upon economic, demographic and developmental aspects. Dakor's economy is solely dependent on the Temple, leading to stagnation of growth with respect to population and infrastructure. There is a need to come up with solutions that take into considerations the religion, ecology and future scope of Dakor to enhance the overall liveability of the town. This paper aims to bring out the importance of the temple in the development and functioning of the town that supports new urban changes while strongly reinforcing the traditional religious sanctity.

Keywords: *Temple Complex, Floating Population, Ecology, Future Scope, Liveability, Religion.*

1. INTRODUCTION

Dakor is a prime religious landmark of India welcoming a floating population of Lacs on festivals and special days like Poonam. The Temple complex and Lake Precinct has impacted the overall town development and it seeps down to the small nuances in people's lifestyle. The layout of the town echo's the influence of the temple and continues to run its economy on the basis of the activities directly or indirectly related to the temple complex. This has resulted in the stagnation of growth with respect to population and infrastructure despite the rich history and religious values. The high influx of floating population has had many repercussions on the environment and marine ecology. There is a need to rethink the aspects of identity and liveability to foster development that binds the past and future in harmony.

1.1 Aim

The study aims to outline the significance of the Templecomplex as an identity of Dakor in juxtaposition to the future scopes of enhancing liveability. The goal is to explore possible approaches for development and design interventions that can integrate Religion, Ecology and Futuristic ideas to induce growth.

1.2 Research Objectives

The objectives of the study are:

- To understand the religious value of the Temple complex and its inter-dependence on the town.
- To address the socio-cultural, physical and ecological concerns in relation to the high influx of floating population.
- To identify the future scope of the town with respect to Economy, Demography and Development.
- To present appropriate design strategies and proposals that support new urban changes while strongly reinforcing the traditional religious sanctity.

1.3 Scope and Limitations

The scope of the study lies in the distinct factors and issues of the town. The strategies outlined are unique to the town of Dakor, based on specific data analysis of the existing conditions.

2. METHODOLOGY AND MATERIALS

The methodology adopted for the study was carried out in two stages:

Stage 1: Analysis of the existing condition of Dakor.

Primary data was collected through multiple site visits that included a detailed mapping of streets and Ghats, photographs, sketches, mapping pilgrim activities and video shootings to capture the pedestrian movement and pattern.

A local level survey was conducted to find out about the importance of the Temple for the locals, issues faced by them due to the high rush of pilgrims and their expectations from the town, ten years down the line. Questions were asked to find out more about the community, their religion, sources of education for children and the night life in Dakor.

The data collected was then converted into charts, graphs and legible maps to clearly depict the existing condition.

Stage 2: Proposing design interventions and strategies. The data analysed was used to frame a hypothesis regarding Decentralization and expansion of activities to induce economic progress of the stagnant town. The hypothesis was supported by ground and site specific solutions. The paper is presenting a proposal that is an extension of the hypothesis framed supporting the conclusions derived.

The methodology adopted is summarised in Figure 1 in the form of a flow chart.

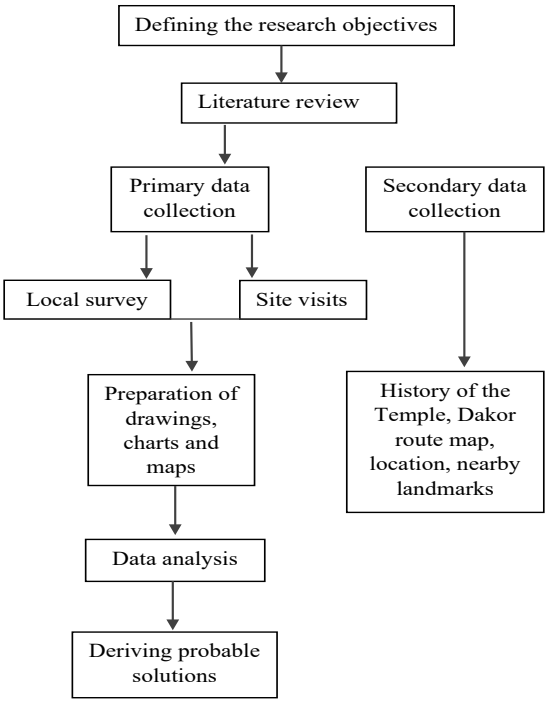

Figure 1: Study Methodology

3. LITERATURE REVIEW

In the current trend of urbanism, the concept of liveability plays an important role in the urban planning field. The term" liveability" itself defines the goals for the quality of life and social development. It has a major connection with transportation, social cohesion, resilience, and subjective well-being.[3] Measuring the Liveability of a local area can be done through a map survey that includes mapping services, facilities, public infrastructure and quality of open spaces and roads. This can be followed by a street survey, having questions on street infrastructure, play areas, gardens, vegetation and housing to determine the subjective opinions of people.[4]

Cities are ranked for liveability based on objective as well as subjective factors. Figure 2 given below illustrates the factors of Liveability.

Figure 2: Factors to Measure Liveability[4]

The strategies for improving liveability, can be narrowed down under 4 basic heads—Traffic congestion—Heavy traffic leads to people spending more time in vehicles rather than their homes resulting in frustration and stress. Traffic causes noise and air pollution that further adds to the problem. Social inequalities—These lead to a sense of tension and unrest in a community. It causes poverty, unemployment and unhealthy relations between people, negatively impacting children and teenagers. Environmental issues—A person's physical and mental health is directly related to his or her environment. Hence, clean public places, waste management and hygiene are crucial for a better life quality.

Urban sprawl—This results in the construction of additional infrastructure and housing that leads to a loss of natural habitat and lack of services for new developments

4. THE EXISTING SCENARIO OF DAKOR

Dakor is a small town located in the Thasra taluka of Kheda district. It has a population of 25,658 and is well known as a religious pilgrimage centre housing the Ranchhodraiji Maharaj temple and the Gomti Lake. It is also a well-known trading area selling religious merchandise and items related to sacred rituals[1] Figure 3 given below shows the existing layout.

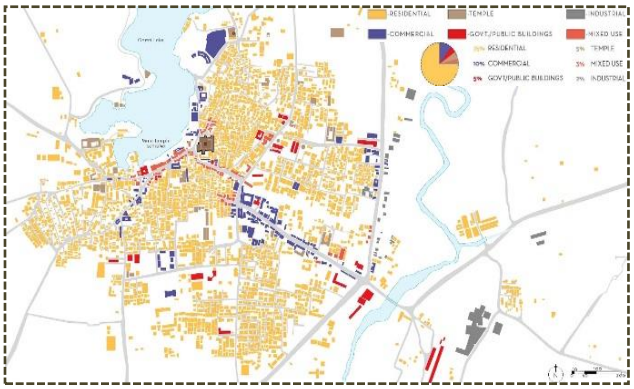

Figure 3: Existing Layout of Dakor

4.1 Significance of the Temple Precinct

The temple precinct is situated on the banks of Gomti lake in the midst of the main Vada bazaar of Dakor. It has 8 domes and 24 turrets, with the central dome reaching a height of 27 m. It is the tallest temple in the district with a golden Kalash and white silken flag, having a strong influence of Maharashtrian style architecture.[2] The floating population which is in lacs is temporal in nature, the temple being visited at Poonam (the full moon day) of Hindu calendar every month with pedestrians thronging it from places as far as 150 kms. The Vada bazaar street is the prime access to the temple that houses the traditional local market known for vessels, toys and religious offerings. These narrow streets (4–5 m wide) are purely pedestrian during the Aarti timings because vehicular access is blocked. Maximum rush of pilgrims is witnessed during this time and it often leads to excessive congestion and overcrowding at the Hiralaxmi node.

4.2 Ecological, Physical and Socio-Cultural Impacts

The shops of Gotawala's near the temple along the entrance to the Ghats, serve as magnets attracting public inflow, adding to the high public density and unhygienic conditions due to improper disposal of waste. Figure 4 shows the crowding pattern at Hiralaxmi node.

Figure 4: Pedestrian Mapping at Hiralaxmi Node

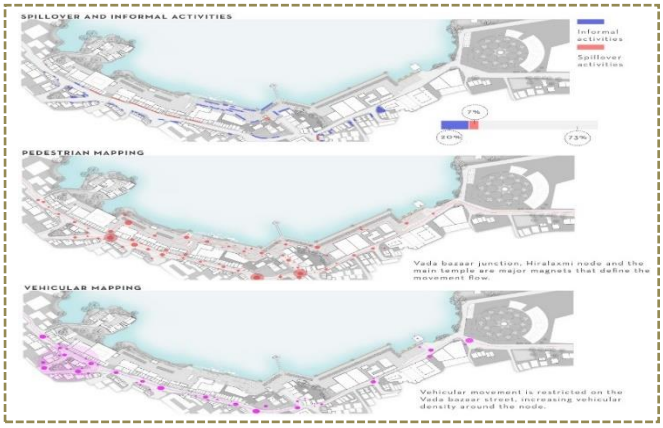

Figure 5: Mapping of Vada Bazaar Street

Various informal activities take place along the Ghats including play areas for children, boating, religious rituals and temporary kiosks selling goods. This has resulted in random garbage disposal in the Gomti Lake and waste accumulation along the Ghats, detoriating the water edge. This has had major repercussions on the lake ecosystem and marine species, including the death of various types of fish. Figure 5 shows the layers of activities, public and vehicles on the Ghats and Vada bazaar street.

During festivals, the town transforms itself into a living organism with the two major streets as the veins carrying life and the temple acting as the nucleus.

4.3 Scope for Future Development

The development pattern of Dakor is uni-directional, growing towards the south-east side of the Gomti Lake. The northern side of the Lake is unexplored and has vast plots of agricultural land under the ownership of the government and private temple trusts. The growth of the townhas stagnated over the years with respect to population as well as infrastructure due to many factors:

- The economy of Dakor is solely dependent on the temple and its related activities.
- There are no educational facilities post primary education in the town, resulting in the migration of youngsters to neighbouring towns and cities.
- The population ratio of Dakor has major percentage of old-age citizens (above 50), resulting in a lack of new scopes and employment generation.
- The built form of Dakor presents an absence of major entertainment and recreational zones for citizens.
- Lacks green open spaces for breathing new life.

A local survey was conducted to determine the interests of the local people as shown in Figure 6 given below.

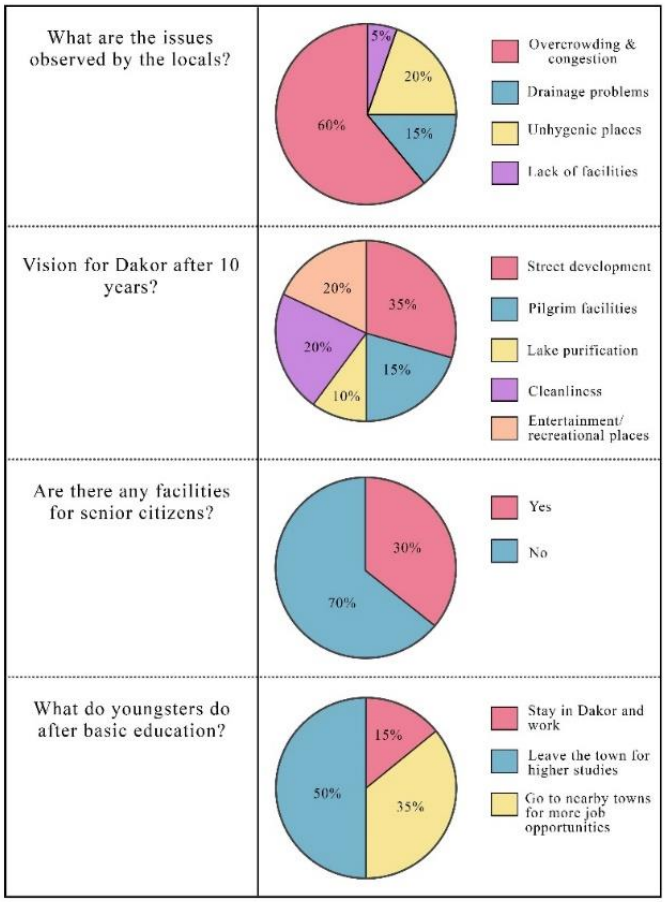

Figure 6: Local Survey Results

5. IDEA OF LIVEABILITY AND IDENTITY IN DAKOR—DESIGN STRATEGIES FOR DEVELOPMENT

The above observations are used to frame a hypothesis with a vision to 'Induce urban development of Dakor through unification of the Lake precinct and enhancement of regional connectivity.' The strategies are an effort to integrate Identity and Liveability using principles of Decentralization and expansion to promote growth of the stagnant town shown in Figure 7.

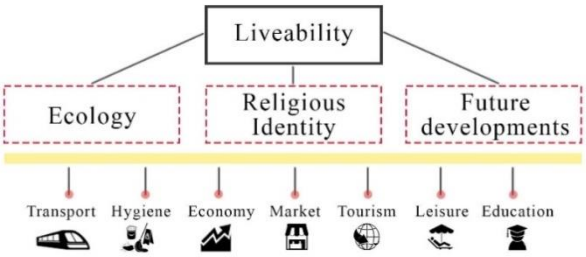

Figure 7: Design Concept

Long-Term Goals (economic growth and development)

1. Decongestion of the town by creating new points of attraction, through infrastructure like parking, play areas and market spaces.
2. Developing new facilities like educational campuses, open parks, ecological parks and recreational zones to attract the young population
3. Creation of additional waterways within the lake by developing Jetty stations and boating services.
4. Lake purification and strategies for waste management along the water edges to maintain the ecological and religious balance of the lake.

Short-Term Goals (Identity and floating population):

5. Redeveloping the existing roads to include footpaths, sufficient width for vehicles and shaded sitting spaces.
6. Reorganising the market spaces and random commercial development along Vada bazaar street.
7. Redevelopment of the core-temple precinct.
8. Shifting the informal and temporary activities from the Ghats to create open spaces within the dense urban fabric.
9. Rejuvenation of dead street pockets and adaptive reuse of structures like TCGL complex.

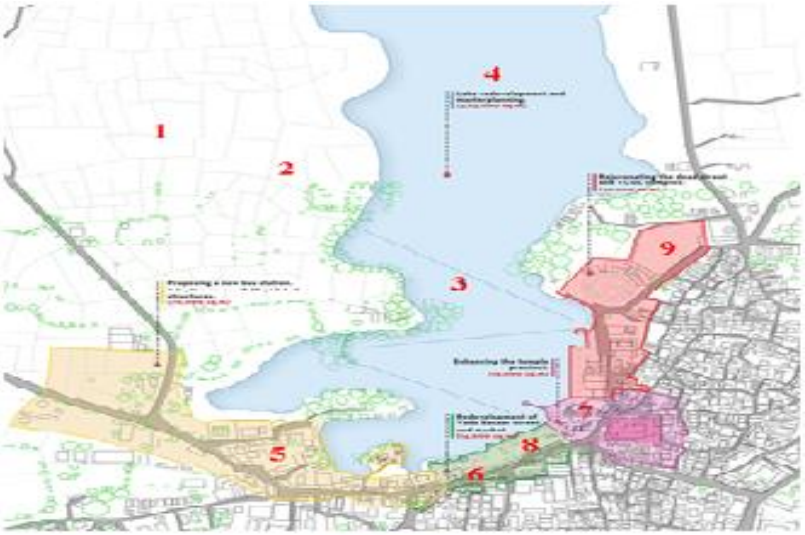

Figure 8: Proposed Development Zones in Dakor

6. RESULTS AND DISCUSSIONS

Despite the rich history and architectural character, the identity of towns is often overshadowed due to the lack of management and infrastructure available. The temple precinct becomes the focal point of development and the town functions on the basis of a temple-dependent economy. In such cases the Locals are often deprived of basic facilities like parks, open leisure spaces, proper streets and services, that are essential elements of a liveable environment.[3]

7. CONCLUSION

The study presented is a detailed analysis of the ground reality of Dakor. The hypothesis derived from data collected can act as a guide for development in towns having similar concerns. The research provides a basic framework for related future studies. The information, however, is largely focused on the core Gamtal area of Dakor. There are many unexplored places within the town that have huge potential for bringing about a positive impact. The overall concept is the application and importance of liveability in urban design.

ACKNOWLEDGMENTS

The Nagarpalika of Dakor has contributed generously in providing the necessary documents and secondary information. The guidance from fellow faculties of SVIT, Vasad and Principal Prof. Sailesh Nair was extremely beneficial throughout the writing of the paper. The efforts and assistance of all the people involved in this research is deeply acknowledged.

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Net Zero Energy Buildings: For Better Future

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ABSTRACT: The issue of global warming is raising day by day. We are now able to see its impacts. There are many sectors which are responsible for climate change. Building industry is one of them which emits lot of carbon under the name of urbanization. To change this, we should start thinking on minimizing the energy consumption of every structure. Net zero energy building can be the best solution for this global issue. In this research paper we will be stressing upon minimizing the energy consumption of structure. The main purpose of this research is to make every structure more sustainable and energy efficient. Methodology followed is studying previous research on this topic. Also, three book case studies, one live case study on net zero energy building and their comparative analysis has been studied. The research concludes by understanding the importance of energy efficient buildings in future through comparative analysis.

Keywords: *Global Warming, Carbon Emission, Construction Industry, Net Zero Energy Buildings.*

1. INTRODUCTION

Net zero energy building has been now becoming one of the most prominent topics in construction industry because of the daily rising environmental crisis. Every day there are development happening in every corner of India which is making it one of the major energy consumers in world. We can't restrict the rising energy requirements as energy is important for the development. But we can reduce the dependency of buildings on non-renewable resources for their daily energy requirements by making them capable to produce their own energy with the help of renewable resources. Here, net zero energy buildings come in picture. The concept of "net zero energy building (NZEB)" was first put forward at twenty-first united nations climate change conference (COP21) in the context of global response to climate change and sustainable development.[1] The background of net zero energy building is essentially different from that of the "energy saving building" which was brought up during the world oil crises in the 1970s.[1] In 2015, the U.S. Department of Energy issued its official definition of NZEB: In terms of primary energy, its annual energy consumption is less than or equal to the generated energy of the individual building and nearby renewable resources. [2] In the relevant EU standards, the NZEB is able to produce energy, and the production is equal to or greater than the energy consumption.[2] It emphasizes that fossil energy consumption of building is less than or equal to renewable energy production through applications of active, passive design, efficient energy systems and renewable energy systems.[2]

The concept of "net zero energy building (NZEB)" was first put forward at the twenty-first United Nations Climate Change Conference (COP21) in the context of global response to climate change and sustainable development. The background of the net zero energy building is essentially different from that of the "energy-saving building" which was brought up during the oil crisis in the 1970s. Changing from the concept of "net zero energy building (NZEB)" was first put forward at the twenty-first United Nations Climate Change Conference (COP21) in the context of global response to climate change and sustainable development. The background of the net zero energy building is essentially different from that of the "energy-saving building" which was brought up during the oil crisis in the 1970s. Changing from the

Aim

To make present structures more energy efficient for future.

Objectives

Objectives of this research paper are: a) Study of net zero energy buildings. b) Analyzing the data available on net zero energy structure. c) Finding different techniques to make any structure energy efficient after its construction.

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1.1 Scope and Limitation

Study has been carried out to understand the importance of net zero energy buildings in current scenario. Different case studies and research papers will be analyzed in this process. Modern techniques will be studied for making structure more sustainable.

This research paper only covers the after-construction techniques for making structure more sustainable.

1.2 Methodology

- **Phase I:** In phase 1 study of literature has been done referring various research papers.
- **Phase II:** In phase 2 study of reports published by government bodies and some news article has been studied.
- **Phase III:** In 3rd phase case studies have been done on India's famous net zero energy buildings.
- **Phase IV:** Live case study of Nashik's first energy efficient corporate office has been done.
- **Phase V:** Comparative study of all case studies and conclusion part has performed in 5th phase.

1.3 Book Case Study

1.3.1 *Indira Paryavaran Bhavan, New Delhi*

Location: New Delhi[3]
Geographical Coordinates: 28° N, 77° E[3]
Occupancy Type: Office (MoEF)[3]
Typology: New Construction[3]
Climate: Composite[3]
Project Area: 9,565 M^2[3]
EPI: 44 $kWh/m^2/year$[3]

Indira Paryavaran Bhawan, the new office building for Ministry of Environment and Forest (MoEF) sets is a radical change from a conventional building design.[3] The project team put special emphasis on strategies for reducing energy demand by providing adequate natural light, shading, landscape to reduce ambient temperature, and energy efficient active building systems.[3] Indira Paryavaran Bhawan is now India's highest green rated building.[3] The project has received GRIHA 5 Star and LEED Platinum.[3] The building has already won awards such as the Adarsh/GRIHA of MNRE for exemplary demonstration of Integration of Renewable Energy Technologies.

Figure 1: Indira Paryavaran Bhawan View

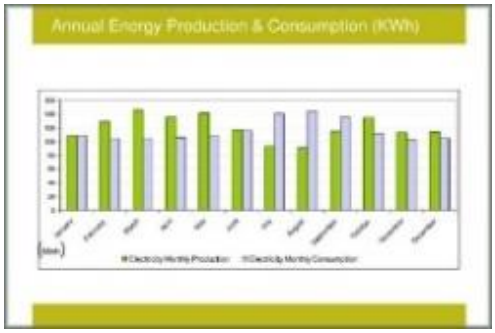

Figure 2: Annual Energy Production and Consumption Graph

[3]The energy consumption of Indira Paryavaran Bhawan is 67.3% less in comparison to the GRIHA benchmark. [4]The project adopted numerous green building concepts for occupants' wellbeing and eco-friendly approaches like water conservation and rainwater harvesting.[4]

Figure 3: Landscape Designing of the Courtyard

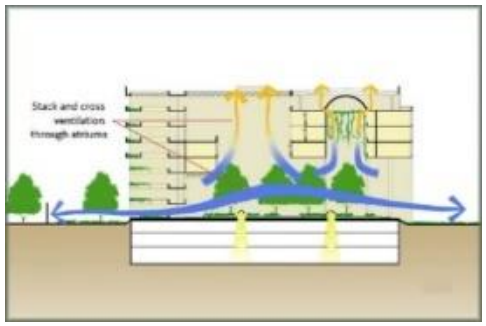

Figure 4: Ventilation Through Courtyard

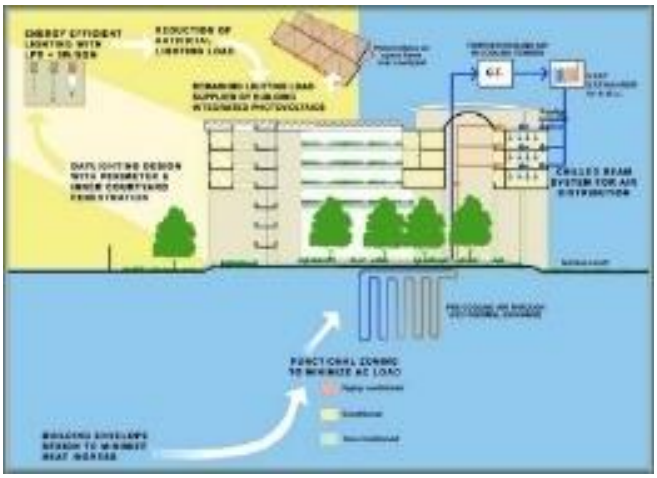

Figure 5: Energy Saving Active Design Strategies

Authorities have got permission to cut 46 trees but only 19 trees were cut, and 11 trees were planted to make up for it.[4] Onsite STP with FAB/MBBR technology constructed to recycle the total water amount to create zero wastewater. Water consumption has been reduced by 64% by providing water-efficient fixtures.[4]

The Indira Paryavarn Bhawan met the energy demand with the green and clean energy solution, Efficient Solar PV systems. [4] The building has a solar PV system installed in a 6000 m^2 area of 930 kW capacity.[4] The total area covered by the panel is 4650 m^2 by 2844 solar panels which generate 14.3 lakh unit annually which is huge in amount.[4] This is the first govt. building in the country to achieve the landmark of net-zero energy building and one of the very few full-fledged multifunctional office buildings in the world to do so on a tight urban site.[4]

1.3.2 *Avasara Academy Lavale, Pune*

Location: Pune[5]
Coordinates: 18°N, 73°E[5]
Occupancy Type: Academic[5]
Typology: New Construction[5]
Climate: Warm and Humid[5]
Project Area: 11,148 M^2[5]
Architect: Case Design [5]
Energy Consultant: Trans solar Klima Engineering[5]

Avasara Academy, a residential school campus located in the rocky agrarian valley of Lavale in Maharashtra, consists of six similar buildings, each with classrooms on level 1 and 2, and student dormitory and faculty residences on level 3 and 4.[5] Its uncompromising architecture is simple, climate-oriented, functional, sustainable, flexible, affordable, aesthetical, visually exciting and inclusive.[5] Avasara, with high ambition, a modest budget, and scrupulous attention to detail, achieves comfortable internal condition and nearly net-zero energy status without the use of any mechanical system despite the warm and humid climate.[5]

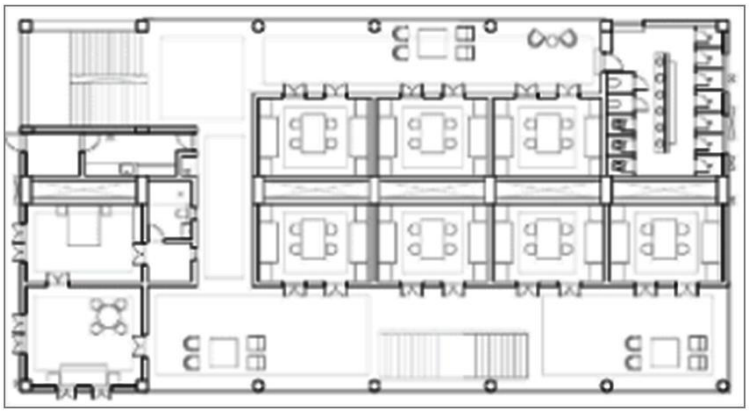

Figure 6: Plan 1

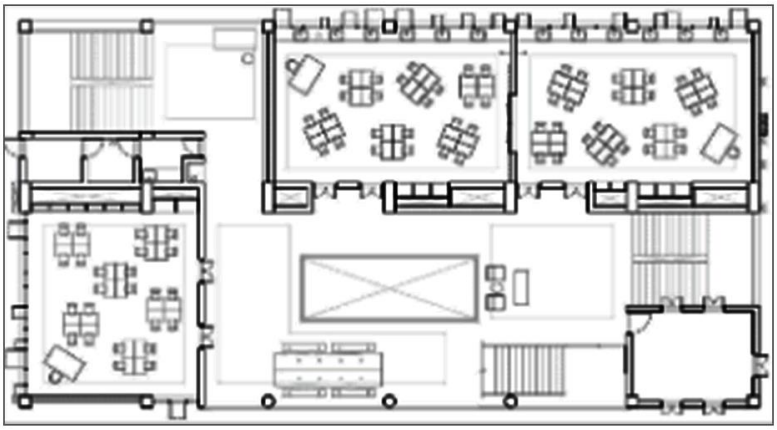

Figure 7: Plan 2

Articulated concrete construction includes the skeleton structure with reinforced concrete floors and the prefabricated structural ceilings.[5] This raw concrete along with the locally sourced stone interior acts as an inert thermal mass; absorbing the solar thermal energy during the day and releasing it again after a delay overnight, resulting in a moderate, more consistent radiant temperature inside the building.[5]The façade is shrouded in bamboo screens with variations in the patterns based on the façade orientation.[5]

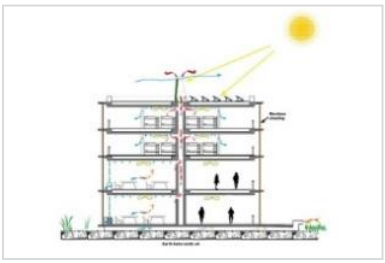

Figure 8: Section—Case Design and Trans Solar

Figure 9: Photovoltaic Solar Panels and Solar Water Heater

Figure 10: Bamboo Screen

Figure 11: Glass Glazing

Passive heating-cooling systems are designed with earth ducts, structurally integrated vertical cavities and solar chimneys to induce ventilation in each building, lowering interior temperatures by 5–9°C during uncomfortably hot summer months.[5] Photovoltaic solar panels and solar water heaters have been installed on the roof to provide electricity and supply hot water to the building.[5]

1.3.3 TERI Office Building-Cum-Guest House, Bangalore

Location: Bangalore.[6]

Occupancy Type: Institutional (office-cum-guest house).[6]

Built In: 1990.[7]

Climate: Moderate[6]

Project Area: 26,663 Sq. Ft[6]

Architect: Sanjay Mohe[6]

TERI has developed the GRIHA rating system which has been adopted as national rating system by MNRE, Government of India.[7] TERI's Southern Regional Center in Bangalore has been developed as a green building and it is one of the first energy efficient and environmentally sustainable campuses in South India.[7] The first reaction to the design problem was to improve the condition of the drain and make it a pleasant landscaped element on the line of Nallah Park, next to the Osho Ashram in Pune.[6] This would be done by using plants that absorb impurities as well as with the help of basic filtration and aeration. [6]

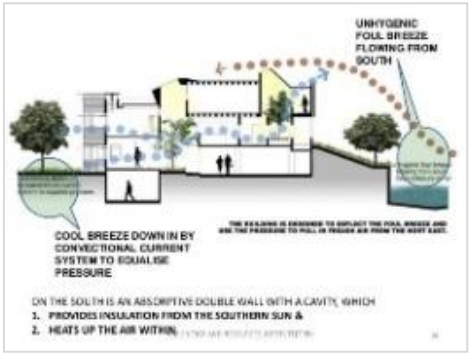

Figure 12: Working of Building Day Lighting

Figure 13: Terrace Garden Detailed Section and Ventilation Systems

The building opens towards the northern side, taking advantage of glare-free light.[6] The south wall is made into a double wall, firstly to provide insulation from the southern sun, and secondly, to heat up the void between the two walls creating negative pressure, thereby enhancing the convection currents.[6] There was detailed day lighting study and the fenestrations have been designed so that the requirement of artificial lighting is minimal during daytime.[6] A scheme of rainwater harvesting, which would be used to water the plants, has been worked out. [6] Rainwater runs through paved roof area will be collected at various levels in small open tanks on the terraces and in a collection sump below. This water will be used for landscaping. [6]

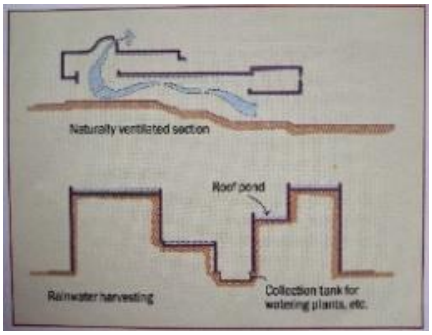

Figure 14: Section Explaining Natural Ventilation and Rainwater Harvesting in the Roof

The ground cover which is disbursed due to the building of this structure, will be replaced on the rooftop, in the form of terrace gardens, giving insulation to the building and reducing solar radiation.[6]Thus, the proposal addresses not only thermal comfort but also visual appeal and environmental issues.[6] An integrated approach to building and system design has been adopted.[6]

2. LIVE CASE STUDY

2.1 Green Space Realtors, Nashik

Location: Nashik.
Occupancy Type: Office Building.
Typology: New Construction
Climate: Moderate
Floor Unit Area: 260 Sq. M
Architect: Sanjay Patil
EUI/EPI: 26.5 KWh
HVAC Engineer: Surendra Shah (Structure cooling)
Green Building Environment: VK. Environmental LLP

Green Spaces Realtors is one of the Nashik's leading Real estate developers, engaged in land development & constructions. Green Spaces Realtors aims as the flag bearer for environmental sustainability by offering a Greener Lifestyle to their discerning customers. "Green Space Realtors" is Nashik's first corporate green building under the LEED certification. The building creates healthy working environment by taking ample of sunlight inside. Orientation of the building is north-south. It has ground + 2 floors covered by flat slab. Entrance is provided from north side. Wall to Window Ratio is 30%. Large windows are provided to take natural light inside. Building envelope is designed with double wall having fly ash bricks and brick cladding with air gap. This technique helps in reducing the heat gain from walls.

Figure 15: Large Window Openings

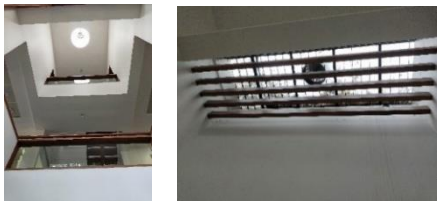

Figure 16: Stack Ventilation by the Help of Turbo Ventilators

Turbo ventilators are used to perform stack ventilation. High albedo reflective paint with SRI > 0.5 is used to reduce heat gain from roof. Thermo drain (TOD) system is used to absorb the heat from the structure. 21 mm diameter plastic pipes were laid out in a grid on the plinth of every floor. It removes 242 Btu/Sq. ft/hour of heat from structure. Water moving through pipes take the heat from slab and passes through radiator that rejects most of it. Then this lukewarm water is stored in tank and during night when the cool air absorbs the residual heat this stored water gets recycled. This cycle continues every day. The energy required for pump and fan is supplied by solar PV system.

Figure 17: Chiller Figure 4.5: PV Solar Panel

The EPI, an outcome-based metric for building energy performance, was calculated from monthly electricity bills from June 2016 to May 2017.[8] The EPI for the office building in Nashik was calculated to be 26.5 kwh/m^2/year.[8] This falls within the BEE's voluntary 5-Star benchmark for energy efficient buildings (less than 50 per cent air-conditioned) for composite climate of <40 kwh/m^2/year, and is way below the national benchmark of 86 kwh/m^2/year for commercial buildings in this climate zone.[8]Because of TOD system lot of load on mechanical air-conditioning system has been reduced. Also, TOD system is 50% less costly than the conventional HVAC system. The total life cycle costing (capital and running cost) of the TOD system for a period of 10 years amounts to Rs. 6/sq. ft./year (US $ 1 per sq. m) as compared to Rs. 30/sq. ft./year for a conventional HVAC system. [8] The active components of TOD system get energy supply from the PV solar system fixed over the roof. These all things made this building Nashik's first corporate energy efficient building certified by LEED.

2.2 Comparative Analysis

After understanding three book case studies and one live case study. Comparative analysis of all these case studies has been done. Points considered for the comparison are those who are making these structures energy efficient.

Sr. No.	***Comparison Points***	***Indira Paryavaran Bhawan***	***Avasara Academy***	***TERI Office Building—Cum Guest House***	***Live Case Study Green Space Realtors***
I.	70% Less Use of Energy Compared to Conventional Building	PV Solar system Geothermal Heat Exchange System Onsite STP with FAB/MBBR Rain Water Harvesting	PV Solar system Earth Ducts Vertical Cavities Solar Chimneys Solar Water Heaters Rain Water Harvesting	PV Solar system Double Wall Cavity Solar Chimneys Solar Water Heater Grey Water Recycling Rain Water Harvesting	PV Solar system Thermo Drain System Stack Ventilation Rain Water Harvesting
II.	GRIHA and LEED Platinum Rating	GRIHA 5 Star LEED Platinum	Not Mentioned	IGBCPlatinum	SVH GRIHA 4 Star

Sr. No.	*Comparison Points*	*Indira Paryavaran Bhawan*	*Avasara Academy*	*TERI Office Building—Cum Guest House*	*Live Case Study Green Space Realtors*
III.	75% or More Than it Building Floor Space in Day Lit	Internal Courtyards` External Openings	Half Area Covered with Bamboo Screens Other Area is Covered by Glass Panels	Solar Chimneys Sky Lights	Large Window Openings Double Height Spaces with Large Glass Panel to take light inside Skylight
IV.	Stack Ventilation	Yes	Yes	Yes	Yes
V.	Curtain Walls or Jalis	Not Mentioned	Bamboo Screens	Wall Cladding with Kadapa Slabs	Green Curtain Wall
VI.	High Efficiency Glass	Yes	Yes	Yes	Yes
VII.	Local Material	Not Mentioned	Local Stone Walls Bamboo screens	Kadapa Stone Soil-Stabilized Blocks Laterite Block	Scrap Material of earlier building on same site
VIII.	Energy Efficient Lighting System	Yes	Yes	Yes	Yes
IX.	HVAC System/Chilled Beam System/Screw Chillers	Geothermal Heat Exchange System	Passive Heating-cooling System Earth Ducts Structurally Integrated Vertical Cavities Solar Chimneys	Centrally Air-Conditioned with No CFC and HCFC Centralized District Refrigeration System Air-Conditioning System Using an Ammonia-Based Chilling Unit	Turbo Ventilators Thermo Drain System

3. CONCLUSION

After studying all these case studies, it was found that we can't make any building totally zero carbon building but we can reduce the carbon emission of that building. There are many techniques to reduce the carbon footprint of building and also for making that structure more energy efficient. These techniques are the amalgamation of natural and mechanical techniques. Like, we can reduce the carbon footprint by creating green beds around the structure so that the carbon emitted by that structure will be absorbed by those plants.Net zero energy building (NZEB) is also one of the solutions for reducing carbon footprint. Energy efficient building is the need of an hour. It is important because the energy we are using is generated from non-renewable resources and are going to finished one day. Solution for this is we should try to minimize the energy consumption of structures as much as possible and try to generate electricity required for them by using renewable resources. Also, instead of using HVAC system we can go with other techniques which are less harmful to nature, energy efficient and cost saving also.

ACKNOWLEDGMENT

I would like to express my deep sense of gratitude to my guide prof. Tejaswini Marode for giving valuable inputs and feedback regularly for writing the paper. Also, I would like to thank whole green space realtor's team, Mr. Kiran Chavan and Mr. Tejas Chavan, owner of green space realtors, Nashik for providing necessary information required during live case study.

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नगरांगण: Exploring Jail Infrastructure as an Urban Courtyard

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ABSTRACT: Infrastructure aids the smooth working of a city and the comfort of its people. These 2 factors: Infrastructure and people, facilitate city growth and helps in building up city's character. Today in the face of rapid urbanization, some old infrastructures, existing for many decades, need to be questioned for its admissibility. Can such systems adapt to the city needs, changing perspectives, people's demands and ensure its relevance in today's time? Jail is one such system established by the Britishers which today, sit right in the city core, as a crumbling infrastructure. These Jail Complexes hold great historic chapters and attributes like un-exploited land, strategic location, viewpoints, etc. Exploring these potentials, the space can be a sustainable value-addition for the future smart city, impacting its lifestyle, economics, community bonding, environment, etc. Thus, old Jail infrastructure, if reimagined into 'URBAN COURTYARD' can escalate the city's livability and its urban environment.

Keywords: *Relevance, Adapt, Future smart City, Sustainable, Reimagine, Urban courtyard.*

1. INTRODUCTION

Research Gap: Indian Cities pre-dominantly developed during the British rule. With the advent of Industrial revolution, this process fastened and infrastructure came up for the aid of citizens. Administrative spaces, Judiciary system, spaces for entertainment, leisure, etc. were designed to suffice the demands in that time frame. Today, the scenario, in all the cities, is similar, where some of these ageing infrastructures; built 75–100 years ago, are inefficient and stand ideal. They are ignored, thus creating a huge loss of scarce urban land resource. Jails built during British era is one such system that needs to adapt.

Background Study: In many cities like Pune, Sabarmati, etc. the jails which were planned away from city cores, today sit right in the metropolitan establishment and are a sticking point. Thane City is one of the metropolitans, which has always tried to acclimatize to rapid urbanization. Situated in the heart of the city, thane Central jail, which was once a fort in the city outskirts, is today exhausted, housing 200% more than its capacity. This makes it inefficient and unsafe for the residential neighborhood. Jail typology have potential of evolving to great extends in near future and thus these old spaces built during British Era can be explored as an urban courtyard.

Aim: Toensure relevance and adaptability of old infrastructures (physical system) like JAILS in the face of rapidly developing Thane city context through architectural intervention which will dwell into Urban tissue of the city, its history, changing demands & requirements of the communities around in co-relation with the new infrastructure and smart city concept creating an URBAN COURTYARD for the city.

Thane jail fort has a rich history dating back to the Maratha era. Its ecological context and bio-diversity make it a green lung in the concrete jungle. Along with this, the strategic location, economic potential, and advancements around are some of the great attributes that can aid in the development of a sustainable urban courtyard. The architectural intervention can celebrate the city's history, community culture, and rich ecology through its functions, along with preserving and reusing the existing fort.

2. OBJECTIVES

1. To analyze the Jail system, its position in society, and the related notions.
2. To identify what the jail has offered to the city's historical narrative and how can it be maneuvered today to escalate the urban context by analyzing at macro and micro levels.

3. To analyze the concept of smart city and tying its knot with the historic context.
4. To interpret site through different lenses of Ecology, History, Economic and Cultural attributes.
5. To devise a survey for developing an architectural program considering different stakeholders.

Scope and Limitations: The scope of the study is limited to old British jail infrastructure and understanding its adaptability in current time frame. The thesis has limited its scope to architectural intervention while devising the design scheme. The research further focuses on a specific site and is not a repeating module, but it can be a explored on various other sites sharing similar attributes. Since Jail is a high-security area, constraints on the accessibility of data.

2. LITERATURE REVIEW

2.1 Historic Context of the City and Fort-Jail

Thane has a great historical background. It was a center for trade and was described as port with continuous traffic of ships by many travelers. It was the center for exporting leather, buckram, cotton, and importing horses. With this background, Thane became an important asset for the Portuguese kingdom, as they came down and conquered it. They ruled for over 200 years. The construction of fort was started by Portuguese in 1730. Marathas conquered bassines in 1737 and completed the Thane Fort construction.

British captured the fort by defeating Marathas in Anglo war. The fort was converted into a Jail. They set-up the administrative infrastructure around. Basic Facilities like Civil Hospital, Collector's office, etc. were established for the aid of the people living there.

Figure 1 Thane Fort Jail Location (Source: Author)

Further with the development of Railways, Trade began. Additional infrastructure like roads and bridges were constructed. Industrial zones came into picture.

After independence, Thane grew slowly and attained the status of a developing industrial town. (https://thanesmartcity.in/)

2.2 City Today

Today when the city is home for a population of 18 lakhs (As per 2011 Census) it has tried to adapt to the growing demands. Some of the old infrastructure like the Old TMC building, was shifted to Panchpakhadi (more spacious locality) since it was not sufficient to crater to today's demands. Similar was the case with Thane Mental Hospital built in 1901. The hospital is not much occupied and the proportion of patients have reduced. Therefore, some part of its area is proposed to be used for upcoming Railway station (New Thane) infrastructure.

Thus, the city has always tried to acclimatize to the changing times by relocating, re-molding and reinventing old spaces. Thane Jail can also be one of the examples for the same.

2.3 Thane: Future Smart City

What is the purpose of smart city?

The Smart city promotes economic growth and looks into improvement of quality of life of its citizens ensuring development of localities using technological smart solutions. It mainly focuses on 3 factors: Livability, Economic Ability and Sustainability

2.3.1 *Aim and Strategies*

- Making most from the available resources: and also promote development through Redevelopment, Retro-fitting, Greenfield and Pan city development.
- Quickly adapting to changes.
- Being resilient in the face of shock/stress.
- Having citizen inclusive process.
- Using technology for achieving these goals at larger scale and faster speed.

2.3.2 *Features of Smart City*

- Promoting mixed used development for economic growth.
- Creating walkable localities.
- Preserving and developing open space to enhance quality of life of the citizens.
- Giving an identity to the city based on activities like cuisine, Art & Craft, Education, Culture, Sports, etc. (smartcities.gov.in)

2.4 Potentials of Jail Explored in Different Time Frames

Thane Fort-Jail has a great history, with different role in each era. It acclimatized itself in the timeframes for the city benefit.

2.4.1 *Why was the fort built there?*

The Salsette island (Thane and sub-urban province) was under the rule of Portuguese from 15th to 17th century. They held a very crucial position with Maratha rule in the North and the East India Company in the Bombay city. The Thane creek separated the Portuguese empire and also provided additional protection and hence Portuguese started the construction of 12 Naval bases in the form of forts along the creek of which Thane fort was one.

Thane fort was very important security fortress since it was the easiest access point for the Marathas in the north, as the extend of creek was the smallest here. It thus formed a STRATEGIC NODE and the guarding GATE-WAY to Mumbai and Suburban Regions below. The fort and the area around have seen 7 battles between Portuguese and its enemies and also the Maratha—Anglo war against British. (Tetvilkar, 2012)(Tetvilkar, Ase aple Thane, 2019) (Tetvilkar, Thane Killa)

2.4.2 Why was the fort converted into a jail during British rule?

Britishers established a systematic Administrative and Judiciary system during their rule in India. They were reluctant to spent money on building new structures and tried to accommodate functions like jails in the existing fortresses where ever possible. Like in case on Thane fort. The fort was converted into a jail due to its planning and security attributes. This made it easier for the Britishers to administer and control the place during freedom struggle.

The thane Fort was planned based on the idea of VAUBAN FORTIFICATION. This system improved the defense and offense capabilities of the ruler of the fort. THE GEOMETRICAL FORM of the fort helped the Jail to have a hierarchy based on the type of security circle required. These aspects had made it a successful jail system in itself.

(Hingorani, 2017)

2.4.3 *Why was the fort retained as a jail even after British rule?*

Along with Jail, Britishers established other administrative buildings like Collector office, Court, etc. in the surrounding area.

This already established system was working very well. Also, the proximity of jail to the court aided for easy transportation of the prisoners. Shifting the Jail during that time, when the city was not much developed and road network was not as dense as today, seemed difficult and unnecessary. Thus, the function of jail was retained in the Fort.

These potentials which had different analogies in the past but can be explored in varied ways making it relevant today.

2.4 Articles and Proposals

Conservationist and the citizens of Thane opine that, “The prison which behold chapters of our glorious freedom struggle are now a closed space housing the dark side of the community.” Elderly people, who have witnessed the development of the city and have experienced the change, have many stories to share which the young generation is not aware about. If not preserved, these narratives would be lost forever. Sadashiv Tetvilkar, one of the historians in the city, is keenly trying to bring to light these untold chapters of history through his books. Some proposals by TMC also put forth the idea of opening specific parts of the Jail for public on National Days to make them aware of history. Ideas indicating the historic revival of the fort by completely shifting the jail complex to Godbhandar region was also suggested by TMC. This would not only aid in celebration of history but also increase tourism, in turn creating an economic opportunity.

Thus, this exhausted Jail-fort has many things to offer to the city but these potentials are unexplored as it is not open for its people. The space can be a great value addition to the future smart city of Thane by its sustainable and efficient reuse.

3. MATERIAL AND METHODOLOGY

3.1 Documentation

The existing setup of the site was documented to understand the urban fabric, its strengths and weaknesses, and the potentials for development.

Figure 2: Green and Blues in City

Figure 3

Figure 4: Internal Site Setting

3.2 Survey Methodology for Sustainable Adaptive Reuse

This Methodology for deriving programmes would ensure effective adaptive reuse of the building with people's participation. This is done considering various stake-holders and their attributes & point of views and analyzing this data through the lenses of ECONOMICS, SOCIAL & CULTURAL ASPECTS. (Adaptive Sustainable Reuse for Cultural Heritage: A Multiple Criteria Decision Aiding Approach Supporting Urban Development Processes, 2020).

Step 1: Identifying groups of stake-holders.
The stake holders and their attributes considered.

- *Institutes:* Metropolitan City, TMC, etc.—Revenue Generation, Smart City, Iconic, Imagery of City.
- *Professionals in Real Estate and Conservation:* Heritage and Cultural impact, Economic impact, Development around
- *Community:* Micro level (Immediate context)—Daily usage and access, Standard of living.
- *Community:* Macro level (City/Region level context)—Benefits on larger scale, Needs and Accessibility
- *Tourism and Exchange:* Attracting Outsiders, Revenue generation.
- *Ecology:* Conservation of rich ecology, Ensuring minimum exploitation.

Step 2: Demands of different Stake-holders.

People from different backgrounds like local residents around the site, some residents across the city, Architects based in the city and Conservation architect, etc. were involved in the process of understanding their takes through different perspectives that they had. Along with this, the residents were interviewed in an open-ended manner considering different age groups. This ensured collection of different stories that the older generation had and also gave insights of how the younger generation associate with the site. One of the principal architects of a reputed firm, based in the city for many decades, was also interviewed to understand the ground realities and practical implications of the project. Since the intervention looks forward on creating an identity for the city, the image that it will portray also becomes very important. Various upcoming projects in the smart city of Thane were studied to understand this imageability and the motive behind it.

The interviews from RESIDENTS gave some triggering conclusions. There is lack of community building amenities, and the streets lack liveness and activities. The locality is quiet and enjoy a rich ecology. Circus is one of the major factors that people associate the space with along with fishing.

JAIL AUTHORITIES AND GUARDS were interviewed to understand the current conditions of the Jail. It was found that the staff find it difficult and time consuming to maintain the fort in terms of economy as well as co-ordination. The Jail also faced security related issues due to the growing residential, slums and infrastructure around.

The stakes of GOVERNMENT BODY were analyzed as a representative of how are they imagining the city to be. The main objectives were to promote Tourism and flourish the historic and environmental aspects of city. The focus is to build a strong cultural, environment conscious and smart city image which would also help gain financial benefits.

Step 3: All possible programs from site potentials, interviews, studying proposals and understanding the needs of the residents.

Space for revival of History, Sports and health/wellness center, Fishing and institute for the same, Circus art and allied activities, Bird Watching and Info center, multi-media library, Farming and institute for the same, Production and selling of Local goods (Organic vegetables, Handicrafts, etc.), Celebration spaces, Museum, Shopping + Food + Entertainment center (City center), Jail

Step 4: Various case studies (architectural interventions) in the context of above research were studied to gain the insights of their practical implications. These case studies were classified into 3 categories: Conservation of **Culture, Artform, Space, Ecology**.

4. RESULTS AND DISCUSSION

By analyzing the study above the possible program were categorized into groups according to their typologies.

GROUP 1: Culture and Heritage Conservation Center

(Spaces for heritage revival, Experiential walks, Circus art & allied activities, Sports & wellness center, Celebration spaces, Community leisure spaces, Library, selling of organic food, etc.)

GROUP 2: Entertainment and Commercial Center

(Malls, theatres, Creek water sports, Leisure spaces, Commercial areas)

GROUP 3: Institutional Spaces

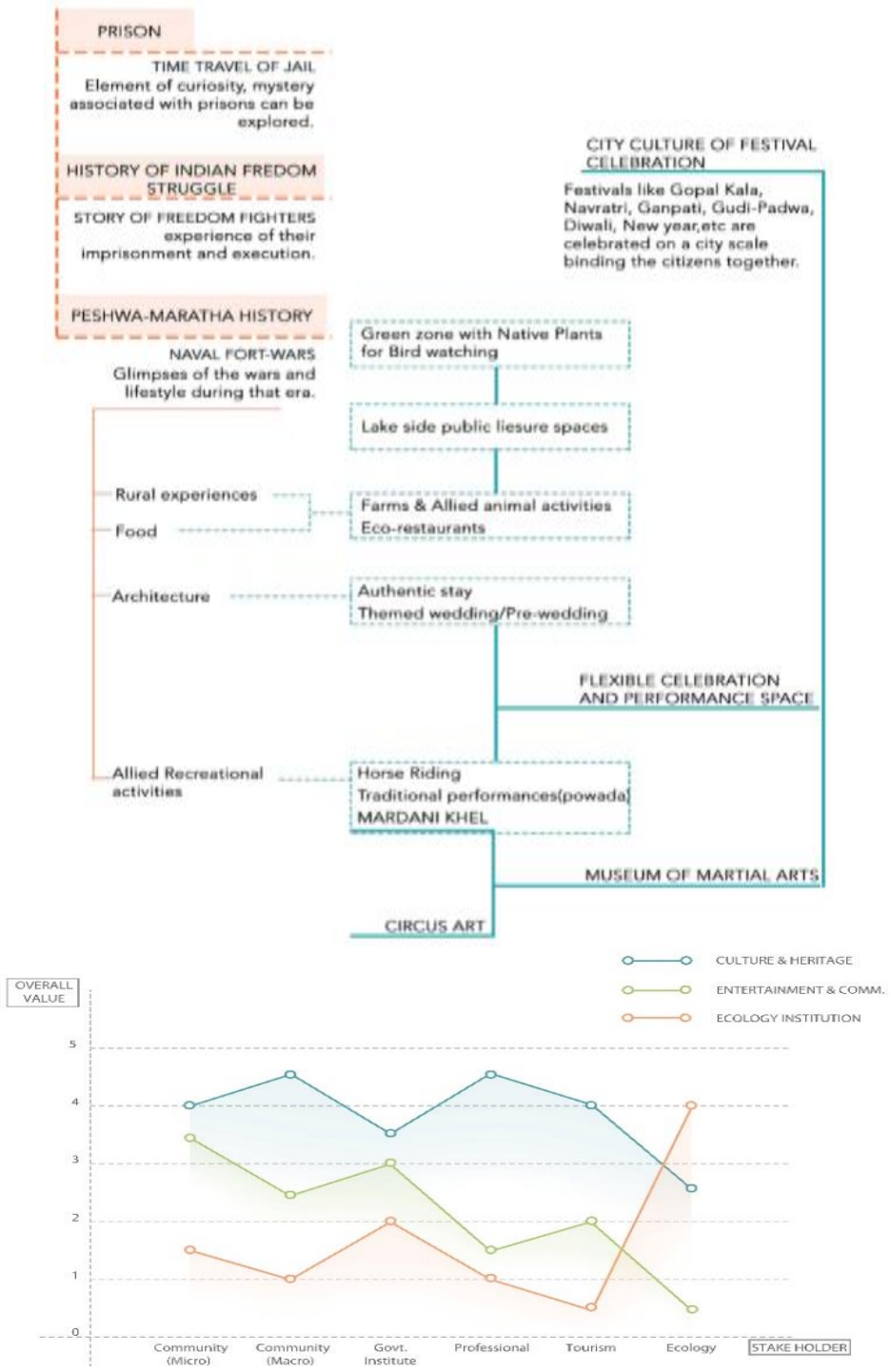
(Farming and institute, food walks, Fishing and institute, Libraries, Bird watching & info center)

Further understanding the impact of these functions on the stakeholders, a tentative typology of programs that ensured sustainable adaptation of the space was shortlisted.

The method focused on analyzing various criterias, through various perspectives of various stakeholders, allowed to arrive at a 'shared solution' capable of meeting the needs for all. It was observed that GROUP 1 typology of programs would allow balanced development meeting the needs of local community, governing bodies and can also be sustainable over time in terms of Economics.

Stakeholders / **Groups**	Community	Ecology	Reuse	Govt.Institute	Tourism
1. CULTURE & HERITAGE	23 %	15%	23%	18%	21%
2.ENTERTAINMENT & COMMERCIAL	32 %	14%	9%	27%	18%
3. ECOLOGY INSTITUTE	15 %	33%	23%	22%	8%

Figure 3: Overall Rating Graph



Flow chart 1: Program Inter-relation

5. CONCLUSION

The space can be reused/adapted, with interventions that would inspirit the cities by celebrating the past and at the same time considering the futuristic typology. The future smart cities, along with the city's history, culture, geography, ecology, etc. can create a unique identity. It will also flourish the tourist industry, benefitting the city economically as well. This can also create environmental and cultural awareness and induce a sense of pride among the residents. These spaces if flexible, can also facilitate resilience during the times of city stress.

Way Ahead: Dynamic Future of Public Spaces

As the infrastructure brought into picture 50–75 years ago is dying today, similarly whatever we built today will also eventually need rethinking. This thought for after-life of a building becomes even more crucial in case of public spaces. People these days demand for constant change. Even though, we as architects structurally imagine the life of the building to be 50–70 years but functionally, the architecture can be uneventful for the people in mere time of a decade. For example, some malls built just around –3 decades ago are deserted today. That is why, there is a need for ensuring maximum flexibility, in terms of functions and structure. The intervention should critically enquire its after-life and possess the quality of easy movement to adapt to newer times. This can be done through various concepts like 'design to dismantle', 'Adaptive reuse' 'Ephemeral Architecture', etc. Thus, the ageing infrastructure, instead of being a questionable area, can be a potential space for exploring the dynamic (ever changing) identity of the future smart cities.

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Perception of a Home—User Appropriation of Spaces

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ABSTRACT: This paper aims to understand the two terms 'House' and 'Home'. We generally define a house as a physically built structure and a home as an idea, where people are associated with each space. Each person has a different notion of a home. Architecture plays an important role to create a sense of home but there cannot be a specific solution as the association with a space changes from person to person. Five row houses from Lantana Gardens Society in Bavdhan, Pune was selected where the built character was same for all, but over the years how users have appropriated their house becomes important to understand their concept of Home. This research will help to understand the changing notion of a Home. The paper will talk about two main aspects: need-based changes and association-based changes. Qualitative method was adopted where interviews were held, literature review of book and research papers was done.

Keywords: *House, Home, Perception, Appropriation of Space, Association.*

1. INTRODUCTION

Sir Winston Churchill says: "We shape our buildings, thereafter they shape us." (Churchill, 1944) However, in today's scenario an architect designs a house and builders construct it for unknown users, thus the association of the user to the spaces lacks somewhere making it uncomfortable to live in their own house. Builders make their brief about the user needs and the built environment, not considering the values of the inhabitants. But by doing so, the intended purpose is not served to its fullest. However, there is an economical advantage of mass-produced housing but designer—user gap is created.

The basic fundamental necessity of a human being is shelter, but what kind of shelter is categorized according to the economy. Due to this economic factor, the spatial quality and spatial organization get hampered in respective housing typologies. Few of the mass-produced houses also lack socio-cultural consideration and relevance of context. Users still find their comfort zone and try to adapt to their houses by adding values to the existing areas. As an architect, one should not only think of functional spaces but also go beyond them and think of the psychological needs of a human. User appropriation of the space could be in two ways, one could be need-based changes with respect to time and the second one could be association related to those spaces and thus changes made.

Qualitative aspects such as light quality, indoor air quality, materials, spatial organizations, volume, access to nature, colour, noise, thermal comfort are the major factors affecting the quality of living. Aspects such as self-expression, sense of belonging, a desire to return home, privacy, relationship with people around and feelings (happy, sad, calm, tired, energetic, strong) affect the association to the spaces. Studying and analyzing these aspects for the site selected on how are they dependent on each other and thus have a strong impact on human psychology. The paper will also evaluate the idea of mass housing on basis of satisfying the user needs, social and cultural aspects, consideration of context and whether they have tried to give a sense of home to the users.

As there is a psychological aspect related to home, there cannot be definite answers but the research can be a driving force for better understanding the notion of a home. People come from various backgrounds, have different cultural influences and physical needs which differ from person to person. Therefore the perception of home differs for all. When we consider building a house, there can be infinite possible solutions to achieve the desired idea of home. But it is impossible to cater to all those solutions as they might not suit all the users. Since all solutions cannot be drawn, it can help to further understand the topic. (Stoneham & Desmond, 2015)

2. LITERATURE REVIEW

2.1 House

House is a physically built structure that protects us from all weather and gives us a place to stay. A house draws association to the physical nature of the built space, the materials from which it is constructed and to a lesser extent the layout from which

the inside spaces take form. This is not to say that a house may not be a home, or even psychologically become one through personalization, time and experience (Duncan, 1976). It is "a building that serves as a living quarters for one or more families".

2.2 Home

It is a place where all the family members come together and stay; they have a sense of belonging and association related. It is a place where values get nurtured. Home does not mean having spacious rooms with all the facilities. It could be a place where a person has constructed on his own according to his/her capability and needs, which will make him/her feel secured. His home becomes his expression. It is "ones place of residence" and "the social unit formed by a family living together". The kind of home a person aspires runs parallel to the personality he has developed. When a home becomes a fundamental aspect of 'being' in the world, it correlates to the ideas and desires a family has for themselves and the environment (Gunter, 2000). One can say that a house is not just walls and opening like the way people conceive it for blocks of flat, but it is a place of belonging, which builds one's psyche, personality, and perception of life as one grows. (Dengle, 1998)

To understand how people appropriate the spaces in which they live and get the feeling of home, two types of case studies were taken up, one designed project and the second, constructed by the users. Artists Village in Navi Mumbai is an incremental housing project designed by famous Ar. Charles Correa for a low and middle-income group of artists coming from fields such as art, music, sculpture, performing art, etc. It talked of the lived experience of the residents where they have modified their houses over the years. The users have personalized their houses, as a community some similarities can be seen in all the houses. Though this housing was of incremental type and designed for a specific type of users, it has been taken up to understand the changing needs of people and how do they appropriate the space. The architect had designed and envisaged the project in a particular way, over the years the project shows very little resemblance to the pictures we see of the project. Firstly it was designed as independent load-bearing structures with one or two stories, but now the new houses were two or three-storied concrete-frame structures. The project did resemble the traditional housing of the early 1900s, but the changing lifestyle led to modifications. Each house was unique which gave self-expression but post modification different colours on the facades were seen to make it unique. By using specific colour schemes and paintings done on the wall showed homogeneity at a community level. Territory was marked by placing planters or adding a compound wall. Cluster design helped in building connections with neighbours but at the same time came privacy issues. Private, semi-private and semipublic spaces were thought of but there also came a responsibility of maintenance, which was lacking. Many interviews were done and it was observed that the residents were not happy with the spatial organization, sizes of the spaces and lack of ventilation. This led to modification in their houses. Now, the residents are happy with what they have done, which they call it their home. (Mathur, 2019)

Second case study talks of Kule family and the paper draws linkages between both their houses. A farmer by background, who shifted to Bhandup, Mumbai to complete his education and get a job. Though the resident had built his house with his capabilities, the house reflected modern needs also. He had a patio and a well near his house. The area looks like a slum but has a village-like neighbourhood when experienced from inside because of small open spaces being formed in between the houses. These spaces were used for small gatherings, to have a cup of tea early morning and reading newspaper, children used to play on that patio. He had a strong connection with his village and so decided to return to Konkan and stay there for the rest of his life but his next generation stayed in Bhandup for work purposes. It was observed that the people who had space restrictions and the risk of demolition in the city were free to design and construct their houses in villages. The city houses were small but in his village, he constructed a two storey house according to his needs. As a result, various colours were given to the facades and had different styles to personalize them. Interiors and exteriors expressed the culture to which they belong to. Their house was spacious with open spaces where they had various activities (Rahul, 2020). These two situations of the same family shows how do people try and adjust to whatever they have and make the best out of it to stay there which highlights their notion of home.

To understand the meaning of house and home, looking at this topic through multidisciplinary approaches would give a different perspective. Users try to define the difference between a house and a home in their own words and languages. These words have a deeper meaning to it and are related to intangible aspects. Finding terms used in various languages can help to get an idea of the topic. Poems and other literature are some of the best ways to express the intangible aspects.

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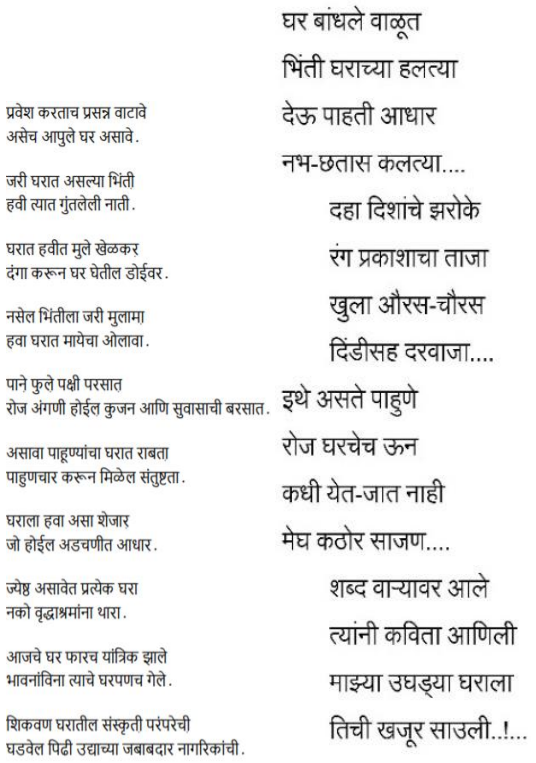

Figure 2: VastavateelKavitaGharby Mr. ShirishPingale

Source: http://www.esahity.com/uploads/5/0/1/2/501218/vastavateel_kavita_shirish_pingle.pdf

The poem is written by Sangeeta Joshi. She tries to bring out the experiential quality of being in a home. The home she talks of is build of sand where the walls are shaking, meaning they are not so strong, but still gives support to stay and a sloping roof to protect from the sky. Openings being in all directions bring ample light scattered inside the house. She overstates the sunrays as guests coming every day but no rains coming. As there are many windows, wind gushes inside singing a song. Poetess ironically says the homebeing in open, is shaded by a date tree. This means her home is exposed to the environment unprotected as date trees do not havehuge foliages. (Joshi, 2019)

The second poem written by ShirishPingle talks of the environment a home should have. When you enter a space and feel happy, that is how a home should be. Though the walls being rigid dividing into different spaces, there should be affections between the family. The poet talks of having a courtyard '*angan*' where birds come and sing songs on the trees and the rains coming inside the house. Today what we see, houses have become unemotional that where it lacks to become a home. (Pingle, 2020)

3. MATERIAL AND METHODOLOGY

After doing a literature review on Artists Village, Kule family, two poems and a brief understanding of the terms House and Home, certain research questions were identified and accordingly research methodology was adopted.

Research Questions

- What is the difference between House and Home and how do people perceive the existing house/space as their home because of which they adapt to it?
- What are the positive attributes of a house, which the users associate with more?
- What could be an architect's role or what sensitivities must be considered while designing houses specific to the context in India.
- What value additions can be done to the spaces on the unit level and cluster level?
- How have they made their house different/unique than others according to their values over the years to make it home?

The topic has a psychological aspect in it. To find answers to the research questions, the method adopted was of qualitative type. Semi-structured interviews were done and questions were asked in Hindi, Marathi and English. Questions asked were related to what activities happen in each space, what do the users like and dislike about the built form and reasons for having a specific type of interiors. These questions helped to draw out the association they had with their house from the memories they shared. To get desired answers few other questions related to their history were asked. To understand the character and function of spaces, various terms related to house and home were asked to the interviewee in their languages. Firstly, factual data of all the residents living in the society was collected in the form of a chart. It had the status of occupancy, name, duration of stay, background (community), owner/rent. 5 houses were selected on 3 criteria: Community, duration of stay (more than 20 years, 10–15 years, less than 5 years), modification done in the house. Photo documentation was done to see current houses and photos were gathered to understand how space changes with change in activities and house character before modification. 5 plates were made for 5 houses where the modification was shown through 3d models and spaces were indicated with local terms used by the users in their language. It also had a basic timeline that shows the changes made in the house.

Site selected for this research is Lantana Gardens, a row house society in Bavdhan, Pune around 30 years old society. There are three iterations identified. The houses being identical, people have changed many things in their houses over the years. Few were need-based changes and few were association-based, bringing the values of an old house into the new one. Modifications were seen because the owner of the houses has changed. A mixed community stays here, thus helping in understanding how the notion of a home change according to cultural values of different communities and at an individual level.

Figure 3: Location Plan of Lantana Society, Bavdhan, Pune

Lantana Gardens was selected as it is far from the city but well connected to the city, though it has a busy road next to it and an old neighbourhood nearby, the society is in midst of nature. The neighbourhood and the society have developed so much over the years that all required amenities are nearby but when one enters the society, he/she gets the feel of staying in a village with greens all around.

4. RESULTS AND DISCUSSION

Table 1: Factual Data of Selected Site

LOCATION-LANTANA GARDENS, BAVDHAN,PUNE					
ROW HOUSE NO	STATUS	NAME	FAMILY SIZE	BACKGROUND	OWNER/ RENT
1A	Vacant				
1 B	Vacant				
2A	Occupied	Prabhudesai	3	Maharashtrian- Brahmin	Owner
2B	Vacant				
3A	Vacant				
3B	Vacant				
4A	Vacant				
4B	Vacant				
5A	Occupied	Bora	3	Maharashtrian	Owner
5B	Occupied	Kulkarni	4	Maharashtrian- Brahmin	Owner
6A	Vacant				
6B	Vacant				
7A	Vacant				
7B	Occupied	Gulavani	2	Maharashtrian- Brahmin	Owner
8A	Occupied	Ghate	4	Maharashtrian	Owner
8B	Vacant				
9A	Vacant				
9B	Vacant				
10A	Occupied	Ghatge	-	Maharashtrian	Owner
10B					
11A	Occupied	Dinanath	2	Maharashtrian	Owner
11B					
12A	Vacant				
12B	Vacant				
13A	Occupied	Mapari	Office	Maharashtrian	Owner
13B	Occupied	Joshi	3	Maharashtrian- Brahmin	Owner
14A	Occupied	Sudha Shyam	2	South Indian	Owner
14B					
15A	Occupied	Bhavsar	4	Maharashtrian	Owner
16A	Vacant				
16B	Vacant				
17A	Vacant				
17B	Occupied	-	2	Maharashtrian	Rent
18A	Occupied	-	2	Christian	Rent
18B	Occupied	Surte	5	Maharashtrian	Rent
19A	Occupied	Vaidhya	-	Maharashtrian	Owner
19B	Occupied	Patil	4	Maharashtrian	Owner
20 A	Occupied	Patel	3	North Indian	Rent
20 B	Occupied	Ghodekar	3	Maharashtrian	Rent
21 A	Occupied	Paralikar	6	Maharashtrian- Brahmin	Owner
21 B					
22 A	Vacant				
22B					
23A	Occupied	-	5	Maharashtrian	Owner
23B	Occupied	Jogdev	4	Maharashtrian- Brahmin	Owner
24A	Vacant				
24B	Occupied	Khoppikar		Maharashtrian	Owner
25A	Vacant				
25B	Vacant				
26A	Occupied	Dsouza	4	Christian	Owner
26B	Vacant				
27A	Occupied	Thipse	1	Maharashtrian	Owner
27B	Vacant				
28A	Vacant				
28B	Occupied	Kulkarni	4	South Indian	Rent
29A	Occupied	Tamhane	5	Maharashtrian	Owner
29B	Vacant				
30A	Vacant				
30B	Occupied	Badgujar	3	Maharashtrian	Owner
	TOTAL	VACANT	28		
		OCCUPIED	32		
		OWNERS	21		
		RENT	7		

Source: Self.

The above chart represents the factual data collected of the site selected. The houses were selected according to the community, duration of stay (more than 20 years, 10–15 years, less than 5 years) and modifications done in the house. A similar observation was few families who stayed in flats wanted to shift to a big independent house as they had many restrictions in flats and now they have the freedom to do anything as their house is on ground level. The ones who stayed in bungalows previously, either at their grandmother's house or in different cities, wanted a big house at it becomes difficult to adjust in a flat after staying in an independent house. All the families had a sense of contentment as the generation who stays here has bought the house on their capabilities. The house in which they stay reflects their impression, which they wanted to have.

Figure 4: Family 1—Mrs. Jogdev

Source: Self.

FAMILY 1—Mrs. Jogdev defines a house as a shelter where people do compromise with the built, but home is where you unwind yourself. It is a stressbuster. There is always a desire to return home. They have stayed here for 10 years. Modifications were done inside the house according to the changing needs but then marginal spaces started becoming active, as the rooms were small. Terraces were used at night during summers. Quality of the marginal spaces changes according to the scale of activity happening. Gardening was done, as there is a lot of space. They have painted few things and call the marginal space as their café for which they even have given a name. (Jogdev, 2020)

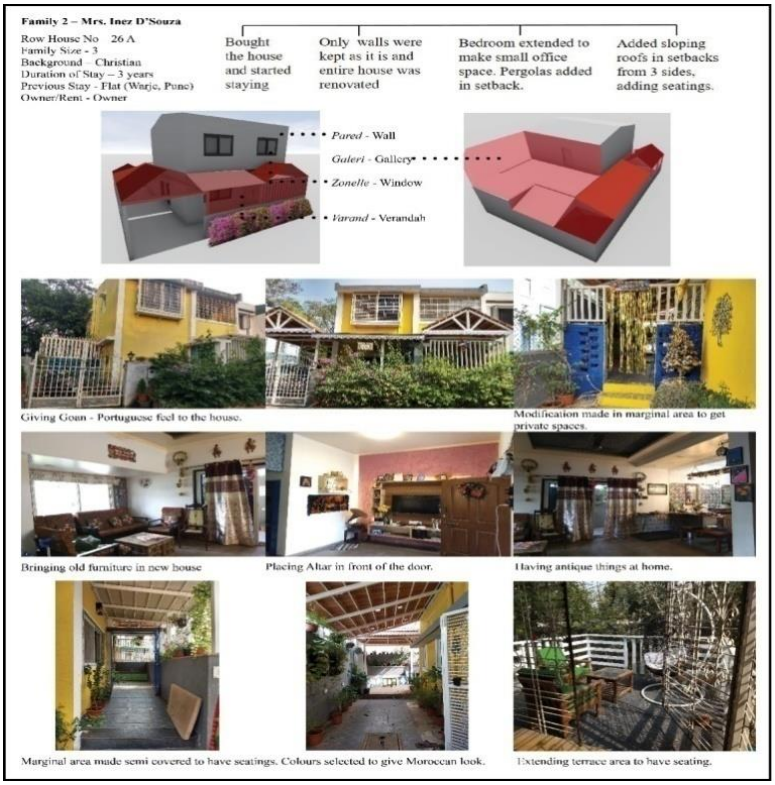

Figure 5: Family 2—Mrs Dsouza
Source: Self.

FAMILY 2—Mrs. Dsouza comes from a Goan culture and has tried to give a Goan-Portuguese look to her house. One can make out where the family is coming from as the colours, furniture, roofs relate to the houses in Goa. To comfort her parent, she has brought in furniture, which was used, at her old house in Goa. The family has associations with furniture, which get back to their mother's memories. In terms of values, placing the altar right in front of the entrance door to get that at first sight and blessings. Using anti-skid dark coloured flooring to make the house comfortable for their three dogs so that they can roam around freely. They had this idea of an open kitchen, there was no wall between the living room and kitchen which otherwise would have restricted the view. All the marginal areas are covered with the roof so that activities can spill over these areas. (D'Souza, 2020)

FAMILY 3—The third family Mrs. SudhaShyam has stayed in this society for more than 25 years here. Since the family size is small, not many changes were seen here as they have combined two row houses to make it one spacious house. The spaces, interiors and the garden reflect their association to their grandma's house in Mangalore.

The terrace was covered with Mangalore tile roof to relate to their old house. Growing fruit and other trees, which were grown in their farms, give them the feel of living in the middle of a ranch as the society has huge trees all around. Her husband has traveled to many places and has brought many decorative items which they have showcased all over in their living room. These small things bring back their memories which they are very fond of telling. They define home as a place where they always feel happy to go back. It should be a place where one is comfortable and associated with everything that is there in their home. Home should not be like a '*vastusangrailai*'. (Shyam, 2020)

Figure 6: Family 3—Mrs. SudhaShyam
Source: Self.

FAMILY 4—Mrs. Sujata Patil had shifted in this society 5 years ago. Her husband wanted a house on the ground floor *(baithaghar)* where they could connect to nature, could do many things around they used to do in the village like growing fruits, vegetables, flowers and many other plants, making compost at home and using it, so most of the waste is utilized as compost. Many changes right from plastering, plumbing, doors, windows, light fitting to adding terrace above were done. The changes were need- based. Their row house being last in the lane have an advantage of getting more marginal space in a trapezoidal shape where they have many plants.

Figure 7: Family 4—Mrs. Sujata Patil
Source: Self.

Creepers are grown over the net in this open space and the shaded area below is used for small gatherings. Daily activities like having morning tea, reading newspaper happen under the shade. Small tree branches were burnt and used to heat water for bathing and to make 'chulivarchaswyampak' during small gathering. (Patil, 2020)

FAMILY 5—Mrs. Paralikar used to stay in a flat but then shifted in this society, as they wanted a house at ground level so that her mother-in-law can go out and walk nearby. As the family members are increasing, they made many additions. Since they owned two row houses, they increased the size of living room, extended two existing bedrooms and added two more rooms for their children. They added a terrace above, covered it with a roof and a kitchen platform so that they can have small gatherings.

In a home, the environment should be pleasant, the people should feel satisfied, any person should come and go happily from the house and this makes a house a home for me. They have a big amala tree in their backyard in which they feel the presence of Lord Vishnu, Every evening they lit a *diya* near *tulsivrindavan* as a religious value.

Figure 8: Family 5—Mrs. Paralikar

Source: Self.

Their house being last in the lane, they have a bigger trapezoidal open space where they have *jhopala* (swing) but not many activities happen there. (Paralikar, 2020)

Figure 9: Mr. Kulkarni's House

Source: Self.

Since all the above five families owned the house had strong associations, but a family staying on rent for a short period can also have associations. Though they have restrictions that they cannot do any changes or additions in their house, there are small value additions done where they get adapted to the place. Mr. Kulkarni, who stays on rent, has changed two row houses in past two years in the same society. The reason being having good neighbours, peaceful environment. They could not do many additions inside the house but have utilized the setback space. Being a retired person, they took gardening as a hobby where they spent most of the time with greens around. His wife has this habit of making *rangoli* every morning and lighting a *diya* near *tulsivrindavan* (basil plant shrine). They wanted a separate space for workship *(devghar)* but could not do it. In their traditional homes, they used to write *'Annapurna prasanna'* on kitchen walls but they miss doing so. They have put up photo frames of their parents, guru and god so that every morning they pray to take their blessings and get the strength to fight anything. These are the values, which they have in their home though they do not own the house. (Kulkarni, 2020)

Analyzing the aspects mentioned above in the paper becomes crucial. All the row houses had ample of light and air ventilation and most of them have increased the sizes of the windows. Houses being on the ground floor, all families had greens growing in their setbacks, even the society being very old, huge trees are growing, and a garden accessible to all. No one changed the material but they have added rooms. There are no major changes, few have change the orientation of the first 3 steps as it becomes a hindrance will going to the washrooms. Another noticeable aspect was the edge of the house. All the houses have something peculiar that makes them different from others. These highlight the culture to which they belong; the beautification done at the entrance is different. All the houses have seatings, swings (*jhopala*) chairs at the entrance door so that people can sit, do their activities and connect to the neighbours. Three houses have low height chain fencing, which marks a boundary of their house, provides a sense of security but at the same time has a clear vision of what all is happening outside. People have planters outside or inside the fence to cut the vision for people coming from outside. The other two houses have compound wall at the front side so that nothing is visible from outside and they have private space where seatings are provided.

The use of setbacks is different for all the families and the way these setbacks are treated is also different. 2 families have kept it entirely open as they don't use the setbacks very often. Family 4 has a green cover going horizontal, which acts as a roof, and this place is accessible to anyone, there are no barriers. Family 2 has covered the setbacks from all sides with roof, compound wall and pergolas so that they get entire private space and nothing can be seen from outside. Family 1 has more association to the outsides as they spend more time. They keep changing the look of the area they have. They have themes, which they follow and decorate accordingly. Any passer-by can see what is happening there, can sit and talk. There are varieties of gates, which can be seen. Some have kept it the way it was provided by the builder, some have changed the gate and installed decorative gates and one family has removed a bigger gate so that anyone can access their marginal space and installed a smaller gate for one person to at a time. Though there is a 15m wide road going parallel to the society, there is continuous traffic noise but as one goes inside the lanes, there is less noise. Though there are 3 iterations seen in the society, few row houses have problems with the position of windows. Harsh sun rays hit the bedrooms and the users used thick curtains.

6. CONCLUSION

From the above study, one can say that there are few negotiable and non-negotiable aspects that can be drawn which contributes to the sense of belonging.

Negotiable Aspects

- Sizes of living room and bedroom.
- Maintaining a big house.
- Direction of entry to the house for few families.
- Separate room for *devghar.* Though it was not provided earlier, people have *devghar* in kitchen itself. Combined row house families have given a separate room later.

Non-Negotiable Aspects

- Value and position of *tulsivrindavan* and *devghar.*
- Direction of entry to the house for few families.

- Connection with open spaces (marginal areas from 3 sides) where all the selected families do gardening and have talk with neighbours.
- Planting specific trees and the association towards them.
- Placing small idols or frames or stickers or any other noticeable thing, which hints on to the culture a family, belongs to.

By analysing few houses, the idea of House and Home cannot be generalised to all. However, while designing some flexibilities can be given so that the users can appropriate the space. Like in the case of Belapur housing, though it is an incremental type designed for specific community, one can always see how planning was done which provided flexibility to the residents, organization of built and unbuilt spaces, not having rigid boundaries. The above analysis and literature review can be a way of thinking instead of being a design guideline. Few points discussed above which are seen as changes common amongst many families might help to expand the concept of home, which can be universal. The qualitative aspects mentioned above, analyzed for five houses have proved to be valid and correct which have affected the quality of living and users association to the spaces. These have helped them to define their meaning of House and Home. These aspects need to be considered every time and need to be strengthened while planning. The architectural elements analyzed for selected houses highlight the impact Architecture has on the perception of a space, which then makes it a home. If we consider this society, initially all the houses had same character but over the years, families have appropriated it according to their needs and capabilities. Here economic factor comes into place. Row houses having the advantage of being on ground level have some place to expand whereas in a flat system there are many restrictions. A concern arises that the families who stay in flats have very little scope to make changes. Changes seen are mostly in interiors. Further, in-depth research can be done on how the users in flat system get a homely feeling. Floor plans being the same for all irrespective of orientation consideration, which can be placed anywhere in the city, how the users make it their own home. What design considerations need to be thought of which might give them flexibility. This topic can also lead to further research for houses on rent where tenant's perception of spaces might hint at common guidelines.

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Types and Applications of Xeriscaping in Landscape Design

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ABSTRACT: Landscape is a vital component of the urban environment that can provide environmental, human health, psycho-social and economic benefits, it is also a large user of water. Landscape design today integrates a wide variety of functional elements. Xeriscaping can be applied to any landscape design and may require 2 or 3 years to develop a xeric landscape as it is a form of landscape design that uses less amount of water, thus solving the problems such as water scarcity, droughts, etc. The main motive of this research is to study the applications of xeriscaping in landscape design. Using the principles of xeriscaping, applications, collect information in terms of location, types, methods, uses, medicinal benefits. To study the environmental and landscape design aspects and summarize physical and aesthetic properties of various plants by exploring the applications of various types of Xerophytes.

Keywords: *Xeriscaping, Landscape Design, Xeric Plants, Water, Irrigation.*

1. INTRODUCTION AND BACKGROUND OF STUDY

The research paper deals with the types and applications of xeriscaping in landscape design. The main aim of the paper is to study the types and applications of xeriscaping in landscape design by focusing on 5 objectives which are to study the principles of xeriscaping, study the applications of xeriscaping in landscape, collect information on xeriscaping in terms of location, types of plants, methods, uses, etc. and understand the medicinal importance of the xerophytes. (xeriscaping plants), analyze collected data in terms of observations and inferences. The scope of the paper is to study the environmental and landscape design aspects, to summarize physical and aesthetic properties of various plants, exploring the applications of various types of Xerophytes. Xeriscaping is a branch of landscaping which consists of the plant species which require less amount of water as compared to the other landscaping types. In landscaping, there is a huge water usage whereas in xeriscaping we can create a functional and beautiful outdoor space using less amount of water. Xeriscaping is a technique for designing landscape by reducing the water usage or by promoting irrigation. It was first introduced in Denver due to the scarcity of water, a new concept evolved which used less water and also achieved a beautiful outdoor spaces. Mostly the plants used are native plants as it requires less maintenance instead of using exotic species which would require constant attention and water to survive. Using native plants, also be able to reduce or eliminate the need for fertilizers and pesticides. Xeriscaping is now popular in some of the regions due to its environmental and financial benefits. The most important environmental aspect of xeriscaping is selecting vegetation that's appropriate for the climate. Vegetation that thrives with little added irrigation is named drought-tolerant vegetation. Xeriscaping often means replacing grassy lawns with soil, rocks, mulch, and drought-tolerant native plant species. Plants that have especially adapted to arid climates are called xerophytes. Saves water, less maintenance, no fertilizers or pesticides, improves property value, pollution free atmosphere, provides wildlife habitat are some benefits of xeriscaping. Planning and style, soil analysis., practical turf areas, appropriate plant selection, efficient irrigation, use of mulches, appropriate maintenance are a number of the principles of xeriscaping which are further detailed out in the paper.

2. LITERATURE REVIEW

Xeriscaping is the practice of designing landscapes to scale back or eliminate the necessity for irrigation. This means xeriscaping landscapes need little or no water. Xeriscaping's purpose is to scale back water usage and maintenance by transforming the landscape with native plants rather than using varieties that are not local to your region, which likely need constant attention and watering to survive. Every type of landscape requires proper maintenance which is achieved but

proper planning and designing that makes it efficient. The research paper illustrates the issues and tries to give a basic idea of solutions to save water in landscaping but also maintain the aesthetic and functional value of landscaping. This research can also apply to different areas, cities with some contextual changes in it, the research paper can act as a baseline for it. The secondary data is collected using references from various books about xeriscaping and some internet sites and some notable reference of some similar research papers performed in the past.

There are numerous reasons why this type of arrangement should be taken into consideration: lowered consumption of water, reduce maintenance and less cost to maintain, reduced waste and pollution, reduce fertilizer use. A well-planned xeriscaping landscape, besides the presented benefits can be as successful as any other type of garden design. Although it involves conserving water it can be attractive, colorful and it utilizes a variety of styles (even formal style), shapes and textures. Contrary to the impression that "xeriscaping" shall include only cacti and succulents, many ornamental herbaceous and woody plants can be used for this type of arrangement. The common qualities of the plants intended for "xeriscaping" landscapes justify the use of certain groups of ornamental plants, as well as species: spontaneous, succulent, decorative herbs, some perennial and annual species.

3. METHODOLOGY

The paper combines the articles and conference proceedings by searching the keywords and the original content and data from official websites of xeriscaping and some books related to the same. The method of this paper consists of 7 principles. All the data collected is from the online methods due to the pandemic.

4. RESULTS & DISCUSSION

Incorporate as numerous of the natural principles of the location into the design as possible, resembling as existing trees and shrubs. untroubled native plants won't need water fore-establishment and may be more water efficient than new plantings. The public area is the largely visible area that most visitants see, such as the entry to the home. In a traditional landscape, this area generally receives the most care, including the most water. Thus, the careful design of this area is important for water conservation. This area can be designed to require minimum water and conservation without sacrificing quality or appearance.

The private area of the landscape, generally the neighborhood, is where maximum outdoor activity occurs. It's generally the family gathering area. It may also include a vegetable garden or fruit farm. The landscape in this area needs to be functional, appealing and durable, but it also should be designed to require lesser water than the public area of the landscape.

The service area is the working or serviceability area of the landscape, an area commonly screened from view and containing similar items as scrap barrels, outdoor equipment, air- conditioning units or a doghouse. In terms of routine preservation, this area would be designed to require the least care and water of the three areas.

Develop a Master Plan Once you have settled on a design scheme and a water administration arrangement, give form and portrayal to the varied spaces in your plan. With the identification of planting spaces as well as edging materials, groundcovers and paving, the master plan begins to take form. This is a plan showing the final product of your sweats. Straight lines or smooth flowing curves are elegant—tight turns or needless bends can be conservation problems. Use right angles and avoid acute angles that are delicate to maintain and irrigate. Remember that simplicity in the design will ensure easy conservation and water—use effectiveness. A prototype masterplan.

The shrub beds in the public and private areas of the landscape to give seasonal interest, variety and reduced maintenance. Shade-tolerant ground covers are used under the existing trees on the left side of the front and right back of the property. A large area in the left back of the property was made a natural mulch play area for children. Note how the water—use zones changed during the redesign of the property.

		VINES						
Botanical Name	Common Name	Flower Color/ Time of Bloom	Growth Rate	Group	Exposure			
Antigonon leptopus	Coral Vine	Reddish Pink/ Summer	Fast	Deciduous	Sun			
Campsis radicans	Trumpet Vine	Orange/Summer	Fast	Deciduous	Sun/Shade			
Clematis hybrids	Flowered Clematis	Purple, Pink White/Spring	Medium	Deciduous	Sun/Semi-shade			
Fatshedera lizei	Fatshedera	Not Showy	Medium	Evergreen	Shade/Semi-shade			
Ficus pumila	Climbing Fig	Not Showy	Slow	Evergreen	Sun/Shade			
Gelsemium sempervirens*	Carolina Jessamine	Yellow/Spring	Medium	Evergreen	Sun/Semi-shade			
Lonicera x heckrottii	Goldflame Honeysuckle	Pink/Spring	Fast	Evergreen	Sun/Semi-shade			
Lonicera sempervirens*	Trumpet Honeysuckle	Orange-Red Yellow/Spring	Fast	Evergreen	Sun/Semi-shade			
Parthenocissus quinquefolia	Virginia Creeper	Greenish White/Summer Not Showy	Fast	Deciduous	Sun to Shade			
Parthenocissus tricuspidata	Japanese Creeper	Not Showy	Fast	Deciduous	Sun/Shade			
Rosa banksiae	Banks Rose	White/Spring	Fast	Semi-evergreen	Sun			
Rosa species	Climbing Roses	Many Colors/Spring	Fast	Deciduous	Sun/Semi-shade			
Trachelospermum jasminoides	Star or Confederate Jasmine	White/Summer	Medium	Evergreen	Sun			
		GROUND COVERS						
Botanical Name	Common Name	Flower Color/ Time of Bloom	Normal Height	Growth Rate	Group	Exposure		
Ajuga reptans	Carpet Bugle	Purple/Spring	2-4 in.	Medium to fast	Evergreen	Shade/Semi-shade		
Hedera canariensis	Algerian Ivy	None	6-8 in.	Medium	Evergreen	Shade/Semi-shade		
Hemerocallis spp.	Daylily	Many colors/ Summer	12 in.	Fast	Evergreen	Sun/Semi-shade		
Hypericum calycinum	Aaronbeard /St. Johns Wort	Yellow/Spring	8-12 in.	Medium to fast	Semi Eevergreen	Sun/Semi-shade		
Juniperus conferta	'Blue Pacific'/Shore Juniper	None	12-18 in.	Fast	Evergreen	Sun		
Juniperus horizontalis	Creeping Juniper	None	12-24 in.	Moderate	Evergreen	Sun		
Ophiopogon japonicus	Dwarf Lilyturf or Mondo	Not Showy	5-6 in.	Medium	Evergreen	Shade		
Phlox subulata	Moss Phlox or Thrift	Pink, White,Purple/Spring	3-4 in.	Medium	Evergreen	Sun		
Trachelospermum asiaticum	Asiatic Jasmine	Fine	4-6 in.	Medium	Evergreen	Sun/Semi-shade		
		ORNAMENTAL GRASS						
Botanical Name	Common Name	Texture	Height and Spread	Panicle Length	Exposure			
Calamagrostis x acutiflora	'Stricta' /Feather Reed Grass	Fine	5 ft./3 ft.	12 in.	Sun			
Carex morrowii	Japanese Sedge Grass	Fine	1 ft./1 ft.	3 in.	Sun/Semi-shade			
Chasmanthium latifolium*	Upland Sea Oats	Fine	3 ft./2 ft.	8 in.	Sun/Semi-shade			
Cortaderia sellonana	Pampas Grass	Fine to Medium	8 ft./6 ft.	20 in.	Sun			
Cortaderia sellonana 'Pumila'	Dwarf Pampas Grass	Medium	3 ft./4 ft.	2 ft.	Sun			
Elymus glaucus	Blue Wild Rye	Medium	5 ft./4 ft.	10 in.	Sun			
Erianthus ravennae	Ravenna Grass	Medium to Coarse	9 ft./4 ft.	20 in.	Sun			
Miscanthus sinensis 'Strictus'	Porcupine Grass	Medium	7 ft./4 ft.	12 in.	Sun			
Miscanthus sinensis 'Variegatus'	Variegated Equalia	Fine	6 ft./3 ft.	11 in.	Sun			
Pennisetum alopecuroides	Australian Fountain Grass	Fine	3 ft./2 ft.	3 in.	Sun			
Pennisetum setaceum	Fountain Grass	Fine	4 ft./4 ft.	12 in.	Sun			
Pennisetum setaceum 'Rubrum'	Crimson Fountain Grass	Fine	4 ft./4 ft.	12 in.	Sun			
Pennisetum villosum	Feathertop Grass	Fine	3 ft./2 ft.	3 in.	Sun			
Phalaris arundinacea 'Picta'	Ribbon Grass/Gardeners-Garters	Fine	2 ft./3 ft.	6 in.	Light Shade			
		SMALL SHRUBS						
Botanical Name	Common Name	Texture	Form	Normal Height	Growth Rate	Group	Exposure	
Abelia x grandiflora	Abelia	Fine	Irregular to Oval	3-4 ft.	Slow	Evergreen	Sun/Semi-shade	
Aucuba japonica 'Nana'	Dwarf Aucuba	Coarse	Oval	3-4 ft.	Slow	Evergreen	Shade/ Semi-shade	
Berberis thunbugi	Japanese Barberry	Medium	Oval	3-5 ft.	Medium	Evergreen	Sun/ Semi-shade	
Buxus microphylla var. japonica	Semi-Japanese Boxwood	Fine	Rounded	3-4 ft.	Slow	Evergreen	Sun/Shade	
Deutzia gracilis	Slender Deytzia	Fine	Mounded	2-4 ft.	Medium	Semi evergreen	Sun/ Semi-shade	
Gardenia radicans	Creeping Gardenia	Fine	Spreading	2-4 ft.	Slow	Evergreen	Semi-shade	
Azaleas	Hybrids	Fine	Upright Spreading	3-5 ft.	Slow to Medium	Evergreen	Semi-shade	
Hydrangea arborescens	'Annabelle'/Smooth Hydrangea	Coarse	Rounded	3-5 ft.	Fast	Semi evergreen	Sun	
Ilex cornuta 'Carissa'	Carissa Holly	Medium	Rounded	3-4 ft.	Slow	Evergreen	Sun/Semi shade	
Ilex cornuta 'Rotunda'	Dwarf Chinese Holly	Coarse	Rounded	3-4 ft.	Slow	Evergreen	Sun/Semi shade	
Ilex crenata 'Compacta'	Compacta Holly	Fine to Medium	Rounded	3-4 ft.	Medium	Evergreen	Sun/Semi shade	
		MEDIUM SHRUBS						
Botanical Name	Common Name	Texture	Form	Normal Height	Growth Rate	Group	Exposure	
Aucuba japonica	Japanese Aucuba	Coarse	Upright	6-8 ft.	Medium	Evergreen	Semi-shade/shade	
Berberis julianae	Wintergreen Barberry	Medium	Oval	5-6 ft.	Slow to Medium	Evergreen	Sun	
Buxus sempervirens	Common Boxwood	Fine to Medium	Rounded	5-8 ft.	Slow to Medium	Evergreen	Semi-shade	
Forsythia intermedia hybrids	Border Forsythia	Medium	Irregular	5-7 ft.	Fast	Deciduous	Sun	
Hydrangea macrophylla	Bigleaf Hydrangea	Coarse	Rounded	5-8 ft.	Fast	Semi evergreen	Sun	
Hydrangea quercifolia	Oakleaf Hydrangea	Coarse	Upright Irregular	6-8 ft.	Medium	Deciduous	Sun	
Ilex comuta	'Burfordii Nana' /Dwarf Burford Holly	Medium To Coarse	Rounded	5-6 ft.	Slow	Evergreen	Sun/Semi-shade	
Ilex glabra		Medium	Rounded	6-8 ft.	Medium	Evergreen	Sun/Shade	
Jasminum mesnyi	Primrose Jasmine	Medium	Mounded Trailing	5-6 ft.	Medium	Evergreen	Sun/Semi-shade	
Kalmia latifolia *	Mountain Laurel	Medium	Upright	5-8 ft.	Slow to Medium	Evergreen	Semi-shade	
Southern Indian Azalea		Medium	Rounded Irregular	5-8 ft.	Medium to Fast	Evergreen	Semi-shade	
Spiraea prunifolia	'Plena' /Bridalwreath Spirea	Fine to Medium	Rounded	5-7 ft.	Medium to Fast	Deciduous	Sun	
Spiraea vanhouttei	Vanhoutte Spirea	Medium	Rounded	5-7 ft.	Medium to Fast	Deciduous	Sun	
Yucca filamentosa	Adam's Needle Yucca	Coarse	Upright	5-6 ft.	Medium	Evergreen	Sun	
		LARGE SHRUBS						
Botanical Name	Common Name	Texture	Form	Normal Height	Growth Rate	Group	Exposure	
Rhododendron canescens*	Piedmont Azalea (Rosy Purple Flower)	Medium	Rounded	10-15 ft.	Medium	Deciduous	Semi-shade/Shade	
Rhus typhina	Staghorn Sumac	Fine	Open Spreading	15-25 ft.	Fast	Deciduous	Sun/Semi-shade	
Temstroemia gymnanthera	Cleyera	Medium	Upright	8-10 ft.	Slow to Medium	Evergreen	Sun/Semi-shade	
Viburnum lantana	Wayfaringtree Viburnum	Coarse	Round Spreading	10-15 ft.	Medium	Deciduous	Sun/Semi-shade	
Viburnum opulus	European Cranberrybush Viburnum	Coarse	Upright Spreading	8-12 ft.	Medium	Deciduous	Sun/Semi-shade	
Viburnum plicatum var. tomentosum	Doublefile Viburnum	Coarse	Round Spreading	8-10 ft.	Medium	Deciduous	Sun/Semi-shade	
Viburnum x pragense	Prague Viburnum	Medium	Oval	10- 12 ft.	Medium	Deciduous	Sun/Semi-shade	
		SMALL TREES						
Botanical Name	Common Name	Texture	Form	Normal Height	Spread	Growth Rate	Group	Exposure
Acerbuergeranum	Trident Maple	Medium	Oval	20-25 ft.	10-15 ft.	Slow	Deciduous	Sun
Carpinus caroliniana*	American Hornbean(Ironwood)	Medium	Loose Rounded	20-30 ft.	15-25 ft.	Slow	Deciduous	Sun/Shade
Cercis canadensis*	Redbud or Judas Tree	Medium	Oval	25-30 ft.	20-28 ft.	Medium	Deciduous	Sun/Shade
Chionanthus virginicus *	Fringe Tree or Grancy Gray-beard	Coarse	Irregular	10-20 ft.	15-20 ft.	Slow to Medium	Deciduous	Sun/Semi-shade

Cotinus coggygria	Common Smoketree	Medium	Upright Spreading	10-15 ft.	10-15 ft.	Medium	Deciduous	Sun/Semi-shade
Erlobotrya japonica	Loquat	Coarse	Rounded	10-20 ft.	8-12 ft.	Medium to Fast	Evergreen	Sun
Halesia carolina*	Silverbell	Medium	Spreading	20-30 ft.	15-20 ft.	Medium	Deciduous	Sun/Semi-shade
Ilex x attenuate 'Savannah'	Savannah Holly	Coarse	Pyramidal	25-30 ft.	10-15 ft.	Medium	Evergreen	Sun/Shade
Ilex decidua	Possumhaw	Medium	Loose Rounded	20-30 ft.	15-20 ft	Medium	Deciduous	Sun/Semi-shade
		LARGE TREES						
Botanical Name	Common Name	Texture	Form	Normal Height	Spread	Growth Rate	Group	Exposure
Acer floridanum*	Florida Maple or Southern Sugar Maple	Medium	Oval	40-50 ft.	20-25 ft.	Medium to Fast	Deciduous	Sun/Semi-shade
Acer rubrum*	Red Maple	Medium	Rounded	40-50 ft.	25-35 ft.	Medium	Deciduous	Sun/Semi-shade
Acer saccharum	Sugar Maple	Medium	Oval	60-80 ft.	25-40 ft.	Medium to Fast	Deciduous	Sun/Semi-shade
Betula nigra*	River Birch	Medium	Oval	40-70 ft.	40-60 ft.	Fast	Deciduous	Sun
Carya illinoensis	Pecan	Medium	Rounded	50-60 ft.	30-40 ft.	Medium	Deciduous	Sun
		ANNUALS						
Botanical Name	Common Name	Height (in.)	Planting time	Exposure				
Ageratum houstonianum	Ageratum	24	Spring/Summer	Partial Shade				
Anthirrhinum majus	Snapdragon	6 to 36	Spring/Fall	Sun/Partial Shade				
Begonia x semperflorens	Wax Begonia	6 to 12	Spring/Summer	Partial Shade/Shade				
Brassica oleracea	Ornamental Kale	6	Early Fall/Late Winter	Sun				
Calendula officinalis	Calendula	12 to 24	Early Fall/Late Winter	Sun				
Capsicum annuum	Ornamental Pepper	6 to 12	Spring/Summer	Sun				
Catharanthus roseus	Madagascar Periwinkle	6 to 18	Spring/Summer	Sun/Partial Shade				
Celosia cristata	Cockscomb	6 to 30	Spring/Summer	Sun				
Cleome hasslerana	Spider Plant	36 to 60	Spring/Summer	Sun				
Coleus x hybridus	Coleus	12 to 36	Spring/Summer	Partial Shade/Shade				
Cosmos bipinnatus, /C. x sulphureus	Cosmos	12 to 48	Spring/Summer	Sun				
Digitalis purpurea	Foxglove	12 to 60	Fall/Spring	Sun/Partial Shade				
Eschscholzia californica	California Poppy	12 to 24	Early Fall/Late Winter	Sun/Partial Shade				
Gaillardia pulchella	Blanket Flower	12 to 30	Spring/Summer	Sun				
Gomphrena globosa	Globe Amaranth	8 to 24	Spring/Summer	Sun				
Impatiens wallerana	Impatiens	6 to 36	Spring/Summer	Partial Shade/Shade				
Limonium sinuatum	Statice	12 to 24	Spring/Summer	Sun				
Lobularia maritima	Sweet Alyssum	4 to 8	Early Fall/Late Winter	Sun/Partial Shade				
Melampodium paludosum	Melampodium	24 to 36	Spring/Summer	Sun/Partial Shade				
Nicotiana alata	Flowering Tobacco	12 to 36	Spring/Summer	Sun/Partial Shade				
Pelargonium x hortorum	Geranium	12 to 24	Spring/Summer	Sun/Partial Shade				
Petunia x hybrida	Petunia	6 to 12	Spring/Summer	Sun				
Portulaca grandiflora	Rose Moss	1 to 3	Spring/Summer	Sun				
		TURFGRASS						
Botanical Name	Common Name	Shade Tolerance	Propagation	Green Foliage	Plant			
Axonopus affinis	Carpet Grass	Fair	Seed	Spring, Summer, Fall	May-July			
Cynodon dactylon hybrids	'Tifway', 'Tifgreen', Bermuda	Poor	Sprigs,Plugs, Sod	Spring, Summer, Fall	May-July			
Eremochloa ophiuroides	Centipede	Fair	Sprigs,Seeds,Plugs, Sod	Spring, Summer, Fall	May-July			
Festuca arundinacea	Tall Fescue	Good	Seed, Sod	Most of Year	Sept-Oct			
Poa pratensis	Kentucky Bluegrass	Good to Fair	Seed, Sod	Most of Year If in Shade	Sept-Oct			
Stenotaphrum secundatum	St. Augustine	Excellent	Sprigs,Plugs, Sod	Spring, Summer, Fall	May-July			
Zoysia hybrids	'Emerald', 'Meyer', 'Matrella',Zoysia	Good	Sprigs,Plugs, Sod	Spring, Summer, Fall	May-July			

5. CONCLUSION

There are numerous reasons why this type of arrangement should be taken into consideration: lowered consumption of water, reduce maintenance and less cost to maintain, reduced waste and pollution, reduce fertilizer use (NPK).

A well-planned xeriscape landscape, besides the presented benefits can be as successful as any other type of garden design. Although it involves conserving water it can be attractive, colorful and it utilizes a variety of styles (even formal style), shapes and textures.

Contrary to the impression that "xeriscaping" shall include only cacti and succulents, many ornamental herbaceous and woody plants can be used for this type of arrangement.

The common qualities of the plants intended for "xeriscape" landscapes justify the use of certain groups of ornamental plants, as well as species: spontaneous, succulent, decorative herbs, some perennial and annual species.

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Study of Different Façade and Roofing Systems for Automobile Industry, Pune City

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ABSTRACT: After the make in India products, the Industrialist welcomes the dealers, clients to enter their premises and look at what has been created through customer experience center meanwhile people tendency towards being just a temporary shed which is not the case nowadays. The structural system consists of rigid frames that are fabricated from plate steel and a "cold-formed structure. An industry promoted development proposal industrial building proposal out of lots of new materials & technologies. Different types of construction method have been implemented such as Façade design is the art of creating and giving space an aesthetical touch. Façade system being played a very important role in architectural design. This study, as a postgraduate project, is aimed at functions for façade design and execution systematics further studies that will investigate various other parameters and explore the outcomes of different areas of construction management functions in terms of strategies for implementing.

Keywords: *Industrial Buildings, Structural System Materials, Roofing, Building Elements, Aesthetics.*

1. INTRODUCTION & BACKGROUND OF THE STUDY

As manufacturing activities grew, transportation industries expanded to support the new production capacities. Delhi service industry contributes the largest chunk of the State Domestic Product about 70% out of which 25–30% is into automobile industrial complexes. Bangalore has a wide range of all types of industries as well automobile industry. The state provides 20 percent in the automobile Industrial sector. In Mumbai and NaviMumbai, two important recommendations have been given that have influenced the planning for the MIDC area and Industrial Sectors. Pune is the centre of large industrial as well as automobile clusters like M.I.D.C areas such as Talegaon, Pimpri-Chinchwad, Bhosari, Ranjangaon, Chakan, Khed, etc. The township of PCMC is having over 5,000–7000 manufacturing units. It is generally observed that maximum German Companies come to Pune for business. There are over 225 German companies that have set up their businesses here. Located on the Delhi Mumbai Industrial Corridor has promoted these things to a greater height. Pune is one of the biggest automobile markets with giant manufacturing companies, including Bajaj Auto, Tata Motors, Mahindra & Mahindra, Force Motors, and Volkswagen. Several component manufacturers of automotive parts like TATA, Robert Bosch GmbH, ZF Friedrichshafen AG, Visteon and Continental AG are located here. The fifth-largest automotive industry in the world is there in India and will be the third-largest in coming years. Catering to a vast domestic and international market, modes of fuel-intensive mobility will not be as sustainable in the future, to address the automobile industries that are developing an option of Electric Vehicles and has targeted achieving 70–80 percent electrification by 2030–2035. In India Industrial shed started with the conventional method which were having solid plinth machine foundations only and with a general span ranging between 30m x 60m. These are generally two-coloured blue-white combinations or single-color sheet roofing and cladding structures with heavy sections used for structural support members. The Industries used to have a typical plaster-painted RCC building for office in front and a north lightor a conventional Industrial shed just behind the RCC building. Nowadays which is not the case after the technology is coming day by day it is been upgrading like P.E.B structure, lightweight metal structure, Cold form structure, etc with the help of aesthetical elements to it, which will be seen ahead in this paper.

- **Research Question:** Why has architectural design experimentation in industrial buildings not been seen in India?
- **Research Gap:** Technology and different material palette options are available for Industrial construction happening on such a large scale then why architectural design experimentation has not been seen over these years.
- **Aim:** To study the technical aspects of construction and details of the different roofing and façade system.
- **Objectives:** The main objective is to make a comparison and recommendation to aim at the above architectural design experimentation and how it can be aesthetically aswell as technically apt.

What are the implications of experimentation?

Structural Systems material used for cladding roofing etcalong with sustainable materials part if any can be used.

- **Scope:** Study for façade and roofing system of Automobile Industry only, for architectural and aesthetical factors.
- **Limitations of the study:** The study has been limited to automobile industrial buildings limited to Pune industrial zone only.

Available Material Palette.

Cost and time factors are not being analysed.

2. LITERATURE REVIEW

Manufacturing Process of Automobile Industry: Components of the auto factory represent solely the ultimate innovative method of producing an automobile, for it's here that the parts are provided by several outside suppliers. Chassis are the type where vehicles are constructed from the scratch to the whole body. The frame is the base on which the body rests & from that allalternative assembly elements follow. The vehicle body type, the ground set up is the biggest body part to that a mess of other parts and braces can later be welded. As it moves down the assembly line, all the fixtures is been clamped simultaneously and the core of the vehicle is built. Before painting, the body passes through a rigorous inspection process, while the body in operation. The bodyof the whole vehicle goes through process of whole lit room where it is fully wiped down by inspectors using cloths soaked in oil. Finally, Interior finalization the painted shell proceeds through the interior area where workers assemble all of the parts which includes wiring, dash panels, lights, seats, door and trim panels, speakers, all glass except the windshield, steering column, and wheel, body weather strips, vinyl tops, brake, carpeting, and front and rear bumper fascia's and vehicle are ready for a test drive and wash test and then despatched. Due tothe departmentalization of work & process, it can be divided at different locations.

Considerations & Elements in Industrial Construction Components of the automobile assembly plant represent the architecture design which should add character while providing flexibility to the design and functional aspect of industries. All elements including the aesthetics, scale of the industries, materials colors, roof styles, openings, towards responsive architectural design. All Industries should be energy-efficient to conserve natural resources. Buildings' appearance should be reduced to feel a massive box or a typical shed. The front side of industries in most cases has been seen from the roadside, therefore, it should include architectural features such as a great aesthetical features which include large glass façade windows, openings, change in color, texture, and material which will add special aesthetic elements to building. Exterior material and color selection in aesthetically pleasing, of high quality & compatible with materials structure and nearby environment.

Figure 1: Typical Conventional Industrial Shed

Source: http://www.karimindustrialsheds.com

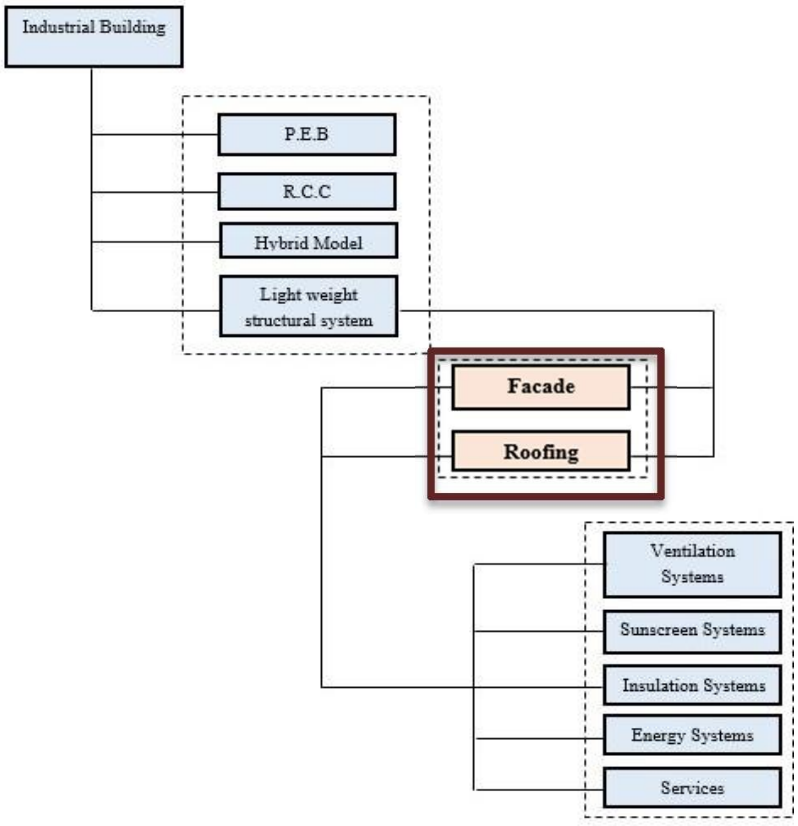
A comprehensive material scheme and color scheme should be developed for every site. Industry branding and signage should be compatible with the main building on the site. The exterior façade of Industry shall be factory finished stained, integrally colored, or other suitable. Materials include split face or concrete finish colors, precast

concrete, painted or stained site concrete, factory finish, standing seam metal roofing, galvanized metal roofing, insulated glazing panels, High reflective mirror glass, sandwich panels, etc. It's been observed that despite different architects and architectural designsthe Industrial buildings look the same.

2.1 Roofing Systems

Industrial buildings have numerous forms of roof pattern several of which has a flat roof, pitched roof, superimposed roof, insulated roof, standing seam roof, galvanized color roof systems, etc. The choice of roofing system should be considered keeping in mind various factors such as ventilation, natural light, rainwater, climatic conditions, wind velocity, loading, costing, etc. Generally, there is partial translucent sheeting being done on roofing for natural light to come inside premises along with a turbo ventilator. In most common means of admitting Daylight is through the roof light. Electric lightning is usually designed as though there was no daylight, in terms of achieving the desired illumination of lux level. However, the vendor or the consultant should be aware of the temperature of the degree of daylight and sunlight to assess the suitability of reducing the temperature control system. To every day maximize day light-weight to return in an exceedingly shallow floor plate is been most popular. Wind-driven industrial turbo roof ventilators are designed to exhaust hot air and industrial pollutants such as mud, toxic gases, fumes, heat, humidity, odor, stale air, damp and different invisible irritants and waste material particles from the building.

Table 1: Overall Automobile Industrial BuildingSystems



Source: Building Skins – Christian Schittich (Ed).

3. METHODOLOGY

3.1 Structure of Industrial Design

1. **RCC with truss** the design of conventional truss buildings takes more time and it offers fewer quality finishes design aids. In India, Codes are not updated & traditional codes given by IS are used. The Structural Members used are Hot rolled sections which are very heavy in weight. Heavy structural members' weight makes it difficult

to design foundations due to which foundation cost and heaviness increases. Very slow delivery time. It takes 20 to 26 weeks to construct approx. 500 MT conventional building after finalizing the design. The price per square meter is very much higher than the P.E.B building. The conventional building cannot withstand seismic forces because of its rigid heavy frames and the heaviness of the structure itself. All the necessary Components are designed individually where there is no guarantee about the performance or holding of the structure. Erection in this case is slower and morenumber of labours is required. Heavy types of equipmentare necessary.

2. **RCC with PEB** (Pre Engineered Buildings) is the building that is engineered at a factory and assembled on site. Sections are fabricated at the plant to the exact size as per requirements, transported to the site, and assembled at the site with the necessary connections required. This type of P.E.B Construction is used to build Industrial Buildings, Metro Stations, Warehouses, etc, for finishing and pace of construction required, the use of PEB structure in the replacement of the Conventional Steel design nowadays is used now and then. In Conventional Industrial designs, resulting in more advantages, easy fabrication, and more customization. This type of building structure can be finished internally to serve many functions that actual low-rise building design. Eg. of P.E.B are warehouses, Canopies, Factories, etc.
3. **Precast with PEB** roof this construction technique involves the making of the floor, wall units, beams, and columns off-site. For this, separate factories and appropriate facilities are required. All the precast panel units are made as per the design and drawing given by the consultant's specification and requirements, as per different sites they are brought to the site and placed and joints are being filled. This method is suitable for repetitive construction activities on a massive scale.

4. MATERIAL PALLETS AND SERVICES

4.1 Material Palette

- **Sandwich panels** are used to clad the walls for Industries. Every surface panel comprises a thermally insulating material, on both sides with sheet metal for insulation purposes. Sandwich panels are not structural materials but act as a partition walls.
- **Aluminium Composite panel** is the panels made up of two thin coated aluminium sheets and a polyethylene core stuffed in between. ACP sheets are used especiallyfor external cladding, interior application, and signage and they are available in many colors which is a greateradvantage.
- **Acrylic Sheeting** embossed recommended solution for roofing. It is generally made from the joining of high-impact acrylic materials and has long durability **Bitumen roof sheets** are one of the cheapest roofing solutions and are Roofing lines' most affordable roofing sheets. They are Waterproof, low maintenance, lightweight and straightforward to install. These are notused nowadays.
- **Galvanized steel roofing** sheets are made up of galvanized steel with a corrugated design to provide great strength. It is a lightweight sheet, which makes it easy to install. Due to their lightweight, these sheets are widely used in the industrial sector. It is available in different thicknesses, colors, and sizes. It can also be customized according to customers' requirements if in a greater quantity.
- **Engineered wood** includes a different range of wood products that are manufactured by binding the different wood particles and different wooden boards, which together is fixed with adhesives or different compounding material, and methods of fixation to form a composite panel. These are used as the exterior cladding with polish, paint, or clear coat can be applied after placement of it.
- **FRP (fiber-reinforced plastic)** roofing sheets are composite polymer plastics reinforced with fibers for their strength, elasticity, etc. Some company offers fiberglass Opaque and Translucent sheets FRP sheets for different applications. There are many colors available in these sheets due to which it can be used in many color combinations.
- **Relwood** is made of PTF Technology which builds a bonding between natural fiber and the polymer. This gives a feel of natural look and feel of wood. It is made insuch a way that it has the adaptability to resist water, sun,wind, and doesn't affect after many years. It is recyclableand termite-proof. It is generally used for cladding.
- **Copper sheeting** has such a factor and durability that no other metal roof has. Its appearance gives a unique aesthetical element to industry, due to its elegant look, it is the preferred material for many architects. Copper resistance comparatively among other material range ranks among the highest of modern roofing materials.

- **Eatme Wall** is a façade system that is a simple green wall concept. Which can be used for the existing or new buildings. It sustains the growth of natural vegetation. The plants which are planted improve the natural shading and air quality.
- **Glass facades**, which are in direct contact with sunlight, only low glass cannot be used, as they will trap the heat inside, leading to overheating of interiors. In such a case, solar control low glass is used, which blocks solar radiation, as well as provides thermal insulation.

There are many other materials available in the market which day by day are coming along with the technology, being constraints to paper have tried to mention the main façade and roofing elements.

Figure 2: Different Materials – Bitument Sheet, Eatme Wall, FRP Sheet, Galvanized Steel Roofing
Source: Different source from Google.

4.2 Case Study Glimpse International

Tabacco Factory, Kanfanar: The optical effects of the front changeability have been achieved through the composition of several surfaces of different sizes that change constantly while moving around the premises.

For the façade design, the architect has thought given to a balance between natural and human creation which includes on left side production, technology, and right side natural environment.

New factory Building, Elin Motoren Gmbh, Austria: The vertical sections of the hall are shaped, requiring that production work be as natural light inside premises as possible. A continuous row of windows forms the skirting upper features bounding both long facades.

Metal Foundation, Spain: The structure is enclosed with a skin of massive steel structure with dark black color and red color runs in access to shows the path of circulation in premises. Inside there is lots of natural light coming as compared to the darkness outside. The small piece of red color on the industrial building breaks the whole monotonous shade of black to balance with the outer colors.

Roofing	Roofing
Conventional	*Non-Conventional*
Acrylic sheet	Bitumen sheet
Aluminum sheet	Galvanized sheet
Galvanized sheet	Aluminum roof
Copper Sheet	FRP sheet
Polymer sheet	
Facade	**Facade**
Conventional	*Non-Conventional*
ACP sheet	Bitumen sheet
Aluminum roof	Galvanized sheet
Galvanized sheet	FRP sheet
Copper sheet	ACP sheet
Eat me wall	Copper sheet
Rel Wood	Glass Facade
Glass Façade	
Acrylic sheet	

Figure 3: Case Study Images

Source: Industrial building Planning & Design – JulianWeyer, & Sergio Baragano.

4.3 Services in Industries

Ventilation Automobile assembly plants are typically vast areas that need a combination of natural and mechanical ventilation to control the indoor airflow andexhaust fans are implemented for outflow of the air.

Polluted air must be exhausted since air is being pushedout, fresh air needs to be pushed in.

Insulation is an object which is used in every building as insulating for thermal management in some form or other. Whereas the bulk of Insulation in buildings is for thermal purposes, the term conjointly applies to acoustic insulation, fire, (e.g. for vibrations caused by industrial applications in industries). Typically an insulation material will be chosen to perform many of the function'sjobs to its tolerant use.

There are many other services that play a role but due toconstraints to paper have tried to mention the main.

5. CONCLUSION

Non-Conventional element material cannot be used more nowadays due to outdated technology. It is observed generally conventional buildings are much simpler construction methods in large-scale projects such as industries. There is now much more customization available with the latest technology available. There is was no such signature element of architect seen in industrial construction earlier but now with the latest technology available it is been seen gradually where people wish to spend on the façade system with new materials in the market. Some material still utilizes time for installation and are not easily available in some regions but it will decrease as of in some years. The costsfactor more in industrial construction that's why people tend to finish with whatever cheaper material is available. There can be experimentation possible as we have seen through latest technology and material available.

6. RECOMMENDATIONS

1. After the P.E.B. has come into picture structure system has become much more advanced in terms of finishes, customization, etc.
2. Roofing and Façade material in the conventional system is much more feasible and lots of customization can happen here rather than nonconventional structure and material used.
3. The owner or stakeholders are more focused on product rather than infrastructure which nowadays isnot the case. It is more feasible to try more experimentation in industrial architecture in India.

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Cost Efficiency of Facades for High-rise Residential Buildings in Mumbai by Value Engineering

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ABSTRACT: A facade treatment was important feature for project as an external envelope and face of structure. It was one of the finishing stages, so initial facade design get compromised to manage with any budget constraints and cost reduction strategies. Value engineering was applied on various stages to find out suitable facade systems for high-rise residential structures. This tedious process involved time and cost for decision making.

This research paper formulated a methodology for selecting best suitable materials or technologies for high-rise residential facade treatment by evaluating their functional value with relative life cycle cost. This provided ease for designers and decision makers for selecting suitable materials or systems for facade designing at initial stages to completion stage to adopt cost efficient alternatives as per the project requirements.

Keywords: *High-rise Residential, Facade, Cost Efficiency, Value Engineering.*

1. INTRODUCTION

A facade was the external envelope of a structure. It should be durable against external climatic conditions, physical elements and it should maintain indoor comfort for users. A facades of high-rise residential buildings were treated for protection from outer elements, enhancing aesthetics and maintaining comfort for occupants of the structure. A project budget played a major role in designing and selecting the features for a facade treatment.[8] It must be easy for operational parameters. Facades were also important as they provided aesthetics to the structure and added face value to it.[6] Facade designing differed as per the type of structure. Facade of a high rise residential building needed to satisfy aesthetics and user comfort parameters. These structures were seen as landmarks for the city and gave pride to the developers as well as city. [8]

Mumbai is the economical capital of India and possess maximum numbers of high-rise residential structures in the country. [8] As per the Revised Development Control Promotion Regulations for Greater Mumbai 2034, several elevation features were counted in Floor Space Index (FSI), which were previously free of FSI.[1,2] This had massively affected the availability of built-up area and respective saleable area of the project. Developers changed designing strategies, which was resulted in restricted facade design elements for residential buildings.

Percentage of the cost expended on facade treatment, varied as per the type and budget of the project in the city. Construction of facade treatment occurs in the final construction stage. Escalation in cost of other structural systems gets balanced by compromising on facade treatments. Providing cost efficiency will lead to cost reduction or reaping maximum value for developers as well as for users.

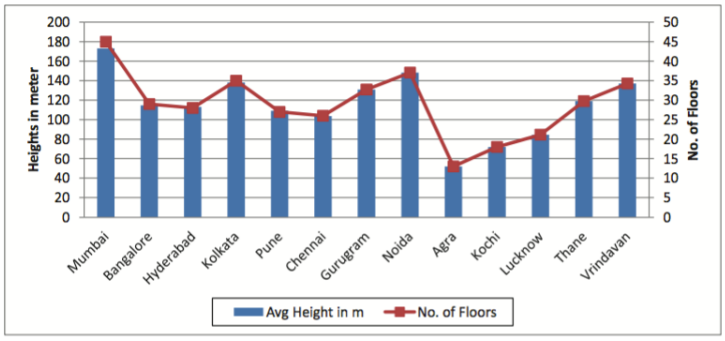

Figure 1: High-rise Building Average Height and Floors in Indian Cities[7]

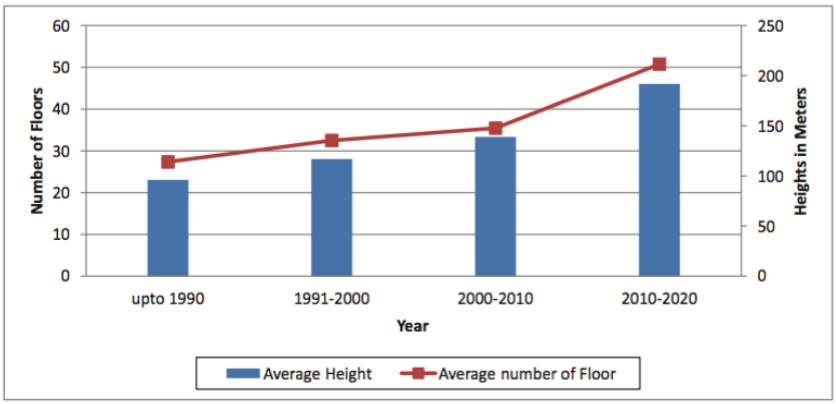

Figure 2: Growth of High-rise Buildings in Mumbai[7]

This research paper aimed to achieve cost efficiency in facade treatment of High-rise residential building in Mumbai. Its objective was to formulate a methodology to evaluate facade techniques or systems for High-rise residential buildings in Mumbai by Value engineering. Research prepared the tool to equip decision makers and designers to formulate well planned strategies for cost-efficient alternatives without compromising on quality for the facade of high-rise residential buildings in Mumbai.

Currently adopted designing and construction techniques are analysed on the basis of their functionality, workability and impact on project cost. These techniques are evaluated by calculating their functional values for durability, weight, comfort achieved by the facade system with respective Life cycle cost. Ease achieved by these guidelines for decision making will lead to reduction in time and cost incorporated by it. The research paper is restricted for high rise residential buildings in Mumbai.

2. LITERATURE REVIEW

Mumbai was the economical capital of India. Everyday thousands of youths were shifting here in search of better career and financial opportunities. To accommodate this rapidly increasing population in a limited land area, high-rise buildings were constructed. These structures were a necessity of the city. High-rise structures promoted the city's image and help it to reach Global Status. It also helped to improve the status in global economy which attracts investors. Mumbai had adopted high-rise residential construction on the largest scale as compared to other cities of the country. In India, Mumbai was the only city which had buildings higher than 50 meter before 1990s. Mumbai has the first position in terms of average height of high-rise buildings and number of floors in India . High-rise residential development was increasing in Mumbai with continuous growth.[8]

Types of High-rise structures in terms of height[8]

- High-rise buildings - 23 m to 150 m. height
- Skyscrapers - 150 m & above
- Super tall structures - 300m & above

Climate of Mumbai is warm and humid.[3] Facade treatment of Buildings in Mumbai had to sustain durability against these climatic conditions and protection and comfort against it. Below are the criteria which need to be fulfilled for facade treatment of structures in warm and humid climates.

Window to floor ratio for Warm-humid Climate is 16.66%.[3]

- Visible Light Transmittance (VLT) of the non-opaque building envelope components shall comply with the minimum VLT values as given in.[3]
- Thermal transmittance of roof should comply with the maximum U_{roof} value of 1.2 W/m^2.K Residential Envelope Transmittance Value (RETV) for building envelope (except roof), should comply with the maximum RETV of 15 W/m^2.

In DCPR 2034 Revised Regulations were provided for construction developments in Mumbai region. Revisions were mentioned in regulation 31(1)(2)(3) of DCPR 2034. These regulations were basic guidelines for permissible facade treatments in Mumbai.[1,2]

Table 1: Permissible Facade in Mumbai[1,2]

	DCR 1991	***DCPR 2034***
1.	Cantilever balcony projection was permissible till 2.40 m.	Permissible Cantilever projection is 2.00 m.
2.	Permissible flowerbed projection was 1.20 m. from building line and 0.75 m. from balcony line.	No flowerbed projection is allowed
3.	!0% of built-up area, balcony projection was free of FSI.	!0% of built-up area, balcony projection is allowed with payment of premium to Municipal Corporation
4.	Chajja or flowe^rbed projection can project at any level of external beam.	Chajja should be placed at the external beam bottom.
5.	No specific limit for ornamental projection was specified	Ornamental Projection should not extend beyond 0.30 m and should be placed at the external beam bottom.
6.	1.20 m. free of FSI service duct was permissible for kitchen.	Service duct is not allowed for kitchen face
7.	1.20 m. Free of service duct was allowed for any height of building.	1.20 m. Free of service duct is allowed. Incase of high-rise buildings it can extend upto 2.00 m.
8.	No refuge floor is allowed at mid landing of staircase	Refuge floor can be provided at every alternate mid-landings of staircase after 24 m. height.

Source: DCR 1991, DCPR 2034.

High-rise residential building facade was designed considering environmental performance, social, technical and economical Factor of facade features. Facade material was selected as per their durability against physical strength against structural, chemical, thermal resistance and economic factors. Economic factors were selected for Initial construction cost, maintenance cost and removal cost. For long term facade design considerations maintainability, reliability and sustainability of facade material was considered. Life cycle cost of Facade system was calculated by adding initial cost, procurement cost, repair cost, energy cost, operating cost and subtracting salvage value.[7]

Double-glazed facade was the most cost-effective system due to its minimal facade thickness and high local rental loss. Eco-block facades were found to be the least cost-effective system. Single-glazed-spandrel facades were found to be the least cost-effective. [9] Glass selection is expected to save on cost.[6]

Value engineering effective method to achieve desirable results for decision making.

Alternative ways in which value engineering is applied[10]

- Maintain functionality and quality but decrease cost
- Increase value of functionality and Quality but maintain the cost
- Increase functionality and quality and also decrease the cost
- Increase functionality and quality by increasing the cost.

Application of Value engineering[10]

- I**nformation phase:** Information such as Project design, Project background, obstacles in the project and project cost is gathered.
- **Function Analysing Phase:** Function of each element in project is analysed with respect to its cost. Highest potential and cost involving areas are figure out.
- Cost to worth analyse need to be done on each item.
- **Creativity Phase:** Proposing alternative ideas to original proposal to reduce the cost.

- **Evaluation Phase:** Alternatives chose need to analysed for its effectiveness through life cycle cost and cost savings.
  LCC = initial cost + replacements/repairs cost + Maintenance cost + Operational Cost-salvage cost
- **Decision analysis Phase:** Process of analysing chosen alternatives to save project cost.
- **Decision making Phase:** Most effective alternative is chosen.

3. METHODOLOGY

To work on cost efficiency, cost affecting areas of high-rise residential building facade treatments in Mumbai were identified by literature review and interviews with facade consultants , project managers & designers. Parameters for evaluating facade systems are enlisted from[6,7] literature review and interviews. These different Parameters were scaled and rated for evaluation facade treatments of high-rise residential buildings in Mumbai. Rating scales were formulated by using standards codes from literature reviews and current adaptations by professionals for decision making on facade designing of high-rise residential structures in Mumbai. Designing and Construction techniques & alternatives were analysed on the basis of their functionality, workability and their impact on project cost. Research prepared tool by using Value engineering.

3.1 Interviews

Researcher carried out interviews with facade consultants, Designers and Project Managers to collect data on strategies and types of facade systems used for high-rise residential structures in Mumbai. Following insights has been received from them:

1. Thickness of panels used in facade treatments of high-rise residential structures, needed to increase with increasing height to sustain against increasing wind pressure on. By applying value engineering, high-rise residential structures were segmented height wise as per wind pressure and temperature acting on it. According to it, framing and panel thicknesses of facade systems were selected. Darker tint was chosen for glass panels to get protection against increasing sun-rays and temperature.
2. Openable shutters, sliding panels or casement windows were available alternatives for window opening treatments. Glazed sliding windows were the most preferred alternative for window shuttering. Toughened or laminated glass panels were chosen as panels as per design preferences.
3. Unitised or semi-unitised window units were used for window opening of high-rise residential buildings. Unitised units were ready to install units. If they could be install from inside, they were more convenient to install. If Unitised units couldn't be installed from inside, specialised equipments were required e.g. cranes. Semi unitised panels were manufactured in factories. They were assembled and installed on site.
4. Cost efficient facade systems of high-rise residential buildings not only provide maximum functionality and quality with cost expended for them but also start payback after a certain time duration. This time is upto 4 to 5 years.

4. RESULT AND DISCUSSION

Application of value engineering was an essential step for decision making on facade designing of high rise residential buildings, but it incorporated time for analysis and decision making. [10] The research prepared a tool to evaluate facade systems for high rise residential buildings. This tool was providing net value for facade systems of high-rise residential buildings net value by value engineering formulae.

Net Value of facade system = Functional Value of facade system/Life cycle cost of facade system

[A] Functional Value

The functional Value for system or technology was evaluated on parameters given below:

1. **Durability:** Durability was calculated by a) Resistance against wind pressure and b) Average life in years.
   (a) **Resistance against wind pressure:** 1Meter X 1Meter panel of each system with appropriate metal framing and required sealant was considered for evaluating resistance against wind pressure. Wind pressure acting on high-rise structures was ranging from 1.5 KPa to 3.10 KPa.[5] Systems having resistance below 1.5 KPa wind pressure were not suitable for the facade of high-rise residential structures in Mumbai. This category was segmented (Ref. Table 2, Column 1)

2. **Average Life:** Average Life Span of R.C.C. High-rise residential buildings was 60 to 80 years old.[11] This life was mentioned for structural construction of buildings. Facade systems were not a part of preliminary structural framing. It needed repairs and replacements. 50% of the total structures life span was considered as working life span of the facade system for rating on value scale. Rating scale of functional values 1 to 10 provided values for 0 to 45 years of life span. Facade systems with lesser years of working life were rated with lower values and values were increased as per increased life of years. (Ref. Table 2, Column 2)

Table 2

Rating Scale [Table 2]				
	Durability			*Comfort*
	1	*2*	*3*	*4*
Functional Value	*Resistance against Wind Pressure (1X1m.) KPa*	*AVG. Life Span (years)*	*App. Weight (kg/sq.m.)*	*App. U Value W/mk*
1	1.50 to1.70	0–5	More than 450	More than 5.00
2	1.70 to 1.90	5-10	401 to 450	4.50–5.00
3	1.90–2.10	10–15	351 to 400	3.85–4.50
4	2.10–2.30	15–20	301 to 350	3.30–3.85
5	2.30–2.50	20–25	251 to 300	2.75–3.30
6	2.50–2.70	25–30	201 to 250	2.20–2.75
7	2.70–2.90	30–35	151 to 200	1.65–2.20
8	2.90–3.00	35–40	101 to 150	1.10–1.65
9	3.00–3.10	40–45	51 to 100	0.55 -1.10
10	more than 3.10	More than 45	0 to 50	0–0.55

3. **Approximate Weight of the Facade System:** (Ref. Table 2, Column 3) Weight of the facade system was calculated as kilograms per square feet. Light weight systems were easy to handle and transport. Facade systems were expected to be light weight to put less pressure on structural systems. These systems were rated on scale of functional value 1 to 10 as per their weight kg/sqft. Lightweight materials were rated with more values.[4,12]
4. **Comfort:** Warm and humid climate of Mumbai needed to be treated with temperature control for the internal comfortable environment for the user. Maximum U value of the external envelope of high-rise residential structure in Mumbai could be 1.2 W/mk.[3] Facade systems were rated for U-value ranging from 0 W/mk to 5 W/mk with assigned functional value from 1 to 10 (Ref. Table 2, Column 4).

[B] Net Cost of Facade System: Net cost of facade system was calculated by

Net cost of facade system = Initial cost + Installation Cost + Operation & maintenance cost-salvage cost of facade system.[10]

Addition of initial cost and Installation cost gave construction cost. Salvage cost was the amount received by scrap material created after completion of workable life of the facade system.

5. CONCLUSION

Net value evaluated for the facade system by using tool created in the research, provides ready reference for decision making and helps to select desirable facade systems for high-rise residential structures in Mumbai. The research was evaluates functional value of a facade with the Net cost of the facade system. This provided comparative analysis for the facade systems of high-rise residential structures for Mumbai. Cost efficiency was achieved by selecting desirable functional value and cost incorporated for it. Decision makers can reduce time and cost involved in the decision making process by referring to this tool.

Methodology mentioned in the research can be utilised further for evaluating upcoming systems with current facade systems. Scale of tool can be enlarged by adding more functions as per requirements of project. Tool can be further improvise on functions of humidity resistance and aesthetics of facade treatments.

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Environmental Sustainability in Contemporary Temples: A Case Study of ISKCON, Delhi

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ABSTRACT: Metropolitan cities are socio-economic centres; many people relocate to these areas making up a diverse population. There are numerous religions with different beliefs, cultures and traditions this paper focuses on the Hindu religion. The structures most associated with Hinduism are temples. Their teachings are adopted by many in their life. Metropolitan cities have both historic and modern temples. Modern era temples can be coined as 'contemporary temples'. The term contemporary can be adapted via their architecture, attractions, sustainable practices etc. Sustainability is a wide term and a global initiative, it is embedded distinctly this paper focuses on environmental sustainability. Different various ways in which environmental sustainability can be practised in temples are on-site waste management, use of renewable energy, recycling etc. This paper studies the existing modes of environmental sustainability in temples and provide further interventions which can be adapted by other temples and in turn by people.

Keywords: *Metropolitan City, Contemporary Temple, Environmental Sustainability, Waste Management, Renewable Energy.*

1. INTRODUCTION

The world is growing at a very fast pace, major contribution in developing countries such as India comes from metropolitan cities. There are many metropolitan cities in India, this paper is focused on Delhi. In such cities modernism is taking over, but culture and heritage are being preserved by its diversified population groups, historical structures and by modern structures being built keeping cultural heritage at core. A major part of culture comes from religion, the interlinked traditions and teachings which are carried out in structures namely temples. Temples are highly regarded places for learning and adaptation for a number of people for their daily lifestyle. Considering the above, the main question is, will people adapt sustainable practices for their lifestyle if it is included within religious practices and religious structures? The existing theology in numerous ways already cover various sectors of sustainability in both tangible and intangible ways. Environmental sustainability is one type which can be projected towards devotees, tourists and residents through tangible aspects. There are various levels on which environmental sustainability has been adopted by contemporary temples, which can act as a model for all existing temples, both historic and contemporary. There is existing research which has been conducted in the sector of religion, related to theology, evolution, tourism and sustainability. This paper aims to study the existing measures taken by contemporary temples in terms of environmental sustainability. The objective is to study a live example and existing research the using the combination of both the studies to provide interventions which can be followed by other temples on various levels and thus can be implemented by people as well within their lifestyle.

2. LITERATURE REVIEW

Religion is an intangible aspect of life which is expressed and experienced through tangible elements such as structures, rituals, festivals etc different for each religion and for each individual. In simple words it is the relationship between human and divine. India is often referred to as the land of spirituality, religion, pilgrimages and diversity. There are various religions practised throughout the country the prominent ones are Hinduism, Islamism, Jainism, Christianity, Buddhism and Sikhism. Amongst these religions Hinduism is the most practised one in terms of the population statistics. Hindus make up about 79.8% of Indian population [1]. (KRAMER, 2021) The structure most associated with Hinduism in terms of religion is a temple. A temple is a place of worship and an epitome of religion. Throughout the vast history of the religion there have been innumerable temples, many of which have been conserved or preserved and are present throughout the country. Temples can be classified on the basis of various parameters such as *deity, time period, architecture, number of visitors, attractions* etc. On the basis of the above parameters, classifying the temples into two categories i.e., historical temples and contemporary temples. Historical temples can be defined as the ones which have been constructed in traditional manner and

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preserved in the same way throughout time. Contemporary temples are the ones constructed in the contemporary period which may or may not follow a traditional style of architecture and thus conserve heritage and culture in different ways [2]. (Basu, 2015) Temples are idolized by devotees, if environmental sustainability is adopted as a part of the ongoing theology the same will get communicated further on.

Contemporary is marked by characteristics of the present period [3]. (Merriam-Webster, 2022) The definition of contemporary is ever changing, as with time present is continuously evolving, to keep up with the notion even temples have to evolve throughout keeping in mind the present needs. Temples need to be inclusive for all, age groups, universally accessible, multiple modes of communication should be used to attract more people, adapt sustainable practices within the premises. These structures are idolized throughout by the devotees and different practices carried out here are adopted by people in their day-to-day life. The major incorporation which can be seen in structures in the contemporary period is sustainability on various levels. Contemporary temples are no different and hence many are following sustainable practices throughout their premises.

Sustainability is a wide term, the worldwide accepted definition, “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” [4] (World Commission, 1987). The three major sectors of sustainability are society, economy and environment. This study is focused on environmental sustainability. Environmental sustainability can be defined as “meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them, and more specifically, as a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity.” [5] (Morelli, 2011)

The existing research for religious sustainability exists in various forms such as religious sustainability and its evolution, sustainable tourism, impact of tourism on sustainability, study of one or more sustainable practice in a structure and other experimental research on different practices and its conclusive effects on the area. This paper provides a study focused on one sector of sustainability and the practices associated with that particular sector.

3. METHODOLOGY

The paper follows an empirical research method. The case study is selected by studying the prominent temples of New Delhi. A comparative analysis is done for the selected temples based on set parameters deity, time period, architecture, number of visitors, attractions. Then narrowing down the temples built in the contemporary era from the prominent ones. Selecting the case study from the contemporary temples, the one exhibiting the most contemporary traits on the basis of the selected parameters. The selected temple is then studied and data is collected using primary and secondary resources. Primary data is collected via observation and interviews conducted on-site with devotees, tourists and the staff at random. Secondary data is collected by studying existing research in the field, temple website, documents, reports available to general public, along with the cooperation of the organisation and primary data provided by them.

The collected data is used as a basis of forming interventions along with the existing research from literature study.

4. CASE STUDY

4.1 ISKCON Temple Delhi – Glory of India and Vedic Cultural Centre, New Delhi

ISKCON Delhi is also known as Sri Sri Radha Parthasarathi Mandir, a well-known Vaishnav temple of Lord Krishna and Radharani. It was inaugurated on 5 April 1998 by the former Prime Minister of India, Atal Bihari Vajpayee. It is situated at Hare Krishna Hills, Sant Nagar, East of Kailash area, South Delhi, India [6]. (ISKCON Delhi, n.d.) The temple is made to be more than just a temple, it is an educational and cultural hub featuring the name ‘Glory of India and Vedic Cultural Centre’. Regardless of whether you follow the religious convictions spread by the ISKCON or not, you can generally stroll into these intricate sanctuaries any time of the year and submerge in the spiritual energy, building greatness and peacefulness of the spot [6]. It is a contemporary temple using cutting edge technology with varied modes of attractions presented via multimedia technology to showcase ancient medieval texts in a modern way. The temple complex houses a museum, library, gift shop, restaurant, open air theatre, fountains and gardens along with the main temple attraction. The number of visitors range from approximately 8000 on the weekdays, 16500 on the weekends and the number reaches in

Lakhs during major festivals such as Janmashtami, New Year and Gaura Purnima to name a few, along with other Indian festivals. [6,7]. (Organisation, 2022)

Table 1: Tourist Statistics

**Population of the Area*	*Weekdays*	*Weekends*	*Festivals (in Lakhs)*
41200	6000–10000	12000–18000	1–6

**Source*: https://geoiq.io, *Source:* [6, 7]

4.1.1 *Architecture*

The temple is designed by Architect Achyut P. Kanvinde with landscape by Architect Ravindra Bhan. The temple style is conventional meets modern, where Indian temple architecture has been showcased in a brutalist manner. The complex exists on a hilly terrain, the natural landscape has been maintained throughout the design, softscape is introduced by making various pockets of greeneries among the hardscape and the temple is placed on the highest point of the site. Traditional materials such as brown dholpur stone and white marble are majorly used in the structure. Traditional stone carving methods along non-traditional carving patterns can be observed on the main temple and adjoining structures. The temple is bold interpretation of traditional temple architecture.

Figure 1: ISKCON Temple Delhi

Source: https://myoksha.com/iskcon-temple-delhi

4.1.2 *Environmental Sustainability in ISKCON*

The temple is not only modern in terms of architecture and attractions, but is one of the few which have taken a step towards sustainable development of the whole complex. It has a tie up with UNESCO, and follows environmental sustainability on various levels. [7] The major components which contribute to environmental sustainability from this temple complex are:

1. On-Site Waste Management
2. Use of Renewable energy

4.2 On-Site Waste Management

The temple has been installed with a flower-to-compost machine in the year 2018, which is one source of waste management. Waste management at religious places through an electronic automatic organic waste decomposer, recycles flower and organic waste every day, converting it into odourless compost for green areas, thereby reducing city waste and pollution.[8] (Angelique Foundation, 2019). The composter installed is a GBES bio-composter, which is fully mechanical and can convert organic waste into nitrogen rich compost and reducing the original volume by 60–80%.

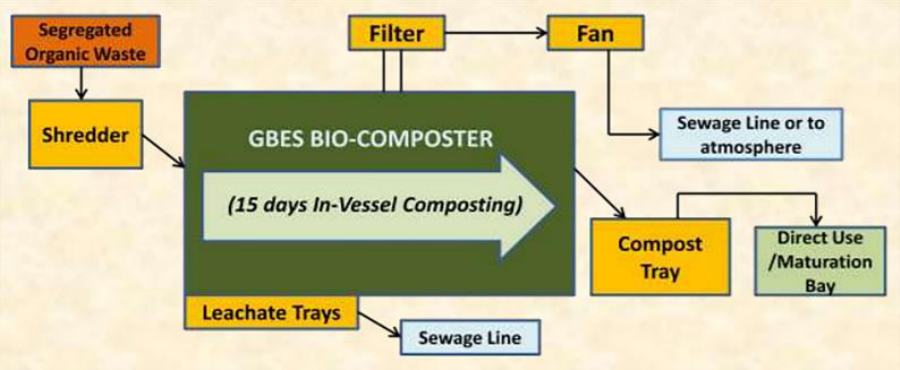

Figure 2: Flower-to-Compost Process
(*Source:* http://www.gbes.in)

The garlands, flowers which are used in the temple complex as an offering or for the purpose of decoration of the structures after their utilization are used as the input material in the compost machine which then converts the waste material into fertilizer. This fertilizer is then used throughout the complex in all the gardens (Except the Tulsi garden). The machine can convert 100 kg of garlands/flowers into 30 kg of usable compost/fertilizer in one time, the daily number of garlands which the complex goes through ranges from about 40–50 kgs and on the occasion of important festivals the whole complex is decorated, so at that time the input goes up to 10 times, i.e., approximately 500 kg, which is processed into 150 kg of fertilizer. This process is not only helping in on-site waste management up to a certain level, but is also helping in creating a no-waste cycle related to one major aspect of an everyday religious practice. This being done using a machine is for waste produced on a higher scale, the same can be adopted by devotees on a smaller scale by making their own compost bin for various biodegradable waste from their households such as food waste, dried leaves etc and use the resulting fertilizer for their garden/plants. The composting process helps in reducing the overall waste produced by the temple complex and further reduces dependency on external garbage collection facilities.[7]

Figure 3: Recycling/Compost Machine
Source: https://twitter.com/m_lekhi/status/1042070722804236289?lang=ga

4.3 Use of Renewable Energy

The temple is a major tourist spot and a frequent visit for the devotees, due to continuous movement and footfall the energy used in the complex is continuous as well. The complex houses solar panels to cater to some part of the energy required. The complex added SPV panels of 100kwh cumulative capacity in the recent year, which was a project taken up under a Corporate Social Responsibility (CSR) scheme by Power Finance Corporation Ltd. (PFC) in the year 2019–20 which was then implemented by Rajasthan Electronics and Instruments Ltd. (REIL), the project was estimated at 0.483 Crores [9]. (Power Finance Corporation Ltd., 2021) The SPV panels are fixed on the roof of 3 buildings present in the complex. Solar panels provide with a renewable source of energy which can be used throughout the year. The design of the complex also plays a major role in reducing the energy consumption, most of the spaces can function on daylight and natural ventilation for most part of the day till 4 pm at least, during all seasons. This helps in minimum usage of non-renewable energy sources in the whole complex.

Figure 3: Solar Panels on Rooftop of Building, ISKCON Delhi

Source: Author.

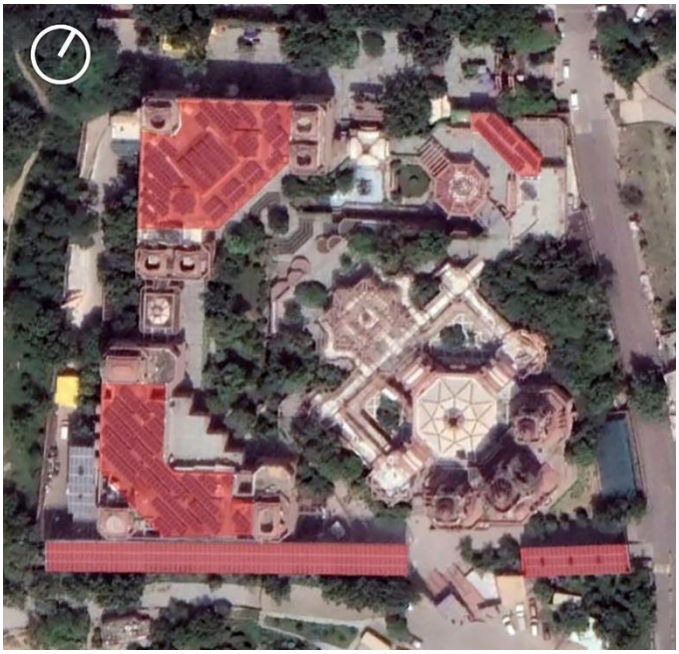

Figure 4: Solar Panels on site, ISKCON Delhi

Source: Google Earth.

Solar panels can be considered as a high scale option by general public and thus prevent them from investing in the same, but it is a one-time investment with a longer return period. Those who can afford the investment should do so and others can go ahead with small scall solar energy usage in their residences.

Other contributions of ISKCON include, Food for life, an initiative active since establishment of the temple, they provide food for needy and aid during natural calamities. This is carried out by various ISKCON establishments placed around the globe. This initiative as well tries to keep minimal waste generation, such as using biodegradable Dona's (bowls) and plates which does not add to landslide waste. The various gardens present within the premises have also helped in increasing green cover of the area and maintain good air quality inside the temple area.

5. RESULTS AND DISCUSSIONS

ISKCON has taken a step towards environmental sustainability within their establishment. This is not only limited to the case study discussed in the paper, but the organisation as a whole. The use of even one environmentally sustainable process, helps in catering to a part of a problem, be it environmental degradation of the area, reduction of energy consumption, teaching sustainable lifestyle to people. There are numerous practices on different scales which can be adopted by any religious facility and thus through them by their devotees, tourists and local residents.

A green initiative namely 'ISKCON Environmental Initiative' is functioning under the organisation. The ISKCON Environmental Initiative promotes adoption of environmental sustainability standards across ISKCON temples, outreach centres, and communities. ISKCON temples represent the first impression of Krishna Consciousness to the general public. In a context of global importance of care for the Earth, especially among younger people, temples have the opportunity to be at the forefront of representing Krishna Conscious environmentalism to the general public. This initiative is designed to support temples in moving towards more sustainable practices [10]. (ISKCON Environmental Initiative, 2021) This initiative provides initiatives for temples on various levels and also basic guidelines for environmental sustainability of their devotees or tourists. This platform in all scales be it the global community or a small household, the research done for is available to public on their website.

6. CONCLUSION

Basic interventions which can be carried out by any temple, religious structure, religious organisation in terms of environmental sustainability is classified in 4 major categories namely, construction materials, energy, plantation and on-site waste management. Detailed interventions for each are given in the Table 2 below.

Table 2: Interventions for Environmental Sustainability

Category	***Interventions***
Construction Materials	- Use of recycled materials - Use of locally available materials where new materials are required
Energy	- Use of alternate sources of energy such as solar power, wind mill etc. (area specific) - Efficient use of energy, maximum use of daylight and natural ventilation - Use of latest technology for avoiding wastage of non-renewable energy such as LED bulbs where required.
Plantation	- Planting locally available native species. - Using dried leaves during seasonal changes in compost formation - Planting a kitchen garden within premises to cater to some part of requirement.
On-Site resource management	- Installation of water harvesting system, can be embedded within the design. - Composting of all biodegradable materials and using the by-product for maintain green areas. - Separating recyclable materials during waste collection. - Reuse of water used in fountains or attractions within the gardens - Composting of garlands, flowers, food waste retrieved from the daily offerings or decorations.

Source: Author.

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Cost Effective Single Family Housing Unit for Middle Income Group in Context with Life Cycle Process of Building Materials

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ABSTRACT: In India, housing units add a large amount of energy consumption. Thus, there is a need of energy efficient design to reduce the demand in energy consumption. While designing energy efficient houses, there are chances of cost getting on higher side due to the sustainable construction materials and renewable energy. The main aim of the paper is to find out the parameters for cost-effective single family housing unit for middle income group. This study will focus only on the materials required for wall construction. This is an analytical and applied research which will prove the applicability of these materials as cost effective through life cycle process. The methodology adopted for the research is background study, market survey, and comparative analysis of conventional & sustainable construction materials and their life cycle process. It will lead us to apply this study in the practical field for the awareness and benefit of clients.

Keywords: *Cost Effective, Single family, Residential, MIG, Wall Materials, Life Cycle Process.*

1. INTRODUCTION

1.1 Background Study

Majority of people in India are more inclined towards affordable housing. The built size ranges in India for Affordable housing is generally correlated with the income status and these guidelines are set by the Ministry of Housing and Urban Poverty Alleviation. (Bhavya Kattamudi, 2018). There were various government schemes which have been launched in India for affordable housing in past years. The 'Pradhan Mantri Awas Yojana' is currently focusing on 'Housing for All' till 2022. Previous government schemes were adopted majorly for rural population, EWS and LIG sections of the society. Indian government has launched a scheme for middle income housing group for affordable housing named 'Pradhan Mantri Awas Yojana (PMAY)' which is a credit linked subsidy scheme, in 2016 and issued the guidelines in January 2017. In this scheme, they have defined the MIG in two parts, MIG-I and MIG-II on the basis of their annual income and specified the dwelling unit carpet areas. Even if the government schemes support affordable housing in India, there has no mention of sustainability principles in the construction process.

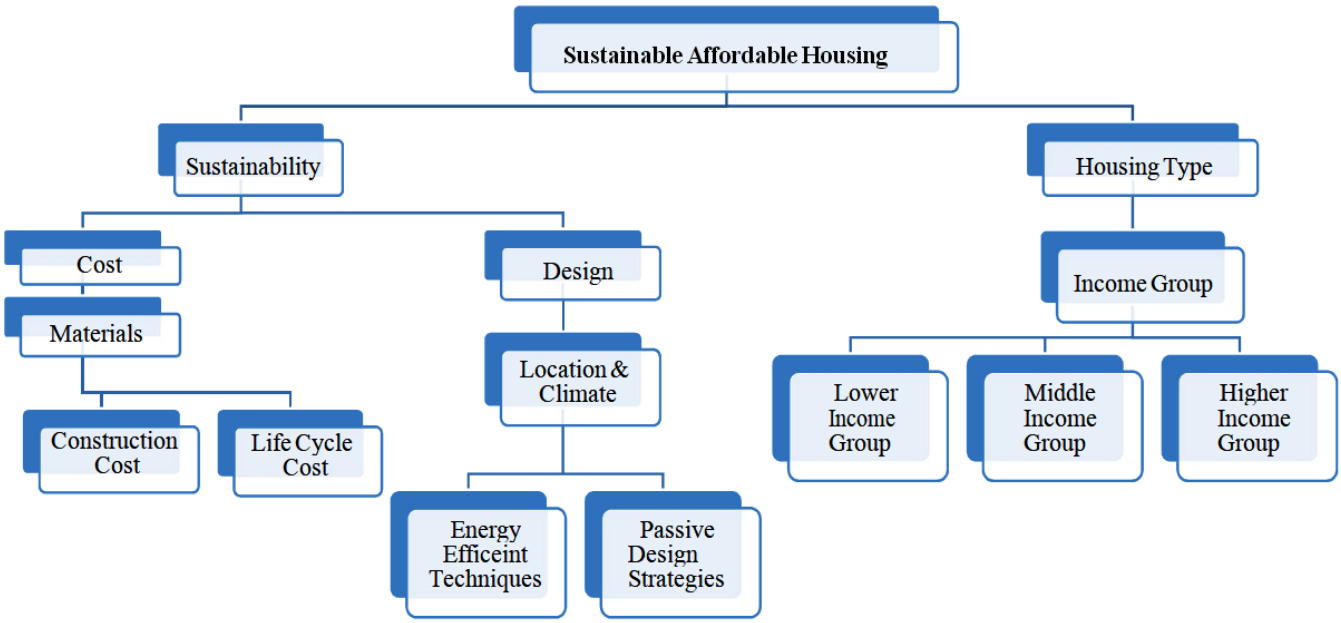
GRIHA (Green Rating for Integrated Habitat Assessment) India, is working towards making affordable housing sustainable in lines with government's PMAY-Housing for all by 2022. It has launched a new rating variant 'GRIHA for affordable Housing'. Though, there are guidelines regarding the sustainable housing issued by government or aligned agencies, there is no social awareness about it. To understand the importance of sustainability, one needs to understand the meaning of it.

Sustainability can be defined as meeting the needs of today without compromising the needs of future generations. Sustainable housing has the potential to produce good quality housing at a price that is affordable both in the short and long term. Thus, sustainable housing must aim at economic, social and environmental sustainability from planning to implementation phase and at the same time result in housing that is affordable, accessible and environmentally less damaging. (Vijai Shanker Singh, Deep Narayan Pandey, 2012). The criteria for the further study has been considered from the derived variables are as follows: a. Housing for middle income group, b. Hot and dry climate of Maharashtra, c. Materials and d. Life cycle process of materials.

1.2 Research Gap

The extensive background study of the various researches has been carried out and it came to notice that the previous studies/researches on the topic do not encompass the sustainability factor, parameters for cost effectiveness with a focus on

single family housing units. To add further, there are hardly any studies in terms of the life-cycle analysis of a cost effective middle income single family housing unit in hot and dry climate of Maharashtra, India.



Flow Chart 1: Variables in Sustainable Affordable Housing

1.3 Research Question

What are the parameters needed to be followed to achieve a cost-effective single family Middle Income Group (MIG) housing unit through life cycle analysis?

1.4 Aim

To find out the parameters for cost-effective single family housing unit for middle income group through life cycle analysis.

1.5 Objective

1. To find out the parameters of cost effectiveness of a MIG housing unit.
2. To narrow down the parameters stressing on materials, conventional and sustainable, for wall construction found in the region.
3. To prove the applicability of the selected material as cost effective through life cycle process.

1.6 Scope

To explore the opportunities of cost effectiveness in terms of passive thermal design, building technology, construction materials, renewable energy sources and construction cost while studying and apply the knowledge, gained through the study, in the practical field.

1.7 Limitations

This study will be limited to a target population, i.e., middle income group, hot and dry climate of Maharashtra and commonly found construction materials for wall in the region as the walls constitute most of the mass of a building.

2. LITERATURE REVIEW

2.1 Building Materials

For years the building industry has been dependent on an endless supply of materials, supplies, and energy resources. Hardly ever has this practice been judged with respect to the environmental impact of using these materials; the environmental costs' that go into extracting, producing, manufacturing, transporting, installing, and recycling these materials. These become more significant when buildings at a global scale consume about 40% of the raw stone, gravel, and sand, 25% of wood, 40% of energy, and 16% of water each year. Costs include depletion of non-renewable materials and resources, production of waste by- products, amount of pollutants released, and the deterioration of air, water, soil, and the habitat that surrounds them. A building industry that depends diminishing resources will on ultimately become more costly as the resources will continue to be depleted, and it would thus create a negative environmental impact.

2.2 Sustainable Building Materials

A sustainable material is environment friendly, readily available and made from renewable raw material that uses only renewable energy for extraction, production, transport and can be recycled.

Sustainable materials have following major benefits:

- They have a similar or lower price compared to traditional materials
- They do not exhaust the existing supplies of finite materials
- They save energy and reduce harmful emissions
- Since they are less harmful to occupants, they make healthier buildings.

The understanding of the life cycle of the material, the structure, property-energy relationships, and environmental impacts that occur through the extraction, processing, use and reuse of the product forms the basis of selection of sustainable building materials.

2.3 Life Cycle of a Building Material

It is the most appropriate way to analyze and assess the environmental impacts of a building and building materials. The life cycle of a building material, as shown in Figure 1, starts right from its extraction or acquisition from natural resources, and the various processes it undergoes during production and manufacturing to turn a product to its packaging, distribution, use, recovery or disposal.

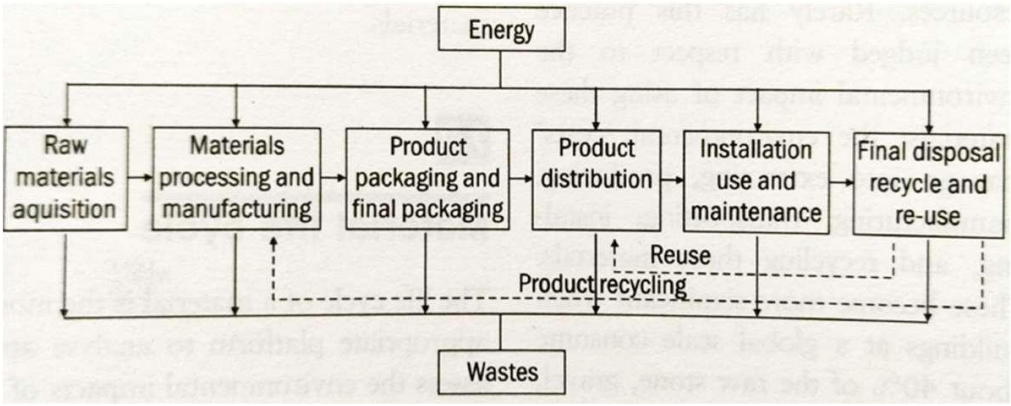


Figure 1: Life Cycle of a Material

Source: Sustainable Building Design manual

2.3 Life Cycle Analysis

The LCA (life cycle analysis) is a tool that measures the environmental performance of a building material for a comprehensive understanding of the environmental impact and the improvement that can be offered at each stage in the life

cycle of a material. The LCA caters to the wide range of impacts in a stage-specific process, where each stage poses an opportunity as well as a constraint to improve the environmental effects. This provides an alternatives and set of efficient qualitative conclusions that can help a designer choose from a variety of building materials depending on their respective environmental and economic performances.

From the literature review, it is understood that to prove the material as cost effective as well as sustainable, one needs to do the life cycle analysis of that materials. It will prove the applicability of that material in a cost effective single family housing unit.

3. MATERIAL AND METHODOLGY

To select the city for sample collection, a study was carried out and following cities from Maharashtra which falls under hot & dry climate zone has been listed down. Jalgaon, Nashik, Aurangabad, Pune, Beed, Satara, Osmanabad and Kolhapur and almost the whole of Dhule, Nandurbar, Ahmednagar, Solapur and Sangli districts. (Ref: http://mahenvis.nic.in/Climate. aspx) From the above data, the Districts falling under North Maharashtra Region has been shortlisted, i.e. Dhule, Jalgaon and Nandurbar. The present study is focused on the users who fits in Middle income group-II, with an annual income ranging from 12,00,000–18,00,000 p.a.

Total 45 no.of samples were collected using the stratified random sampling method. A virtual questionnaire was floated to understand following questions like, Annual income, Number of family members, their bedroom requirements in a bungalow, Average construction cost in their area, their awareness about the sustainable construction technology and materials, the monthly operation and maintenance cost of their house, the awareness of measures to reduce it in longer run, Their willingness to opt for higher initial cost but lower maintenance cost in the future. Also a market survey has been conducted to identify the conventional and sustainable construction materials and their cost in the region. A secondary survey, to find out the life cycle process of building materials, has been done with the help of research papers and books.

From the literature survey, the parameters of cost effectiveness of a middle income group housing unit are shortlisted, such as site selection, layout plan, housing unit design, building materials and technologies, finance and miscellaneous cost.

Table 1: Comparison between Clay Brick and AAC Block as Per Life Cycle Process

S.N.	*Parameters*	*Clay Brick*	*AAC Block*
1.	Raw Materials	A mixture of clay (alumina), sand, lime, iron oxide and magnesia	Fly ash, Portland cement, quick lime, gypsum, aluminum powder
2.	Soil consumption	One sq ft of carpet area with clay brick walling will consume 25.5 kg of top soil	Uses fly ash which is a thermal power plant waste product & thus no consumption of top soil
3.	Fuel consumption	One sq ft of carpet area with clay bricks will consume 8 kg of coal	One sq ft of carpet area with AAC blocks will consume 1 kg of coal
4.	CO_2 emission	One sq ft of carpet area will emit 12 kg of CO^2	One sq ft of carpet area will emit 1.5 kg of CO_2
5.	Density	1920 Kg/m^3	551–600 kg/m^3
6.	Consumption of cement mortar	1.44 bags of cement/ Cu.m	0.77 bags of cement/Cu.m
7.	Durability	Red clay bricks are more brittle than AAC blocks (roughly 10–12% breakage), which can lead to wastage on-site as well as faults within the overall construction.	More durable resistance towards fire, seismic activities, moisture, termites, pests, uniform by design enhance the lifespan of the project and limited requirement for constant maintenance or repair work.
8.	Workability	Brick are heavier than AAC Blocks which requires more labour and it increases the dead load of the building.	AAC blocks are generally 3 to 4 times lighter than traditional bricks. Require less labour force on-site.
9.	Sustainability	Significant consumption of top soil negatively impacts the environment long-term.	Manufactured from fly ash, which is a thermal power plant waste product that is non-toxic in nature.
10.	Versatility	Red clay bricks, on the other hand, are bulky and not as effective at-scale.	AAC blocks are lightweight and easy to use, reduces labour cost.

To narrow down further, the study is focused only on building materials found in the region which are burnt clay bricks, hollow concrete blocks, fly ash bricks, stones and Aerated Autoclaved Concrete blocks (AAC). For the comparative study, one conventional (Brick) and one sustainable (AAC Block) building material for wall construction is selected and has been carried out on certain parameters. The parameters are selected on the basis of the study carried out for life cycle process of building materials through the secondary survey of books, various research papers and journal articles.

4. RESULTS AND DISCUSSIONS

The life cycle process of both the materials has been studied. The information about the parameters has been taken from published research papers and studied with respect to life cycle process of materials.

It has been found out that AAC blocks are more sustainable compared to conventional clay bricks because utilization of fly ash, which is a waste product of thermal power plant, leads to the reduction in the cement consumption in the product which ensures in reduction of greenhouse gases. Density of AAC block is 1/3 that of conventional clay brick and it doesn't absorb water. It helps in reducing dead load of structure. Cost of construction reduces by maximum up to 20% as reduction of dead load of wall on RCC structure makes comparatively lighter members. AAC block walls are plane, thickness of plaster required is very less, and so there is substantial reduction up to 50% in requirement of cement and sand for plaster work. The production process consumes less energy, do not emit pollutants and do not creates any byproducts.

5. CONCLUSION

All the findings from the study concludes that AAC blocks are considered to be **cost effective** as compared to the conventional clay bricks on the life cycle parameters.

- **Raw material acquisition:** It uses a waste product of thermal power plant as its important component, does not deplete natural resource. Excavation cost is eliminated.
- **Material Processing and Manufacturing:** Secondary materials such as lime, gypsum, aluminum powder increases the insulation capacity of the AAC blocks which makes its energy efficient which will result in cost saving in the longer run.
- **Product Packaging and Product Distribution:** AAC blocks are light in weight making them cost-effective at-scale and easier to transport to the project site.
- **Installation, Use and Maintenance:** AAC blocks proves to be good in workability, and they require lesser labour on-site. This directly impacts labour costs per project, enabling greater cost savings at-scale. As AAC blocks come in larger sizes, they require lesser joints, which results in a significant savings of mortar. It also boosts construction speed. As it is lighter in weight which results in lesser dead weight, which leads to greater savings in concrete and steel quantities used for RCC framed structure. AAC blocks are designed with inorganic materials and are highly resistant to termites and other common pests. This helps in lowering long-term maintenance costs for projects.
- **Final Disposal, Recycle and Reuse:** The manufacturing process ensures that any waste from the cutting process is recycled back into the raw materials for reuse. There are also no pollutants released when AAC blocks are manufactured. It increases the life-span of a building which will avoid demolition of a building for alterations.

5. CONCLUSIONS

It has been proved from the above study that the use of AAC Blocks significantly reduces the energy consumption and waste generated during its life cycle which results in finding an equilibrium between its environmental and economic performance. It also proves its cost effectiveness as a material, on the selected parameters, to be used in a single family housing unit for middle income group. In terms of energy efficiency, it will also prove to be cost effective as it will result in reduction in energy consumption for heating, ventilation, and air conditioning (HVAC). The present study will help to spread awareness among the public about use of sustainable materials which will be cost-effective in the longer run. There is a future scope for the research to create a prototype of an energy efficient single family housing unit in terms design, materials, construction technology, and use of renewable energy, construction and life cycle cost.

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Lack of Communication Results in Construction Errors amongst Labors

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ABSTRACT: In today's global economic climate, new construction organizations are dominated by multicultural workforces, which are made up of teams from many nations with distinct cultural orientations and values. Language or communication barriers, cultural differences, religious variations, and practice/technological difficulties are just a few of the challenges that project and construction managers must face front on.

Because the construction business is complicated, fragmented, dynamic, and includes numerous stakeholders, good communication is critical to overcoming these problems. Many researchers discovered that the industry has significant challenges in ensuring effective and successful communication throughout the project's lifespan, resulting in project failure. Previous research papers have addressed bad communication in the construction sector; however, this study offers and investigates the identification of causes and consequences that contribute to poor communication.

Further research was done on existing literature to determine the factors and consequences that contributed to poor communication in the construction sector.

Keywords*: Communication, Causes, Construction Industry.*

1. INTRODUCTION

The construction business distinguishes itself from other industrial sectors due to its particular traits and structures. It is an expansive and complicated sector that evolves through time to accommodate and shelter the growing population. It also involves many partners from both the public and private sectors. These features have increased the complexity and difficulty in producing effective, sustainable, and acceptable quality products.

Poor communication among construction teams is one of these difficulties. In this context, poor communication is defined as an ineffective, unsuccessful, and defective communication process of project information that should be avoided in the construction business. Communication is essential to the success of any construction project.

Poor communication has a wide range of repercussions and consequences in the construction industry, including cost overruns, time overruns, disputes, and, ultimately, project failure. It has been demonstrated that ineffective communication results in ineffective consequences. The Project Management Institute researched communication in organizations, specifically in construction projects, and discovered that adopting efficient communication during the project's construction can aid in fulfilling the project's given goals and objectives. It was also shown that extremely effective communication might result in better time and cost management in the production of successful projects.

The purpose of this research is to investigate poor communication in the construction business and to identify the causes and impacts of this problem throughout the project's lifecycle.

1.1 Need of the Study

Creating a diverse and inclusive work environment is an important part of a construction project manager's job. It can help overcome communication barriers and reduce discrimination.

Poor communication in the construction industry can occur on a large or small scale. Forms on a large scale among construction partners such as a consultant, a client, and a contractor. However, on a smaller scale, it occurs between employees of the same company.

As a result, it has a number of unfavorable repercussions on both a large and local scale. On a broad scale, the impacts are considerably more severe, resulting in conflict and project failure; nonetheless, within employees, it can create various

repercussions to the job progress, accidents, and blunders during construction. The bulk of difficulties in the construction business are driven by poor and inadequate communication.

1.2 Problem Statement

Language issues are emerging as an underlying cause of wide range of workplace mishaps. As a result, effective communication plays a vital role in influencing the projects outcome on construction sites.

1.3 Scope and Limitation

Factors of selection of case study would be identified to facilitate the process of single apartment building which are G+3 structure.

The study is limited to pune area.

2. BACKGROUND OF RESEARCH WORK

A thorough review of prior literature was conducted in order to identify the aspects connected to the causes and consequences of poor communication in the construction business.

Good communication skills are one of the factors that contribute to the efficiency and effectiveness of the construction process, as well as helping to decrease the chances of accidents on the building site. According to Trajkovski and Loose more (2006), language is a barrier to communication, such as when providing information to foreign employees in written or spoken form, and it is difficult for employers to offer instructions to workers since they do not comprehend it.

One of the most difficult challenges to tackle is one involving communication issues. According to Salleh *et al*. (2012), foreign workers struggled to grasp work orders, safety standards, and deciphering safety warning signals. This is one of the factors that lead to accidents in the construction sector.

According to Salleh *et al*. (as reported in Loosemore and Andonakis 2007), there is a communication difficulty among foreign employees, which impacts any activity involving compliance with work safety and health. According to the findings of Loosemore and Andonakis' study, around 13.9 percent of respondents believe that language is a barrier to successful implementation of work safety and health in the construction sector.

Trajkovski and Loosemore's (2006) research in the Australian construction sector indicated that the communication language element has contributed to the high accident rate of 85.7 percent of the foreign employees who use a language other than English at work. According to them, 48.7 percent of foreign workers are unable to understand the instructions that were presented due to a lack of understanding for the English language, and 66.7 percent of foreign workers make mistakes in their work because they do not understand the orders.

There are many forms and practices of poor communication in construction industry. A comparative study on causes and effects of delay in Nigerian and Iranian construction projects by Oshodi & Rimaka ranked lack of communication between construction parties from the contactors perspective based on its importance as the 11th and 12th for Nigeria and Iran respectively however the ranks from the consultant perspective were 20th and 13th for Nigeria and Iran respectively. These results confirmed the significance of proper communication in the minimization of time overruns in construction projects.

Misunderstandings due to language problems are emerging as an underlying causal factor in a wide variety of occupational accidents. Implicated in this are language proficiency and literacy, but also readability of instructions. Coupled to these is the fact that the global workforce holds more migrant workers than ever before, and there are a growing number of multi-lingual shop floor environments, especially in the transportation and health care sectors. The term 'language problem related accident' (LPRA) is proposed here by P. Lindhout, J.C. Kingston-Howlett, G. Reniers (2019)

3. METHODOLOGY OF THE STUDY

The data sources are split into two categories: main data and secondary data. Primary data will be gathered using questionnaires and interviews in order to fulfil the research's objectives. Respondents will get at least 30 surveys (main contractor) as well as workforce.

Secondary data will be collected and uploaded from public inspection.

3.1 Process of Work

The strategy used in this study is based on systematic reviews from the existing literatures and from the personal interviews held on sites. Figure 1 depicts the primary methods used to conduct this research.

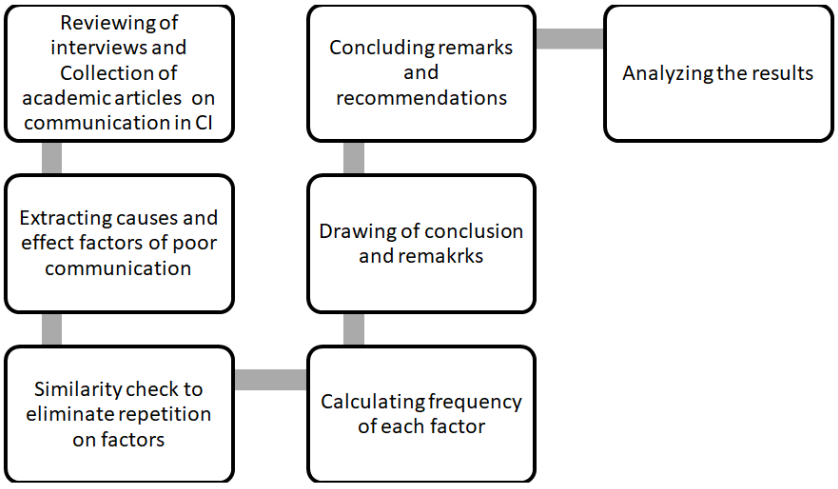

Figure 1: Methodology of the Study

3.2 Similarity and Frequency Analysis

Causes and effects components were picked at random from the interviews and then analyzed using similarity checking and frequency analysis. Similarity analyses were carried out in order to eliminate any recurrence of any factor that has a different phrase or synonyms and a similar meaning. The frequency analysis is a tally of the number of times each factor appears in various sources. This study is a preliminary assessment of the most recurring and repeating factors found in various interviews and construction projects in order to establish the level of significance of each element.

Table 1: Illustration of Similarity Analysis

Causative Factor	*Causative Factors from Initial Studies*
Lack of effective communication system and platform	Lack of good communication mechanism
	Lack of uniform standards of construction information
	Lack of communication system
	Ineffective reporting system
	Lack of feedback system
	Lack of appropriate data channel

Table 1 depicts an example of a similarity analysis of a single factor. It is evident that the factor exists in several interview answers with different phrasing but bears similar meaning, thus a general name must reflect all the elements that satisfy the meaning.

4. ANALYSIS

In this study, a focused investigation from the verbal interviews examined the causes and effects factors of poor communication in the construction industry was conducted. In order to understand the concern of researchers over the past 25 years, it is necessary to demonstrate the development of communication studies in the construction industry.

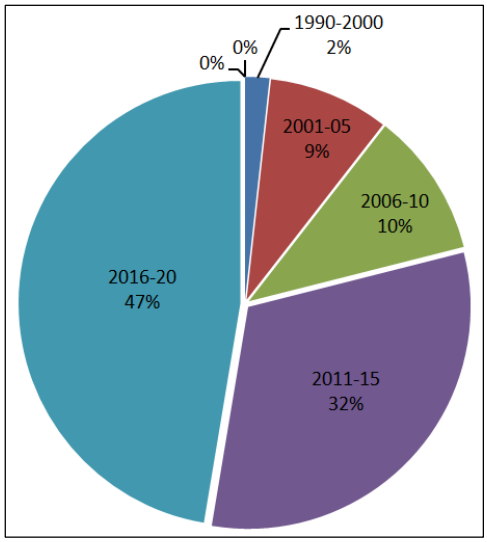

Figure 2: Number of Articles on Poor Communication in Construction Industry

The next section introduces a tabular findings of the causes and consequences elements of poor communication in the construction sector to analyze the relevance and frequency of each component. This aids in developing a clear grasp of each aspect and its role in generating the problem.

Table 2: Causative Factors of Poor Communication and Their Frequency Matrix

Causative Factors	***Frequency***
1. Inadequate communication between construction parties	17
2. Lack of effective communication system and platform	10
3. Poor communication skill	9
4. Language barrier	7
5. Improper communication channels	6
6. Construction crews have different levels of education.	4
7. Lack of support for advanced communication technologies	4
8. Diversity of culture and ethics among construction teams	4
9. Personal barrier	4
10. Slow information flow between parties	4
11. Possessing differed skills levels among construction teams	3
12. Complexity of the construction industry	3
13. Lack of communication plan	3
14. lack of appropriate communications medium	3
15. frequent changes of project contract	3
16. improper communication time management	2
17. Poor planning and coordination	2
18. lack of clear objectives	2
19. lack of mutual respect and trust among construction teams	2
20. Inaccurate delivery of project information	2
21. unavailability of information in the time of need	1
22. Lack of communication procedure and training	1
23. lack of adequate representation for project stakeholders	1
24. Lack of understanding among parties	1
25. Incorrect instructions or technical information	1
26. Gender differences	1

Table 2 displays a list of 26 reasons of poor communication and their repetitions, known as frequency, which are used to define specific factors examined by a number of people in the construction industry. The frequency in the study is defined in Table 2 by the number of repetitions of each component in distinct publications. It has been demonstrated that a lack of efficient communication between construction parties occurred 17 times, followed by a lack of an effective communication system and platform, which occurred 10 times, and a lack of communication skills, which occurred 9 times.

It has been determined that those elements had a substantial role in the phenomenon of inadequate communication in the construction business. This demonstrates the critical need for the construction sector to take quick action to improve the existing condition of communication.

Table 3: Effects Factors of Poor Communication and Their Frequency Matrix

Effects Factor	*Frequency*
1. Time overrun	19
2. Conflict among construction parties	14
3. Cost overrun	8
4. Rework and redesign occurrence	7
5. High accident rate	5
6. Failure of the project	5
7. Demotivated workforces	5
8. Poor team work	4
9. Late response to disaster	4
10. Low productivity	3
11. Misunderstanding	3
12. Design errors	3
13. Low Level of satisfaction among construction parties	2
14. Waste generation	2
15. Poor risk management	1
16. Poor project documentation	1
17. Poor planning	1
18. Affects design process	1

Table 3 depicts 18 impact variables as a result of the problem of inadequate communication in the construction business. It also details the frequency of the repercussions of inadequate communication in the construction business. It is demonstrated that the most often occurring consequence is time overrun, which appears 19 times in prior literatures. The second most common consequence is conflict among different parties which occurred cost overrun, which occurred eight times. This demonstrates how poor communication may have a significant negative impact on cost and schedule overruns in the construction sector. Poor communication among construction partners has been verified as one of the primary causes of cost and time overruns.

5. CONCLUSION

It is determined that, owing to the diversity and changing nature of building projects, ensuring good communication is a big difficulty in the construction business. To improve communication in the construction business, numerous procedures and approaches must be implemented to reduce the causes and consequences elements. Effects are essentially the outputs of causes, therefore removing the causes might result in zero effects. The causative and effect variables were found from interviewing different people from the construction industry for this investigation. Twenty six causes and eighteen effects were discovered from the study. The most common causes were a lack of good communication among construction partners, which was followed by inadequate communication skills. Furthermore, the most common recurrent consequence

was time overruns, which were followed by cost overruns. The identified criteria will be utilized further to conduct a survey to assess the relevance and severity in the occurrence of poor communication in the construction sector.

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Urban Farming in Pandemic and Post Pandemic Situation

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ABSTRACT: Due to pandemic restrictions, many residents stayed indoors. It was about India's food supply and changes in logistics. The blockade of the coronavirus has helped more urban dwellers grow fruits and vegetables at home, empowering urban agriculture and food professionals. After the pandemic, impacts on urban agricultural practices can occur. It is important to know the trends in urban agriculture in the Covid and Post covid situation. How can landscape architects contribute to the post-Covid situation in urban agriculture? Individuals, experts, and various urban agriculture authorities were interviewed for investigation. As a result, the Post Covid scenario can provide landscape experts with a new perspective on planning reviews and proposals. For a pandemic, people used balconies, terraces and backyards for urban agriculture. In an interview, researchers learned that some are practicing urban agriculture to reconnect with nature for a pandemic, while others are for health and nutritional reasons. The data is analysed using a qualitative method. Data on the characteristics of urban farmers include gender, age, education level, major occupation types, time in urban agriculture groups, autonomous farming, and timeshares. cities like Pune, Mumbai, Bangalore, and Aurangabad, every individual or community has faced some or other issue in food supply due to all restrictions mostly the urban cities. so, people who conducted urban farming had many other benefits. probably while designing green master plan there will be a need for urban farming, not just the ornamental plants or trees but also thinking about the edible landscape.

Keywords: *Urban Farming, Community Farming, Individual Farming, Green Masterplan, Post-Covid Scenario.*

1. INTRODUCTION & BACKGROUND OF STUDY

From the History 10,000 years ago, were civilizations in Egypt, China and India practiced urban agriculture as daily lifestyle activity (Philips, 2013). In March 2020, Government announced a complete lockdown in India, so people felt insecure about their daily needs Such as vegetables, fruits, and other necessities. Many press articles speak of urban farming and its growth in the covid situation. Families and farmers in Kerala are becoming self-sufficient in pandemic situation. The Kerala government has launched many policies on urban agriculture. COVID-19 is raising awareness of food quality, hygiene and nutrition not only at the individual level, but also in society. In urban scenarios this could add to the creation of new places for nutritious food and reduce food costs. Cities like Mumbai, Pune, Nagpur, and other metropolitan cities where there are fewer options for outdoor recreational spaces. So, housing societies having large numbers of such spaces had lots of opportunities in a pandemic. So today due to this situation builder community is thinking about such spaces to incorporate in their project (How Urban Farming is gaining importance during covid 19). Compared to this place, like Singapore is producing almost 10 percent of its food through rooftop farming whereas conventional farming is done only on 1 percent of its land (Article, Nourishing cities through urban agriculture, 29 August 2021). As traditional farming practices become more and more problematic, there is now a strong movement in society that takes advantage of the many benefits of urban farming (Toby Kyle, Associate Director, Grant Associates, 2022). Currently, farm households in rural areas are experiencing great difficulties in supplying an ever-increasing amount of food, and in the face of such deepening, degradation of the soil is inevitable. Intensive agricultural practices reduce the nutrient value of the soil, while fertilizers used to replenish soil nutrients often cause problems downstream (Toby Kyle, Associate Director, Grant Associates, 2022). A survey conducted by (Citizen Affairs article) found that in Bengaluru, where people practiced urban farming in various parts of the residences. So many companies around the world have adopted hybrid work scenarios during their pandemics, but what if this scenario continues after Covid? Does this leave the city's office space unused and have the potential for creative reuse? Similarly, given the surge in telecommuting and shopping over the last two years, will retail space remain idle when the pandemic is finally behind us? Most of these areas already have infrastructure suitable for food production, such as water, lighting, air conditioning, elevators and loading bays. Can unused land be diverted by climate-controlled vertical farming? And, like many old market towns, can urban farmers and a full-fledged dining experience revitalize High

Street? (Toby Kyle, Associate Director, Grant Associates, 2022). Another article Talks about the Bangalore and Pune interview explaining why urban farming growth during lockdown is a promising trend. Several people said they have changed their home garden into the kitchen garden, growing microgreens and vegetables such as tomatoes and eggplant. Some of them said that their friends inspired them and helped them create their new gardens at home. Many also spoke about how growing their plants/food made them feel connected to nature. Many of the interviews also stated that how gardening has changed children's behaviour towards food waste. So, we need new research on post-covid situations in urban farming and its aspect in the green master plan.

So, my Research that demonstrates the gap as follows:

- In covid situation what was the trend of urban Farming? and What will be the situation of urban farming post-covid?
- How can a landscape architect contribute to the post covid situation into urban farming?
- So, The Goal of the research is to identify the covid and post covid situation in urban farming and its incorporation in a green master plan.

2. LITERATURE REVIEW

This literature reports on the impact of COVID-19 on urban agriculture in São Paulo, Brazil. Urban gardening in large local nurseries is outside the city, so there is already a kind of social distancing and awareness. So far, the use of these nurseries for food security in São Paulo has been underestimated. In the post-coronavirus era, community approaches have overtaken many of the commercialization channels for urban agriculture that emerged during the pandemic. (Perceived benefits and constraints in urban farming practice during COVID-19 n.d.)-Literature review objective is the ways of urban farming during the COVID19 pandemic, through interviews of local area individuals in the City of Yogyakarta. The researcher additionally investigated the advantage and requirements of urban farming in the pandemic period. Most of the interviewees were seen performing the urban farming activities wisely in pandemic and experiencing its mental benefits. Another constructive outcome of urban farming was by the nursery workers is its capacity to build up the openness of supplements and food security. This review utilized a subjective contextual analysis configuration to evoke urban farming benefits apparent by networks during Coronavirus. Cases included six local area farms situated in private areas in Yogyakarta: Ngudi Mulyo, Melati Green, Gemah Ripah, Winongo Asri, Kampung Markisa Blunyahrejo, and Ngremboko.To address the exploration questions, the researcher has conducted interviews for 113 individuals from the local farms utilizing a poll. So, the data was investigated by using the subjective enlightening examination. the data on urban horticultural farm attributes incorporate sexual orientation, age, level of instruction, kind of the most occupation, length of your time joining metropolitan cultivating gatherings, autonomous cultivating exercises, and time portion of running a metropolitan agrarian business. So, the benefits and limitations to work out the apparent advantages and requirements in urban farming during the Coronavirus pandemic.

(Current trends on a community garden in India n.d.) This paper is investigating the components and impacts of the local area garden on the occupant and furthermore attempts to examine its existence in the Indian setting. Local area garden spaces are fundamental for the actual social and emotional wellness and subsequently, suitable bearings and approaches might be made during city arranging and nitty-gritty wanting to assist the local area with accomplishing a better way of life.

(Shifting Values and New Innovations in Urban Agriculture During the COVID-19 Crisis n.d.). The objective of this Exploration Theme is to research how the connection between individuals and urban farming has changed during the Coronavirus pandemic and what elements affected the capacity of individuals to take an interest in urban agribusiness during an emergency. Furthermore, the Exploration Theme calls for examinations on new agrarian developments and systems pointed towards reasonable food development during this time. We call for research all throughout the planet that reports what the Coronavirus pandemic has meant for inspirations to partake in metropolitan farming, developments in metropolitan horticulture, and how these progressions happened close by pandemic-related difficulties, like food (in)security among metropolitan populaces. The Impact of COVID-19 on Horticulture: Basic Issues and Openings Got from an Unforeseen Event. Effect of the sterile crisis on fancy and vegetable creation. Distinctive creation areas were differentially influenced, and explicit potential procedures should be thought of. Maintainable land use is of basic significance as we think about how to adjust the requirements of a developing populace with the longing to ensure our normal assets and climate.

How is the Godrej Group bringing the concept of urban farming? –Godrej's Vikhroli project has a useful green desert spring for individuals who just moved to precede the lockdown. We have arranged a widely internal tree-lined patio, where

the recently framed local area can invest quality energy amid local and adjusted tree species, with a blend of concealed leafy foods bearing trees. These incorporate the pride of India, downpour trees, palms, altamas, fire, trumet, guava, chikoo, and Jamun trees, among others. Anyway, who is answerable for keeping up with the reap of metropolitan cultivating? - The yard, with coordinated play spaces, likewise houses the private local area's flourishing metropolitan homestead. For this local area ranch, a committed and talented in-house green group keeps an eye on 20 unique assortments of vegetables and spices in a wooden box. The box makes a setting for guardians and kids to associate with nature. The gathered produce is circulated by the office supervisory crew to the inhabitants every other week. While the drive headed out to urge occupants to adjust to a sound, practical way of life, this little ranch was extremely valuable by inhabitants for new products of basil, brinjal, cabbage, capsicum, carrot, cauliflower, celery, chilies, mint, oregano, radish, tomato, and tulsi, particularly during the lockdown down months

3. METHODOLOGY (MATHEMATICAL MODELS USED IF ANY SHOULD BE DISCUSSED HERE)

The research question which arises that in the covid situation what was the trend of urban Farming? And

What will be the situation of urban farming post covid situation?

How can a landscape architect contribute to the post covid situation into urban farming?

So, the method for this research is mostly based on interviews and other data. So that one can understand the trend of urban farming and people performing urban farming and their views in post covid about urban farming. Whereas after reading the literature paper on all contexts related to urban farming, one can understand the broad view of Indian as well as foreign context and methods of urban farming. It also gives me an idea for carrying out my research further on urban farming and framing the post covid seen. So, the methods are as follows:

1. Identifying the city performing urban farming and then taking interviews of residents performing urban farming on an individual level and community level and person engaged its gender, age, number of a person engaged and its profession.
2. The qualitative method and case study-based method has been used to carry out the research.
3. If needed taking interviews of agencies helping out in urban farming.
4. The advantage of research is that while designing a green master plan for city or town thought and implications for urban farming be done.
5. Landscape architecture can get a different approach in the future.

4. RESULTS & DISCUSSION

After conducting interviews from different cities such as Pune, Bangalore, Aurangabad, and Mumbai on an individual level, community level, experts, and agencies based on different age groups, gender, occupation, and professions everyone had their own opinion and concern in the covid situation and post-covid situation. So individually while covid situation people started to practice growing some basic vegetables at home, in pots, as a connect with nature. Since for many days, people were bound indoors, they found this outlet a welcome change, so many people began to practice this. In a covid situation, people preferred social distancing and avoided buying things from vendors they thus started to manage by themselves as much as possible, also there was a lot of time to spend so people started urban farming in their ways and helped them to stay tuned with nature. Professionally some thought of using urban farming differently. At the individual level, many people realized the importance of known sources & toxin-free food, hence it is becoming a trend and people will continue urban farming post covid. One of the interior designers from Pune, thought about designing urban farming inside the house. Through community urban farming people experienced Connection with nature, self, family, and community, emotional solace, nutritional benefits. While some urban farming agencies started Garden club before covid in which they had a get together of members every month. So, a person joining a garden club had compulsory criteria for waste management. So, the waste coming from the household kitchen that has lots of importance in farming for compost with less soil is needed. In covid, they came to know that 30% youngsters have joined newly in the club. so, such kind of awareness and changes were observed at the agency level. An Agency from Bangalore said that during covid all age groups participated in urban farming. Large scale or small scale didn't matter even some used pots or some corners. People preferred balconies, terraces, and backyards for urban farming.

5. CONCLUSION

After reading literature, articles, and conducting interviews of around 4 cities like Pune, Mumbai, Bangalore, and Aurangabad, every individual or community has faced some or other issue in food supply due to all restrictions mostly the urban cities. so, people who conducted urban farming had many other benefits such as some interviews talk about hygiene, health benefits, community interaction, old farming memories, some talked about using urban farming in different ways in their own profession. As interest in urban agriculture continues to grow, a comprehensive challenge and opportunity for landscape designers is to creatively weave these common spaces and integrate them into future master plans. The rise of urban agriculture made possible by deliberate landscaping will not only reduce the intense demand for farms, but will also be an important small step in the fight against biodiversity loss and global conservation. After conducting 22 interviews with people from different background and considering the time crunch, out of 22 interviews 21 talked about they will continue urban farming even post covid may be larger scale or through a different lens. So even some interviews talk about the social landscape that they converted into an edible landscape, this concludes that probably while designing green master plan there will be a need for urban farming, not just the ornamental plants or trees but also thinking about the edible landscape. So further the research can be continued on the thought of the scale

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Resource Persons

Interviews conducted

1. Ar. Jayant Dharap, Pune
2. Ar. Manjiri Mahajan, Pune
3. Pooja Bhale, NDA Road, Bavdhan, Pune
4. Sneha Patni, Baba Petrol Pump, Aurangabad
5. Abhishek Jain, Jain Colony, Aurangabad
6. Sangita Kasliwal, Near Balewadi stadium, Pune
7. Inora Biotech Pvt Ltd. (Nutan Bhajekar), Pune
8. Shailesh Gondkar, Magarpatta City, Pune
9. Suraj Salve, Behind Prozone Mall, Aurangabad
10. Shraddha Chudiwal, Bavdhan, Pune
11. Ar. Shrikant Herlekar Bangalore
12. Hydrilla Urban Farming Bangalore
13. Wolly Urban farming, Bangalore
14. Aditya Ostwal, Pune
15. Ramesh Poddar, Aurangabad
16. Akshay Gavali, Pune
17. Ravindra Pande, Pune
18. Shubham Rohom, Pune
19. Rutuj Gandhi, Mumbai
20. Bharti Thole, Dhule
21. Sarang Ganoo Urban Farming, Pune
22. The Urban Farm, Pune

APPENDIX

Questionnaire

1. What influenced you for urban farming?
2. How is the urban farming coming to a trend now a days?
3. What kind of particular change was observed while covid situation in urban farming?
4. What do think will people continue with urban farming post covid too?
5. Is urban landscape getting a different kind of approach due to urban farming?
6. In covid situation how did urban farming was carried out on individual level and community level?
7. What kind of vegetables or fruits grown in urban farming?
8. What area or spaces did people preferred or used for urban farming?
9. What is the maintained required for urban farming?
10. Will community or individual person or family practice or continue urban farming post covid?
11. What practical benefits You experienced through urban farming?

Table 1

Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
Ar.Jayant Dharap		M	Pune	Landscape Architect	Email	Practicing urban farming even before covid but could give more time and interest in covid	Yes, Post covid urban farming will be continued by Ar. Jayant Dharap	Terraces, Balconies.	Individual level	According to interviewer many people realized the importance of 'known source & toxin free' food, hence becoming a trend, And People continue Urban farming.
Ar.Manjiri Mahajan		F	Pune	Landscape Architect	Email	Personally, for me nothing. But I heard many people started to practice growing some basic vegetables at home, in pots, as a connect with nature. Since for many days people were bound indoors, they found this outlet a welcome change, so many people began to practice this.	If People like or had some benefits from it they will surely practice	Balconies, terraces mostly as in urban areas people do not have the ground available to practice any farming.	I am not a part of any community gardening thing. I have my own terrace garden and I take care of it. I used to go visit my garden 2 times every week. Apart from that my watchman used to water the plants. So, I faced no serious issues.	Eat fresh non-toxic organic food. Save on transport time as we get fresh produce. Good hobby to connect with nature. All your house wet waste is converted to compost and used up as manure. So, you become a low waste generating family.
Pooja Bhale	35	F	Pune	Ecologist	Email	Desire of reconnection with nature	Yes, Hope so people will continue to urban farming.	This is a community-based farming near to Pune so it has a land of 1 acre where farming is been done on weekly basis.	Protecterra is an Ecological foundation which has a community farming concept.	Through community urban farming people experienced Connection with nature, self, family and community, emotional solace, nutritional benefits.
Sneha Patni	30	F	Aurangabad	House Wife	Telephonic	In covid situation people preferred not to touch/buy things from vendors they thus started to manage by themselves as much as possible, also there was lots of time to spend so people started urban farming in their ways. Also helped them to stay tuned with the nature.	Yes, most of the people who can manage will definitely continue urban farming post covid.	Balconies, terraces and backyards were mostly used	Urban farming in covid situation was carried out on individual level due to the social distancing and covid norms.	It helped in growing us own vegetables thus making us self-dependent in situation like covid

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Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
Abhishek Jain	33	M	Aurangabad	Civil Contractor	Email	In covid situation many people have focused to grow vegetables in their own campus in form of urban farming. So, the trend of urban farming grew in covid situation.	Due to unhealthy vegetation condition people are facing health issues and covid has already set trend of urban farming.so I think people have gained positive impact of vegetables on health and has gained good health.so they will definitely continue.	Balconies, terrace, backyard.	During covid situation people were afraid to be in contact with each other .so, individually people have created interest with full enthusiasm but later over a period of time after post covid situation people came together and did it together.	It is very fruitful way to keep oneself engage and happy and in touch with nature. Increasing urban farming is increasing greenery in cities.
Sangita Kasliwal	52	F	Pune	House Wife	Telephonic	In covid me and my daughter both used to grow vegetables such as methi,palak and tomatoes. So, we experienced and got knowledge as actually how does it grow? When does the leaves come and all? It was really fun and happy moment while seeing the product coming out.	Yes, we will continue urban farming post covid in fact we have also thought preparing a permanent space for urban farming for our daily needs.	Balconies and thinking for terrace setup post covid for maximum outcome.	I personally have started it individually but post covid can't say it can grow into community level.	Even if we have no land vegetables and spices can be grown in balconies and other for daily needs. Thus, helping in adopting healthier lifestyle
Inora Biotech Pvt ltd (Nutan Bhajekar)	60	F	Pune	Urban Farming Agency	Telephonic	In starting phase there was no awareness in people about urban farming but as lockdown increased people got panic and then the awareness of food vegetables and daily needs lead to urban farming. Also, about eating chemical free for good health came to increase in urban farming.	Yes, urban farming will be practiced post covid.	Terraces, free spaces in balcony	Individual level as well as community level.	We started Inora Garden club before covid in 1996 in which we meet in 1 month and as like course we have designed. So, person joining garden club has compulsory criteria of waste management. So, the waste coming from house hold kitchen that has lots of importance in farming for compost with less soil is needed. In covid we came to know that 30% youngsters have joined newly in the club.

Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
Shailesh Gondkar	29	M	Pune	IT engineer	Telephonic	I remember when I came home after lockdown, I thought of changing myself my lifestyle. So, I thought of engaging myself in farming activities, I myself felt the satisfaction mentally. So, me and my friends decided to do on community level in our society some void space. We all got engaged and there was a kind of interaction in us. After so long ages we all society members meet after we all were grown up.	Post covid I can't say about myself as I'm doing job in IT company but yes, my family members will surely continue but on individual level.	Balconies and society void spaces vacant space	In covid on Community as well as individual level but post covid individual level.	It's utilising leisure time also benefits us health also saves ample of money.
Suraj Salve	42	M	Aurangabad	Business	Telephonic	I have my grocery shop which was a essential service despite of that In covid I have tried giving myself and family time in the way of urban farming at our backyard. It was on choice what we wanted to eat that was grown. And instantly cooking it.	Yes, even post covid we will practice urban farming but just for maintaince we will hire someone as my daughter and son will go out for their studies so maintain it will get difficult	We practiced it at our backyard.	It was a family-based farming I would call.	Sharing of thoughts and choices came to known to us while farming.
Shraddha Chudiwal	28	F	Aurangabad	Interior Designer	Email	I'm an Interior designer as my sites were off due to covid so spending time with my family while farming was fun. Later on, a thought arise in my mind that why interior spaces can't be green edible rather than vertical grasses and all.	Post covid I'm thinking of changing my own balcony to a vertical farming and maintating it at least 1 hr. in a day which surely, I can rather than using mobile a complete day screening time.	Balcony	Individually I practiced urban farming my mother wasn't that interested	Yes, I think me myself can give a thought into my design about urban farming inside a house.

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Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
Ar.Shrikant Herlekar Bangalore	60	M	Bangalore	Landscape Architect	Email					
Hydrilla Urban Farming Bangalore	38	M	Bangalore	Urban Farming Agency	Telephonic	We offer people a turnkey solution for setting up urban farming may be at commercial level or residential, what I observed is while covid situation the requirement for our setting up increased may be small scale or large.	Post covid might be we have to increase our work man ship seeing the current requirement and thinking about low maintance and user-friendly urban farming techniques	Where they used to find place for such as balconies terraces and even some used parking lots	Individual as well as community level even some offices use it for their pantry.	Requirement methods and getting connected to nature increased.
Wolly Urban farming Bangalore	30	F	Bangalore	Urban Farming Agency	Telephonic	Before covid there was an old interest or hobby or passion it was a driven approach, whereas because of covid lot of people took lots of hobbies and ways to make money so it got a different track because the people who market hydroponics it was made as money making machine.	Apart from urban farming as economic sector what people recognize was that going back to the roots of tradition is the only way as in old times people used grow their food and daily needs in angan and surrounding the house such has turmeric, ginger, giloy has come back now in super market now. So, people have realized what if another lockdown happens and other issue or virus like corona in future so people need urban farming within their limits or may be 5kms where they can go daily or alternate day.	Balconies, terraces, empty void spaces in society, wild space in society.	Our produce is all of hydroponics produce but we have partnership with organic farms, permaculture farms. At the end of lockdown, we were approached by lot of secretary and members that can you come and make something for whole community and parks. Also, they have suggested landscapers that instead of putting ornamental gardens can you design an edible garden.	We saw that during covid all age groups participated in urban farming. Large scale or small scale didn't matter even some used pots or some corners.

Table 2

Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
1. Aditya Ostwal	26	M	Pune	Student	Telephonic	In covid situation when I came home after lockdown, I observed was my family and some of my society members were struggling for daily vegetables. They were even too costly in that situation so one of my friends suggested me about urban farming through hydroponics. I opted for agency in pune who incorporated that unit in my balcony.	Post covid also we will be continuing the same as my mother has good results out of it.	Balconies	We practiced it individually due to covid norms.	Going with the technology and managing oneself in situation is what I learnt in covid situation.
2. Ramesh Poddar	39	M	Aurangabad	Business	Telephonic	While covid situation a big impact on our lifestyle and logistics arises. So, my wife was worried about food and always used to tell me that whenever you go to market purchase vegetables for 15 days. But this was not possible every now and then I thought of growing my own food on terrace and using it wisely.	Same setup of urban farming will be carried out post covid too by us as I won't have time once my business starts post covid for purchasing vegetables and the scare of getting again lockdown or due to any reason can come up so it's better having hygienic food free of chemicals.	Terrace	Individual level even my children used to farm and learn new things.	Grow your own to be healthy is that what I can conclude.
3. Akshay Gavali	38	M	Pune	Govt officer	Telephonic	Being on govt duty it was really difficult for me to carry vegetables daily in covid situation so I thought of growing my food home where my wife can engage herself when I'm in office.	Yes, even in post covid we will practice urban farming.	Balcony	Individual level	Most important benefit I got was about daily supplying vegetables home and my wife got engaged in urban farming
4. Ravindra Pande	66	M	Pune	Retired	Telephonic	Since my age of 18 I'm doing farming and I loved it getting engaged with nature. But since when I have come into Pune city at the age of 40 from a small town, I couldn't farm but I wanted to farm but due to less of land here I couldn't. But later as lockdown was declared I saw all the situation of vegetables not getting	Yes, until my body parts work, I will continue urban farming.	Balcony	Currently individual but after covid me and my group of all old age people we will practice it on a large scale.	Trying to bring my old memories into farming and bringing out some edible vegetables give me self-satisfaction.

Interviewee	*Age*	*Gender*	*City of Practice*	*Occupation and Education*	*Interview Type (Telephonic/ Email/ Live)*	*Covid Urban Farming Scenario*	*Post Covid Urban Farming Scenario*	*Area where urban farming practiced*	*Level of Urban farming (Individual / Community)*	*Conclusion*
						easily available I myself started growing vegetables in pots in balcony and mostly 5 hrs. a day I spend into it as I liked it.				
5. Shubham Rohom	24	M	Pune	Student	Telephonic	I have tried doing farming in my pots and experimenting it just as a fun and a time that I can pass in covid.	No, post covid I won't continue urban farming as there is no one who can maintain and look after it rather than me.	Balcony	At individual level	Maintaince is what that has to be done. so someone is daily needed who can take care of.
6. Rutuj Gandhi	28	M	Mumbai	Event Manager	Telephonic	Less of land available in urban areas such as Mumbai so what I observed was people used to use their spaces in balcony, terraces even some used their windows were there was scope of sunlight.	Post covid I really don't know what will be the scene.	Balconies, window area	At individual	A thought of urban farming in some kind of event can be given where people come and prepare food for 3-4 days by going into the farms and such kind of.
7. Bharti Thole	48	F	Dhule	House wife	Telephonic	In covid I had tried growing so many different vegetables in my backyard and terrace too. Many health benefits I experienced from it. We all were fit in thst situation lemons, methi tomato palak brinjal and all were grown in our farm. Other benefit was the area was cool around and temperature was maintained due to farming on terrace.	Yes, surely looking at its benefits I will surely continue urban farming	Balconies, terraces backyard	At individual level	We have a group of women's where we perform some events periodically so post covid I'm thinking that urban farming and its awareness such kind of some events can be done society.
8. Sarang Ganoo Urban Farming	31	M	Pune	Urban Farming Agency	Email	In covid situation we had prepared some teams and were moving all around in pune for installments. We had lots of requirements from societies, individuals and other govt bodies too.	Yes, people will do urban farming but the use of technology for doing so will be different.	Society gardens, terraces, balcony	Both individual as well community level	Requirement of vertical farming increased and awareness in people was seen.
9. The Urban Farm Pune	41	F	Pune	Urban Farming Agency	Telephonic	In covid requirement increased but there were restrictions of travel so our maintance team couldn't actually reach to every individual.	Might be yes due to its benefits on health and mental calmness.	gardens, terraces, balcony	Mostly individual level	We faced many issues due to covid maintance was the main aspect we faced.

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Feasibility Study of PEB (Pre-Engineered Building) Applications in Non-Industrial Structure— Case of Corporate Buildings in Pune

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ABSTRACT: Time and cost is the most important factor and can be achieved by selecting a correct construction technology. Application of PEB is majorly in Industrial sector. The aim of the research is to establish the viability of PEB structure for a construction of a corporate building and it is achieved through understanding of PEB construction techniques, studying advantages and disadvantages, comparing PEB with RCC structure and formulating the strategies to create awareness. Combination of Empirical and Descriptive study is followed in which the research gap is established from literature study and analytical study of secondary and primary data helped author to evaluate the feasibility study of research process. Based on the analysis, PEB are cost effective, less time consuming, durable compared with RCC structure. It helps author to understand the application is feasible in Non-Industrial Sector, which will benefit the client in terms of time and cost, and contractors to finish the project in lesser time.

Keywords: *Pre-Engineered Building, Non-Industrial, Corporate Building, Office Building, Educational Building, Comparative Analysis.*

1. INTRODUCTION AND NEED

In 1960's the standardized engineering designs of building was termed/marketed as PEB. In structural engineering, a **pre-engineered building** (PEB) is designed by a PEB supplier or PEB manufacturer with a single design to be fabricated using various materials and methods to satisfy a wide range of structural and aesthetic design requirements.

Pre Engineered building is made of steel members and designing is done by computer aided applications. Architect 's play a major role in designing a building using PEB. One can create long span structures, less columns, cost effective, durable and can control and manage the construction work by using steel structures. The research aims to establish an understanding of practical application of PEB structure for a construction of a corporate building. Many people are not aware of Pre-Engineered Building applications for non-industrial buildings like hotels, school, offices, pavilions, stadiums etc. and to achieve this, a study will carried out through by studying the construction techniques like components of PEB and its parameters, Advantages and disadvantages over conventional steel system and RCC, Comparison of PEB structure with RCC, will give more clarity on PEB, application of PEB in other than Industrial sector like hotels, malls, office, stadiums etc.,. PEB has many advantages as compared to RCC and conventional steel structures. Advantages of PEB areLess construction time, low cost, easy to expand in length, can achieve large spans, manufactured in controlled quality and less maintenance. PEB components are manufactured in factory, then transported to desired location and assembled. In 6 to 8 weeks the PEB structure can be erected. Standard codes are followed to ensure satisfactory behaviour of live load, dead load and wind load. As PEB structures have bolted connections, it can easily be dismantled, expanded and reused. In this paper we will discuss about feasibility to design an office/corporate building with Pre-Engineered Steel, with the help of three Case studies, which are selected from Mumbai, Pune and Jammu will help to understand the varied needs, climate, and functions. A Comparative analysis will be made between PEB and RCC as an established construction system and parameters to compare are defined from the literature studies.

PEB application can be seen majorly in Industrial Sector for Production units, Warehouse etc. PEB is famous or known for Rapid construction technology. The application of PEB can be explored other than Industrial built forms. Possibilities or Feasibility should be evaluated based on authentic study. With PEB there are possibilities to construct buildings like Hotels, Malls, Offices etc.

If proven on positive note, the awareness is required about PEB construction technology, so that people start applying it for different buildings. PEB application is mostly known to the users involved in Industrial designs. They are familiar with this term, otherwise it has not been explored much, in construction industry of other sectors than industrial.

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In Pune there are many PEB contractors like Zamil Steel, Interarch, Kirby, S.S. Ghorpade etc. constructing Industries using PEB. Along with the industrial use, PEB construction techniques based on its rapid construction system, must be explored to construct buildings like Hotels, Malls, Offices etc. Saving in the construction time can cause increase in the productivity and business activities and hence can be found appropriate for corporate sector.

2. LITERATURE REVIEW

Sangita C. Dike & Sandip. A. Karale [1] (July 2018) writes about the comparative analysis of G+2 hospital building by considering common structural data The both building frame was analyzed using Equivalent static method by STAAD pro software. Important parameters considered were, such as maximum story deflection, maximum rotation, maximum moment, maximum base shear, maximum compressive stress, and maximum tensile stress are computed and studied for both models.

Momin Afrin Imatiyaj and Mote Prajakta S. [2] (April 2018) talks about the PEB components (portal frames, tapered columns, purlins, girts etc.), advantages of PEB and application of PEB.

M D Gawade and U.P. Waghe[3](July 2018) writes that PEB is less time consuming if the before work design and detailing is done. Comparison of conventional steel building and pre-engineered building proves that PEB is advantageous over CSB. Explains about Components of PEB, design parameters, detailing, advantages and disadvantages of PEB.

3. MATERIAL AND METHODOLOGY

The detail literature analysis was carried out on the following topics: Pre Engineered Building, Overview of PEB, Analysis and Design of PEB and PEB components. The journal papers were collected from journals like IJIR, Journal of Advances and Scholarly Researches in Allied Education, Science Direct & internet sources.

1. Based on the review of the literature, the gap in the knowledge that is the PEB applications in Non-Industrial structure has not been studied.
2. After studying the literature on PEB and its application, it was observed that there is a scope of PEB in other than Industrial sector, but awareness is lacking.
3. Data collection about PEB, various systems in PEB, PEB components, PEB material specification, study of diverse building typologies constructed in PEB, PEB applications, helped to understand the importance and use of PEB in various parameters and aspects.

The study would include literature review of articles published by Indian authors. Parallel available case studies of structures built in PEB materials. Various secondary sources like books by Indian authors and relevant data from magazines shall be referred to for the same.

The comparative cost benefit analysis would be carried out by making a comparative chart showing all the properties of PEB material against RCC.

4. RESULTS AND DISCUSSION

Case studies and Data collection

Case 1: Office building, Taloja MIDC, Raigad

This office building in taloja is constructed in PEB, comprises of Ground + three floors. This building type is hybrid, where staircases and lift shafts are constructed in RCC and rest in PEB. **Prashant Deshmukh[4] (May 2021)** writes due to space constraints in Navi Mumbai, the building space is optimized with efficient slender columns maximizing usable floor space, longer spans for open, column-free spaces and the integration of HVAC systems into structural spaces allowing reduction of floor-to-floor height. For office building, every floor was treated as a separate mass and façade is cladded with ACP cladding and structural glazing. Area of office building is around 500 sq.m. Purpose – Office use, Time - 8 months, Cost - 1Cr and 63L.

Case 2: Educational Building, Pirangut, Pune

This college building is constructed in PEB, comprises of Ground + three floors. This building type is also hybrid, where staircases, walls and lift shafts are constructed in RCC and rest in PEB. Area of college building is around 598.46 sq.m. per floor. Total area –1795.38 sq.m. Purpose – College/Educational, Cost – 2 Crore (excluding plinth and civil), Time – 6 months.

Case 3: School building, Jammu

This school building is constructed in PEB, comprises of Ground floor only. This building is constructed in PEB. Area of building is around 615.16 sqmt. Purpose – School/Educational, Cost – 70 lakhs (without Plinth), Time – 6 months.

Table 1: Comparative Analysis **o**f PEB and RCC

SR.NO.	PARAMETERS	PEB (STEEL)	RCC
1	Material specification	Precise and fixed, carefully and accurately controlled under supervision in the production facility.	Variable, non-homogeneous. The properties of concrete vary widely due to variations in its proportioning and mixing.
2	Fabrication	Done in shop-controlled conditions.	Mostly at site in variable conditions.
3	Dimensions	Precise and accurate measurements carried out by automated machines.	Potential for significant errors as most of the work is man made on site.
4	Capacity	Steel may carry up to 6 times its own weight.	The carried load of concrete is almost equal to its weight
5	Material Foundations	Lighter, simple design and easy to construct.	Variable and generally require extensive heavy foundations.
6	Erection	Easy, fast and efficient. Erection costs and time are accurately forecast based on extensive experience with similar buildings.	Concrete construction takes more time to complete because it must be poured on site and allowed to cure before proceeding.
7	Clear Spans	Larger, up to 90 meters without interior columns.	Smaller and the larger the span the heavier the structure.
8	Building Height	Higher	Shorter
9	Changes	Flexible, tailor-made, changes and revisions can be made easily. Future expansion is simple, easy and cost-effective. One supplier to coordinate changes.	It is nearly impossible to modify a concrete building to meet changing future needs. To expand the structure, the contractor must build a new structure with foundations, columns and most likely must break part of the old structure.
10	Fire Resistance	Needs more protection (multiple options available).	Good Resistance
11	Applications	Industrial and Commercial.	Residential, commercial and many other


Table 2: Element wise Comparative Analysis (Costing noted in Nov. 21)

CHARACTERISTICS	PARAMETERS	PEB (STEEL)	RCC
COLUMN	Time	Supply and erection of all PEB columns with other components is done in 6 to 7 weeks. In comparison with RCC, it is 5 times faster.	Curing of column takes 7 - 10 days
	Cost	Rs. 94435 per metric ton	Rs. 10520/- per cubic meter
	Material	Galvanised steel, mild steel	RCC
BEAM (M25)	Time	Supply and erection of all PEB beams with other components is done in 6 to 7 weeks. In comparison with RCC, it is 5 times faster.	Curing of beam takes 5 - 7 days
	Cost	Rs. 94435 per metric ton	Rs. 10780/- per cubic meter
	Material	Galvanised steel, mild steel	RCC
SLAB (M30)	Time	5 times faster construction compare to RCC slab	Curing of slab takes 14 - 21 days
	Cost	Rs. 10371 per cubic meter	Rs. 10171/- per cubic meter
	Material	Galvanised steel, mild steel	RCC
WALL / CLADDING	Time	5 times faster construction compare to brickwork	wall of 10m length will take 1 day
	Cost	Rs. 1100 per square meter	Rs. 5103 per cubic meter
	Material	mild steel/aluminium with zinc or aluminium coating	Burnt bricks/AAC/Siporex blocks
STAIRCASE	Time	supply and erection in 4 days	Takes 21 days for curing only
	Cost	Rs. 130 per kilogram	Rs.10358 per cubic meter
	Material	Metal/ Stainless steel	RCC
FRAME STRUCTURE	Cost	Rs. 15000 per square meter	Rs. 20000 per square meter

The above parameters were discussed with Industrial experts, to get the actual facts/data's related to PEB and RCC and comparison between two. The experts are from Prashant Deshmukh and Associates (PMC firm):

- Mr. Milind Sathe – Project Manager
- Mr. Pratik Deshmukh – MD of PMC Firm, Pune
- Ms. Pranali Davare – Project Coordinator
- Mrs. Pooja Shitole – Project Coordinator
- Ms. Rachana Upadhaya – Trainee Project Coordinator

4.1 RESEARCH FINDINGS

In last two decades the construction techniques and methodology has undergone drastic changes. The construction activities and cost of construction is increasing day by day. In todays life time is an important factor, consider it in day to day life or in construction field. Fast construction of a building will give an opportunity to the client to use the infrastructure and run the business and earn benefits.

As PEB is known for rapid construction work, but the use is limited to Industrial sector. Whereas it is no where mentioned that PEB is not suitable for Non-Industrial building such as Corporate buildings, Commercial buildings, Exhibition halls, Stadiums, Pavilion etc. Hence corporate building also can designed in PEB located in Pune, where there are many PEB contractors available. With Pre Engineered Steel Building construction technology the construction time is reduced, longer spans can be achieved, other advantages are, less maintenance, flexibility to expand, quality control, energy efficiency as compared to RCC.

A discussion with Industrial experts has helped to consider the fact that PEB is suitable for other than Non-Industrial structures. But the awareness is required about PEB construction technology, w.r.t to cost, time, aesthetical values so as to promote applications for different buildings.

There are many buildings in India and other countries where commercial, educational or office buildings are constructed in PEB, but it is not been promoted or advertised or documented. Due to the lack of knowledge in Engineers, Architects, Contractors, Students about PEB construction technology, the use is limited to specific type of work.

5. CONCLUSION

The study carried out on feasibility of study of PEB applications in Non-Industrial structure helped to conclude it, as follows:

- Pre-engineered steel structures building offers low cost, strength, durability, design flexibility, adaptability and recyclability. Steel is the basic material that is used in the materials that are used for Pre-engineered steel building.
- PEB can be easily provided for longer spans and for higher floors.
- If promoted in a positive way, then PEB can be applied for non-industrial structure also.
- Awareness to be created about PEB application by promoting, by advertising about the buildings constructed in PEB, awareness can be created by writing paper on its usage for non-industrial structure, meeting PEB contractors, encouraging them to give seminars/webinars and share the knowledge/experience with Builders, Architects, Real estate firms etc.,.
- In colleges, PEB construction technology should be taught to the students in detail, which will help the students to explore the option and propose a design with PEB construction technology.

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A Feasibility Analysis on Restoration of Vintage Houses in Kerala

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ABSTRACT: Building a shelter for oneself and loved ones has always been the primary objective for mankind. This led to better options for construction. The houses discussed in the paper are vintage houses[1]. Kerala is well known for its traditional architecture and wooden work which is currently being demolished. The feasibility analysis on these vintage houses in comparison with the new constructed homes is done to establish the fact that restoring the vintage houses after a thorough study of the major damages or repair work will uplift the life span of the structure like a new structure. The other factor is the cost of restoration which will be less or equal to the cost of constructing a new house with similar footprint. The last factor is the time consumption for restoring vis-à-vis the time taken to construct a new structure.

Keywords: *Restoration, Vintage Houses, Feasibility Analysis, Costing, Padipura, Manusyalaya, Veedu, Aasharis.*

1. INTRODUCTION

The initial options for materials in constructing homes were very rudimentary and not fitting the margin of stability, people strived hard for improvement. Varied materials palette was selected from the beginning for the construction of homes. Even to this day, innovative materials are considered experimental to build with for houses. The architecture of Kerala has always been prominent and withstanding the climatic changes and cultural changes for many years. The towns in Kerala are still known for the sloping roofs with mangalore tiles[2], its woodcraft, joinery, underground storage for food grains, the well adjacent to the kitchen, long verandah, windows with timber jaali work, chajja, padipura,[3] laterite stonewalls, timber doors and windows. These are relatively simple designs tailored to exact specifications using geometric calculations and cutting-edge construction techniques, all executed by only skilled craftsmen.

The traditional architecture in Kerala is based on VastuVidya derived from Stapatya Veda of Adharva Veda which includes Residential Architecture (Manusyalaya) under functional architecture. It also includes Temples under conceptual architecture. The terminology for houses is Veedu (Tharavad) which is a shelter to a joint-family. A highly skilled body of craftsmen then applied cutting edge construction techniques that enabled them to execute the designs laid out precisely. Skillful choice of appropriate variety of timber for each function, accurate joinery, precise and deft handling and intricate carving on the walls, columns and roof frames are unique characteristics of Kerala timber architecture.[4]

The trend in the past few years however, has changed and the people settling back in Kerala are preferring to demolish the old structures. As modernism dawned, many demolished these vintage houses to be at par with changing trends or when there was necessity of repair, the tendency was to go for the easiest option of demolishing the structure completely and building a new house. The reasons can be many, some of them are:-the skill required for the repair work of the timber work is very scarce, constructing a new house seems to be simpler than to add the alternatives and changes to the original structure or believing a new structure will last for a longer span and can be handed to the next generation. The cost of repair work for the vintage houses is best known by the Aasharis[5] who taught their skills only to their next generation.

Aim: The aim of this research paper was to conduct a feasibility analysis on the restoration of Vintage houses.

[1] The houses that are older than 25 years and have architectural features representing the architectural history of that area.
[2] Manglore tiles—red coloured tiles made of Laterite clay used as roof tiles.
[3] Padipura—an elaborate entrance gateway for houses with shade and seating sometimes.
[4] Extract from Amazing Timber Resorts by N. Mahesh.
[5] Skilled Carpentars with technical and artistic capabilities.

2. OBJECTIVES INCLUDE

- To study the architectural features of vintage houses.
- To revive it and restore it as much as possible for the next generation, retaining the emotional quotient, heritage value, family asset and conservation of the structure.
- Maintaining the traditional houses with its materials in view. By restoring, the structure gets a longer life along with major features like maximizing recycling material usage and minimizing environmental impact.
- Making a list of the repair work needed for each house and suggesting a remedy as per experts.
- The quotation for the repair work is made with help of experts.

—Aasharis

Scope: In response to the demand of domestic and international citizens for the cultural importance of regional architecture, the State of Kerala with support of the Government of India, embarked on a long term plan called Muziris Heritage Site in 2009. This has led to an impressive effort of the Govt. in protecting, restoring and sustaining a number of natural and built sites.[6] The local recognition has increased for restoration of such structures. The feasibility analysis of this study will give broader perspective to owners to choose from demolishing or restoring the vintage structures.

Limitations: Listed and concentrated on issues observed in the case studies only. In the coverage of the houses, the age of the building differs a lot which might overlook some limitations that are common in ancestral houses.

3. LITERATURE REVIEW

The Vintage or ancestral houses can be based as Grade II-A Buildings, i.e. buildings of regional or local importance with special architectural features or aesthesis—be accorded for setting up a "heritage streetscape". The aim of conservation is to maintain the authenticity of the fabric which includes materials, assembly, integrity, architectural and cultural values. The Character defining for a structure means the overall structural system, non-structural elements such as facades, partitions, stairs, decorative elements of carpentry, techniques and materials used for construction including their quality or grade or characteristics.[7] The different methods for restoration and preservation of these structures[8] are: wooden beams and board that is deteriorated due to water leak/drip from terrace are replacing with new ones keeping the original profile matched.

- *Plaster*—in case of flaking of lime wash, the cement plaster patches should be removed.
- *Paving*—in case of hard paving, it should be removed to create soft spaces and make the surroundings permeable.
- *Gutters*[9]—in case of deposition of soil in the gutters or improper slopes, clogging occurs. For this, the gutters need to be cleaned and re-aligned with proper slopes.
- *Re-pointing*—deteriorated or distressed mortar are removed from joints between masonry units and new mortar with lime base is joined.
- *Wooden Flooring*[10]–damages or deteriorated planks can be consolidated without losing its appearance.
- *Wooden Elements*—Epoxy resin techniques can be used to repair smaller badly deteriorated areas.
- *Termite*—Anti-termite termite can be either be brush-applied (on wood) or injected into desired area (on walls, windows). A typical mix of chemical would contain1 litre of chlorpyrifos in 3 litres of kerosene oil.
- *The architectural features*[11]*for Roof*—the roofing system can be of any choice but covering material should be Mangalore tiles. The colour should be natural terracotta colour. It should be left unpainted. The Eave board width should be 10-15 cm of which the material should be wood with natural timber. The sloping chajjas can be used to functionally protect the openings from the sun and the rain.

For windows, only panelled design should be done, only vertical grills/safety bars are allowed. Ornamental iron work, grills and awning are not allowed.

The wall surface should have a plastered smooth finish to give the appearance of a lime plastered finish. The colour of the wall should be natural, white or off-white or nut brown.

[6]Extract from Article 'Restoration of the Historic Indian Synagogue in Parur—By Jay A Waronkar (2011).
[7]ICOMOS GA2017 6-3-4 Doctrinal Texts Ver 30/7/2017 Principles for the Conservation of Wooden Built Heritage.
[8]Handbook of Conservation of Heritage Buildings published by Directorate General, Central Public Works Department.
[9]Based on Heritage Conservation Course NPTEL.
[10]Structural Woodwork (Practical conservation Guide for Heritage Properties).
[11]Guidelines for Conservation & Preservation Kerala State Tourism Department—Special Tourism Zone.

4. METHODOLOGY

A survey is done for the Owners and Prospective Owners including new generation about the awareness of traditional architecture and their concern for restoring the vintage houses. Based on the survey conducted (25 responses received), it was found that 84% of people prefer the house to be in traditional style of architecture.

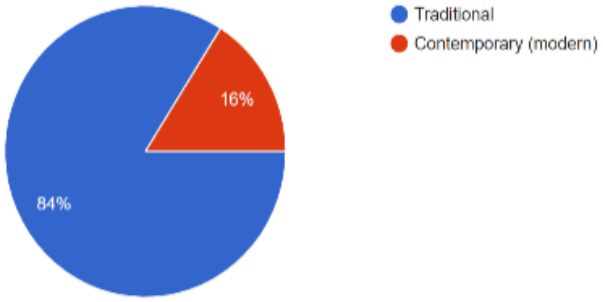


Figure 1: Survey Result of Preference of Traditional to Conventional Architecture

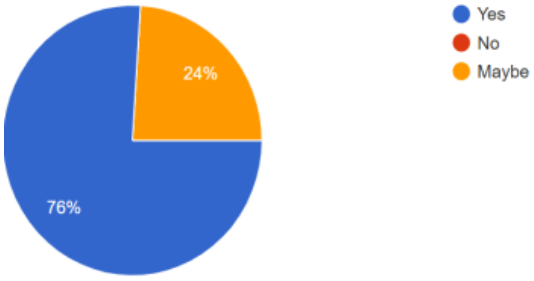


Figure 2: Survey Result of Restoration Compared to Construct a New One

If the cost quotation is below constructing a new house, 76% would prefer for restoration only. About 88% would like to incorporate renewable energy into the vintage structure without damaging it. Along with it, the parallel study is done for reasons supporting restoration, the emotional quotient and the importance of preserving the heritage. A case study of 10 Vintage houses was done, and documented complete with photographs and measurements. The defects and damages of the structures were also listed along with the requirements of the Owner. The Bill of Quantities is calculated keeping the restoration techniques mentioned in the guidelines and the rates are filled by the Experts—Aasharis and Contractors with experience of restoration. The time period required for the Work is taken by the Contractors. A case study of 3 New homes are completed. The Bill of quantities are taken from the actual tender and the rates are also documented. The time taken for the new houses are also recorded. The cost comparison with a new structure, time span comparison and life span comparison is done and the analysis done will be based on this result. It is done by the following phases:

1. Evaluating each remedy-alternative based on its total life-cycle costs including the comparative costs associated with the original construction.
2. *Develop Project Delivery schedule:* Evaluating each viable alternative & including a project delivery schedule that shows critical events and milestones from the time of budgeting to on-time delivery for the restoration project and new construction.
3. *Cost Benchmark:* A cost benchmark is the cost model based on real, similar facilities used to evaluate project costs for a similar type—vintage structure. An average for the houses are taken.
4. Each structural components and non-structural components are studied according to the material used. This study is based on load bearing structures in Kerala.
5. Extent of modification and restoration is decided keeping the Client's thoughts, concerns and budget in mind.
6. Various methods are studied which are available for these type of structures and stepwise jotting is done.

5. RESULTS AND DISCUSSIONS

Kerala architecture is greatly influenced by Vedic and Dravidian traditions. Architecture in any given area is impacted by different aspects i.e. the climate, geographical factors and historical data relevant in that area. The climate in Kerala is humid and the monsoon ranges here for three to four months. The rainfall is above 2000 mm and in many areas it is above 3500 mm.[12]

- The roofs of the homes come down to a very low level to keep the heavy rain away from the walls.
- In almost all houses, the Verandah surrounds the house. This acts as a plinth protection and protects the external walls from the sun and the heavy rain.

[12]Climatic impact on Vernacular Architecture of Kerala, Sept. 8, 2016.

- There are inner courtyards at the center of the house (mostly) to allow the flow of the air.
- The window openings are small generally. In case of big openings, timber jaalis are provided,
- The ridged roof are pitched at an angle between 30 degrees to 40 degrees.
- The overhangs of the roof are supported on timber brackets.
- Some structures also have raised plinth which protect the houses against dampness and insects.

Each house has a distinctive identity. Mud plaster, mud bricks, lime and plaster makes the external walls. The homes are built in accordance with VastuVidya. There is extensive use of timber. Most of the houses have the Padipura as the traditional entrance gate. The classification of houses[13] based on the social position or the occupation one is into are: Cheri–Pariah (outcast), Cheraman, Chala-Agrestic slave, Kudi-Blacksmith, Variyam/Pisharam-Temple servants, Veedu/Bhavanam-ordinary people, Idam-Nayar's authority, Kovilakkam/Kottaram-Richer people. The types of Veedu are classified as Cheri, Chala-Wretched humble house, Ekasala-I shaped single hall house-farmers, Nallukettu-courtyard house landlords, Ettukettu (double Nallukettu)-rich landlords and Veedu (common houses)–in cities and villages.

6. BUILDING MATERIAL

Flooring system: The basic system of flooring is beaten earth which is polished with cow dung. The polishing procedure has to be repeated at regular intervals. There is another type of traditional flooring that is the black coloured traditional flooring. In this, a mixture of lime and sand are mixed. In this, the coconut shell is crushed and added along with white of egg, coconut water and jaggery. Sometimes vegetable extracts are also added. This type of flooring is found in Padmanabhapuram Palace. Another type is timber flooring which is mostly used in attic space or the floor above the structure to make the structure light.

Wall System: Laterite stones are found in many structures. It is the red coloured stone which is abundantly found in Kerala. This stone has a special capability of getting stronger and durable in the open as time goes. Brickwork is also found in many vintage houses. Random rubble masonry is used for dead wall facades or to highlight the entrance, etc.

Mortar: Lime mortar was used. It was mixed with vegetable juices. E.g. a bitter juice or leaf were placed between stones to keep away insects like ants and termites. Such enriched mortars were also used for plastering.

The methods that were adopted for repair work were:

- Inspection of the structure was done to find out the extent of damage and decay.
- On the basis of this inspection report, the cause for the damage was diagnosed.
- The remedial measures were found out for the damages, in this case based on the conservation standard techniques and a report was made.
- A detailed study of the remedial measure was done and a bill of quantity was prepared along with the estimate.
- After the Clients approval, planning shall be done for the work so that it is completed in a systematic manner.

The 10 vintage houses were studied in detail including its measurements and damaged areas.

Figure 3: Repair Work Observed in Case Study

The repair areas for structures seen generally are[14]: Services—plumbing and electrical whether it is concealed or exposed, additions or alterations carried out by the occupants, OCD's—original construction defects, lapses and outcome, lack of

[13]Extract from Malabar manual.
[14]Extract from Diagnosis & Treatment of structures in distress by R.N. Raikar.

material and specifications which goes hand in hand with workmanship compatibility, age related wear and tear, maintenance inadequacies and related response, construction history, basic structural framing provisions and deficiencies, critical areas for weather resistance and their response, external ground area and infrastructure support provisions, bad housekeeping, damage in special elevational treatments—extent, overhangs and its performance, response of terrace for weather protection.

The common damages observed in the case study were discoloration, cracking at the external façade, malfunctioning of certain projecting elements, corroding exposures, condition of existing plumbing line, cracked pipes, vegetation growth, peeling of plaster of both internal and external plaster, efflorescence, plinth protection damage, ground water ingress, ground water flooding during monsoon and rainwater disposal pouts, downtake pipes, etc.

Of the 10 houses, House No. 1 was an abandoned house, here the repair work was extreme. House 9 & House 10 were maintained and were in a better condition. The repair work also for these two houses were very less compared to the other houses. This study is shown in Table 1. The repair work for the houses were on 17 major areas, which include 1. absence of plinth protection, 2. plinth sunk due to flood level, 3. wall plaster—external damage, 4. wall plaster—internal damage, 5. openings (doors & shutter), 6. timber internal roof damage, 7. Mangalore roof tiles damage, 8. rainwater pipe damage, 9. flat terrace waterproofing damage, 10. termites, 11. seating porch, 12. flooring, 13. crack on walls near roof, 14. wooden repair, 15. vegetation damaging structure, 16. faulty electrical lines and 17. Toilet drainage and water pipelines.

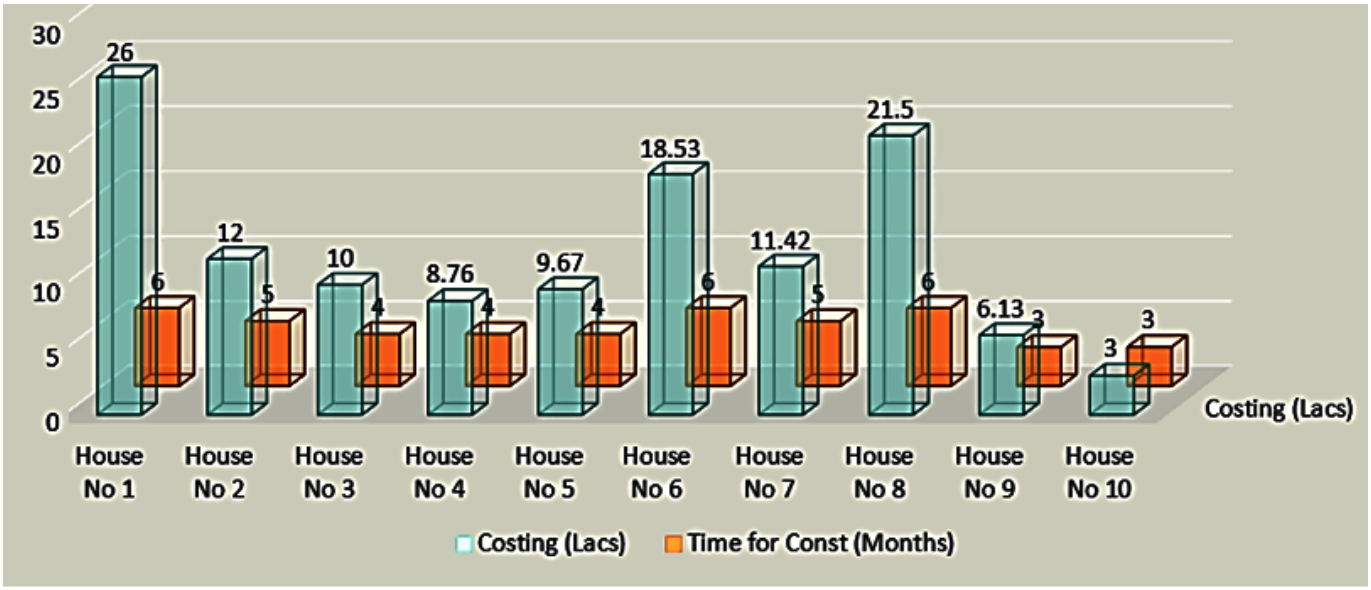
The extent of the damage and the need for repair is seen and verified along with the client. The damage is listed as Item No. 1, Item No.2 and so on respectively as shown in the chart.

Table 1: Chart with the 17 Major Areas of Repair Based on Case Study of 10 Houses

No	Problems identified	House No.1	House No.2	House No.3	House No.4	House No.5	House No.6	House No.7	House No.8	House No.9	House No.10
1	Absence of plinth protection		X	X	X	X			X	X	X
2	Plinth sunk due to flood level		X		X	X	X	X			
3	Wall Plaster-External Damage	X	X	X	X	X	X	X	X		X
4	Wall Plaster- Internal Damage	X	X		X	X	X	X	X		X
5	Openings (Doors & Shutters)	X	X	X	X		X	X	X		
6	Timber Internal Roof Damage	X	X	X			X	X	X	X	
7	Mangalore Roof Tiles Damage	X	X	X		X	X	X	X	X	
8	Rainwater Pipe Damage	X	X	X	X	X	X	X	X		X
9	Flat terrace waterproofing damage				X			X			X
10	Termites	X	X				X				
11	Seating Porch	X	X		X	X			X		
12	Flooring	X		X		X	X		X		
13	Any crack on walls near roof	X	X			X	X	X	X		
14	Wooden Repair	X		X	X		X			X	
15	Vegetation damaging structure	X		X	X	X			X		
16	Electrical lines	X	X	X		X	X	X	X		
17	Toilet and plumbing lines	X	X	X		X			X		

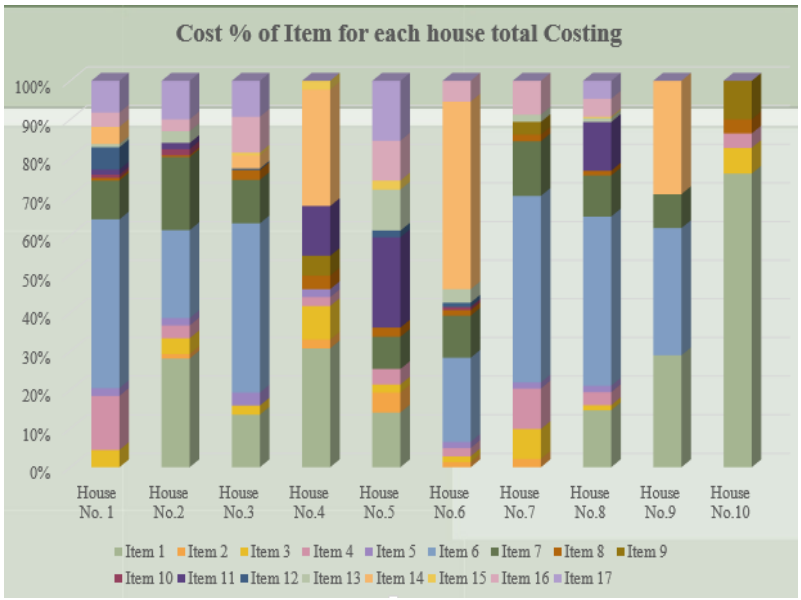
The quotation for the repair works were calculated with the specifications as mentioned for conservation and the rates were taken by the Aasharis and experts with experience in such works. The cost of work depending on the repair of each house ranged from Rs. 26,80,306/- to Rs. 3,00,850/-. Therefore the sq.ft rate also based on the construction area of each house ranged from Rs. 1170.20/sq.ft seen in the maximum dilapidated house to Rs. 97.04/sq.ft at a reasonably well maintained house.

Table 2: Chart Showing the Comparison of Costing of the Project and the Time Taken to Complete in Months



For the construction of a new house, the construction rate would be approximately Rs. 2600/sq.ft where all the civil work and the finishing was included. The estimated time for each work was also calculated and it is mentioned in Table 2. An average time for the repair work was estimated to be between 3 months to 6 months where if well planned and well executed, many items of work can be done parallel to other jobs and the milestones for each work can be achieved.

Table 3: The Costing Comparison for Each Repair Work Out of the 17 Items Listed



As shown in the chart (Table 3), the extent of each repair work, is seen that Item No. 1. Absence of plinth protection, Item No. 6-Timber Internal Roof Damage, Item No. 7. Mangalore Roof tiles damage and Item No. 14. Wooden Repair are more evident in all structures. The least repair work is seen for Item No. 12. Flooring.

7. CONCLUSION

The study of the ten vintage homes in different parts of Kerala gives a clear idea of the extent of repair work for each home and the costing and time required for it. This shall help the clients and prospective buyers of such a home to take a decision

of restoring the home instead of demolishing it and constructing a new one. Restoration shall help in regaining the importance of the heritage of Kerala and transmitting it to our future generation as it was adroitly handed to us. The study of new structures shows that in spite of using newer materials and constructing in a modern theme, the structure fails to maintain itself even for a year. The sloping roofs or the verandah outside the house are all for a reason in the vernacular architecture. Having a flat roof as an option, will only result in leakage issue from the first monsoon itself due to the heavy rainfall. The design concept, construction and materiality has to be understood and followed as it is keeping the climate of Kerala and its history. The emotional quotient of traditional values and cultural perspective is also taken care of.

This shall also help in lowering the impact on the environment and global warming. The amount of embodied energy from concrete and steel bars is much more compared to the old restored structures. The load bearing vintage homes emit negligible amount of carbon emissions to the environment. Also avoiding demolition waste thus reducing the amount of debris that goes to landfills.

It can therefore be concluded that the impact of restoring the vintage homes is much more important in today's scenario and it should be considered by all the city dwellers and village inhabitants in the same way. Thus, even if they are building a new home they will keep the characteristics alive and use the local materials of the village as it was traditionally done.

ACKNOWLEDGEMENT

I would like to express my gratitude to my guide Prof. Alka Tawari, Prof. Kalyani Salvi, Prof Dhaval Ghare and Prof Sunanda Satwah for their valuable guidance and encouragement. Their profound understanding in this work helped me to reach to the conclusion.

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Study of Dwellings in Bohra Settlement at Ranala

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ABSTRACT: The Bohra settlement at Ranala in Nandurbar District of Maharashtra is an excellent example of traditional architecture. It has approximately 200 houses. This study of Bohra dwellings reveals the understanding with which buildings were planned. The traditional characters of architecture reflect the lifestyle and culture of the people. However, many people from the region are relocating to urban areas for better education and jobs, has led to most of the houses being unused for years and hence are deteriorating at a faster rate. This situation is getting worse and urgent steps are required to understand the architecture, and materials used towards the preservation of these heritage buildings in the future. The paper emphasizes the significance of Bohra's design character and the architectural heritage in this village. By identification of typical building elements along with construction material and technology used for rural architectural heritage while responding to the need for the preservation of this heritage.

Keywords: *Bohra Dwellings, Building Elements, Architectural Character, Construction Material and Technology, Preservation and Heritage.*

1. INTRODUCTION AND BACKGROUND OF STUDY

1.1 Importance of Study of Dwelling

Every society has the interest to study and conserve its part heritage, in fact, it is recognized as an important aspect of society's aspirations. As Architect, we areconcerned with the understanding, appreciation, conservation, and continuation of the virtues of quality built forms handed over to us from earlier generations. These built forms which are contextually appropriate are a product of centuries of experimentation, shaped by social, cultural, religious, technological, geo-climatic, architectural influences they have been continuously refined, by trial and error based on the changes in societal characteristics and technology. As a result, these dwellings serve their purpose well-being extremely congruous with their local culture and religion of society satisfying both functional and aesthetic aspirations of these users. The study of these dwellings has good potential for influencing the architectural character appropriate to present context in continuity with the tradition. The traditional Habits of Bohra's from the Islamic community are found in cities like Sidhpur, Kapadvanj, Ahmedabad, Jamnagar, Surat, and Ranala are excellent examples of traditional architecture. It aims to analyze and identify the social and cultural factors which have a critical influence on the structuring of the dwelling unit of the Bohra settlement of Ranala.

- **Aim:** To emphasize the significance of Bohra's design character and the architectural heritage in this village.
- **Objectives:** To study the architectural elements, building materials, applied construction technology, and house forms in relationship with the Climatic response by observation of the structures in the region.
- **Scope:** This topic has significance of future research specially the conservation and heritage management of the entire Bohra settlement of Ranala.
- **Limitation:** To Study and give heritage management proposal for few elements of typical bohra houses at Ranala.

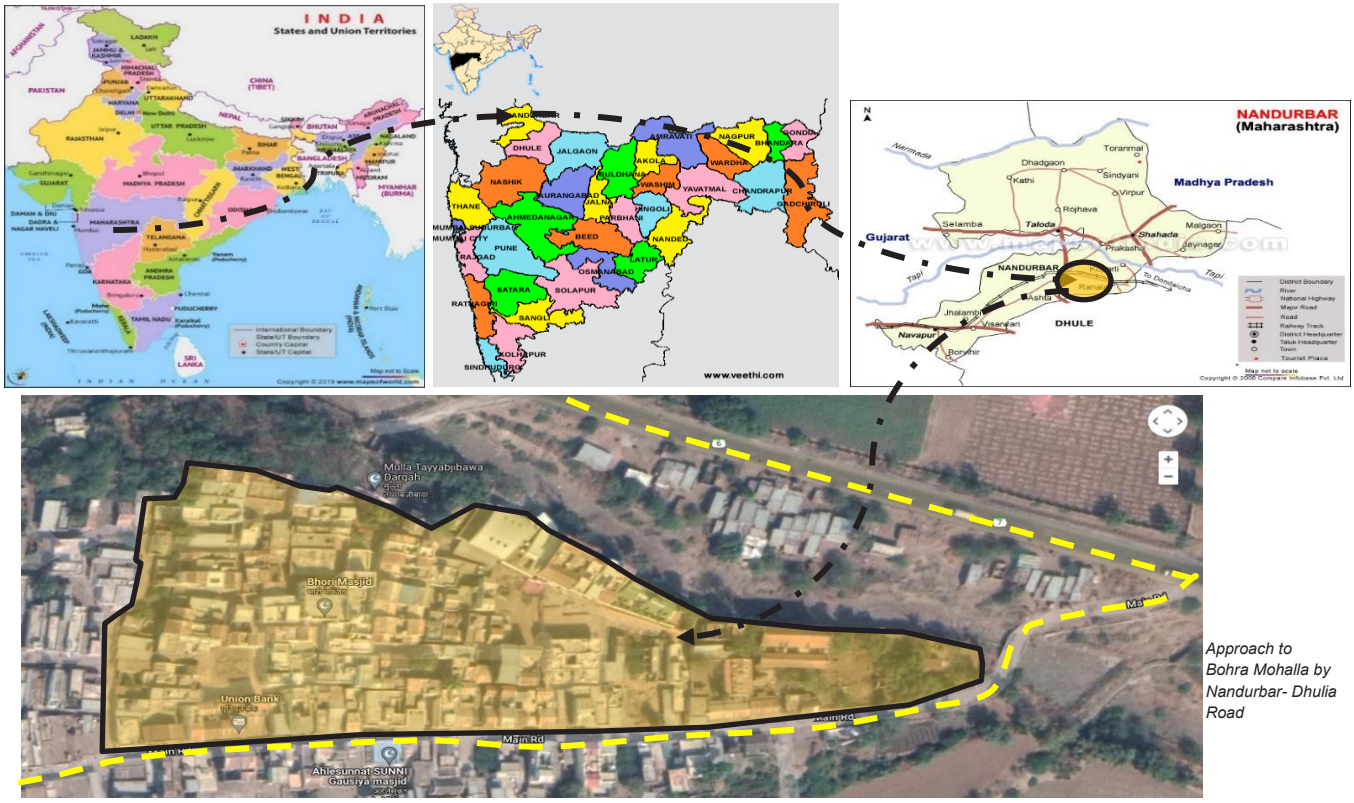
1.2 Historical Background of Ranala

The name had been derived due to two Nalas which are flowing on the two peripheral ends of the town. The town is also being surrounded by thick green vegetation along with a Satpura range on one of its sides. The focal point of attraction of the town is the Mohallas and the Bohrwads of the Bohra's. Bohra's are the people, who migrated from Sidhpur and Kapadvanj of Gujarat during the period of Aurangzeb in the 1850s.

1.3 Location of Bohra Settlement at Ranala

Ranala is a town in the north of Nandurbar district in Maharashtra, 16 km. From Nandurbar. The total geographical area of the village is 3461.58 hectares.

Address: Bohra Mohalla, Ranala, Dist.: Nandurbar, Maharashtra- 425411.
Co-ordinates: 21.345015^{0}N, 74.398803^{0}E.



Approach to Bohra Mohalla by Nandurbar- Dhulia Road

Figure 1: Maps & Satellite Images showing the Location of Bohra Mohalla Ranala (*Source:* www.googlemaps.com)

1.4 Salient Features of Mohallas in Ranala

The people who migrated from Sidhpur and Kapadvanj came here and settled into groups forming Mohallas. Mohalla is the place where the houses are arranged into clusters. In Ranala, Bohra Mohalla is formed on the one end of the town near the river banks and is connected to the market through Main Street. The Bohra Mohalla consists of an area of 18 acres with 200 houses and at present has only 100 houses occupied. It also includes some of the important and other religious structures like Mosque, Dargah, priest house, jamatkhana, etc.

2. ARCHITECTURE

The Bohra dwelling of Ranala is based on the medieval Indian System of row houses. Buildings are long, narrow, deep, and Continuous with two long parallel walls which are shared with other buildings. It has a deep plan with long narrowrooms placed one behind the other with a centrally placed Courtyard for light and ventilation. The plan consists of an entrance space which is a transitional space. When one first enters the transitional space before approaching the center of the house. This place is called “Deli”. The W.C. and the staircase are generally located in the Deli also the entrance door to one of the rooms which is known as “Baithak” through the Deli, so the male guest does not disturb the privacy of the women in the house. The central space called as “chowk” (courtyard) has the kitchen, well bath and “Paniara” (Water place) located around it and it is a hub of the house where various family activities take place, It is also used for dining where family traditionally eats together this place is called as “safa”. The additional place next to the center chowk is called “Parsal”. The other room next to the Parsal is called “ordo”. The bedrooms are located on upper floors and always have a bathroom

attached to them. The Spatial organization clearly shows the segregation areas mostly used by women which is one of the important factors in Muslim culture. The houses in Ranala are built on the principle of a “wooden frame structure” a technology that was not native at that time and which allows up to three upper floors. The joints in the frame structure have been concealed so illusorily that an untrained eye would not even know where to look for them.

The outer walls of the houses are 2’6” Thick and the inner walls are 9” thick. The inner walls are no longer needed for carrying a dead load and the outer walls are carved out to accommodate fancy cupboards and display units. The plinth of the houses is high and is made up of stone to provide a base for the façade and to prevent the dampness from rising up into the walls. Wooden flooring is provided on upper floors and that of mosaic, ceramic tiles, or marble on ground floor, Top floors are supported by wooden beams which are close to one another and are smaller. These beams are supported on the wooden column which are also lavishly carved with motif of flowers and ornamental designs. The columns consist of capital, shaft, and a base which are ornamentally carved. The columns consist of capital, shaft, and a base which are ornamentally carved. Not only the beams and the columns but also the doors along with the door frame are richly carved. The houses generally have a wooden staircase consisting of a well-carved wooden handrail and balusters. The roof is made up of galvanized iron sheets. And are covered with mud roofing tiles (Kavela). The sloping end of the roof is also carved out to give an ornamental look. Thus, attention is not only being given to the carving of the wooden elements but also considerable attention is being given to the articulation of the façade as they reflect the status of the owner in society.



Figures 2, 3 and 4: Image of Houses at Ranala
(*Source:* Click by Author)

3. INTERIOR

According to the Bohra belief, the houses are to be kept carefully clean as it is regarded as a place of worship. The social status of the owners is expressed by the lavishing interiors. The interior of luxurious homes are indeed a visual treat with unrivalled wooden works and priceless artefacts with European metal lamps and glass chandelier which are hung closely into the ceiling which are well decorated with the flowering motif in plaster to give a rich look to the interior. The walls are niched and have cabinets so as to keep imported ceramic plates and glassware with English vases and Constantinople mugs or it has also been placed in a row all around the room walls. The walls are also carved with fancy and elaborated cupboards and display units. The wall cupboards are carved and are decorated with mirrors and paintings. Even the doors of bathrooms on the upper floors which open into the bedrooms are decorated with mirrors like that of the cupboard. The windows are also decorated with English vases so as to make the interior luxurious. The floor is richly carpeted and cushions are placed all around the wall. The swing which is called “Khat or zoola” is traditional furniture of the Bohra that is used in the Bohra houses, which are used for sleeping or sitting. The kiosks “Paniara” for keeping the pots of drinking water are made up of Japanese glassed tiles are another significant element in the house of Bohra which is located in the chowk near the entrance. All these elements give a luxurious and lavishing look to the interior of the Bohrawads. In short the Bohra houses has the influence of British colonial lifestyle.

The houses represent the tradition Architecture but as many people from the region are getting settled in other urban areas the houses are closed for years and are deteriorating and needs to be preserve for the future generations.

4. LITERATURE REVIEW

Case study 1 Sidhpur: Sidhpur is a town in Gujarat, located on the banks of Saraswati River. It is an important pilgrimage center for Hindu devotees and for Shaivism. The city is known for its architectural beauty largely belonging to the Dawoodi Bohra community which has built monumental mansions, made of wood, with stuccoes facades, trellised balconies, gabled roofs, and ornate pilasters which are one of the identifying architecture features of this town. The streets are wider and cul-de-sac. The buildings are narrow, deep, and continuous and the internal layout is almost identical regardless of family social status or income. The house has an entrance in the center, a toilet on one side, and a variation of a kitchen or "paat" (ladies sitting area) on the other. The structures are mostly load-bearing with wooden frames, limiting their height to only one upper floor. The interior of an opulent home is indeed a visual treat, with unrivaled woodwork. The Dawoodi Bohra's from Sidhpur were traders and often traveled abroad. Immensely inspired by their travels led them to construct these houses that are a magnificent mélange of Islamic, European, Victorian, and Indian architecture (i). These 200-year-old avenues of Sidhpur ornate with pastel-color bungalows were quite futuristic because, in the current scenario, their aesthetic quality perfectly fits the definition of what we refer to as "Instagrammable" (i).

Case Study Kapadvanj: Kapadvanj means "The land of Textile" is a town as well as the Taluka of Kheda district in Gujarat India. Kapadvanj Bohrawad is known as one of the historical places which have a special character of the elegantly hybrid architecture. Bohrawad is a neighborhood built around a street and sub streets. For defensive reasons, the streets are provided with entrance gates (iii). In each Bohrawad, rows of narrow deep houses, three to four stories, are packed along the main street and interrupted by cross-lanes at regular intervals. The houses have aparticular style or format, with decorated and carved exteriors with a window that projects into the street (ii). The Bohrawad at Kapadvanj was made up of various Wada's that maintained segregation between different communities and remains one of the most prosperous and well-planned Wada's. Typically, most Bohra houses in the Mohalla's represented an architectural vocabulary of Colonial style façades, at times with 'Islamic or Jain' influences. The Ground +2 upper or at times even 3 upper storied houses with an attic (dagla) in some cases were predominantly constructed with Burma teak framework of posts and beams with load-bearing walls in brick masonry. While the sloping roof of most houses was of tin sheets, Kapadvanj was very progressive, being one of the first towns to have underground drainage and electricity. The basic organization of Kapadvanj houses remains the same as that of Sidhpur houses. Some houses were well maintained, while others were in varying states of disrepair, still others were decrepit and in ruins while the odd modernistic mayhem had begun insinuating itself here and there (ii). While most residents had left the town for promising future or opportunities in metropolitan cities, turning it into a ghost town.

Identification of the research gap from the study: The Bohrawad of Sidhpur, Kapadvanj and Ranala is not preserved at present and urgent steps are needed to preserve it before it is completely ruined.

5. METHODOLOGY

The methodology of study involves:

- Study of history and background of various Bohra settlements to understand the architecturalelements, building materials, applied construction technology, and house forms in relationship with the climatic response and the region.
- Analysis and conclusion done through research design structure

6. RESEARCH DESIGN STRUCTURE

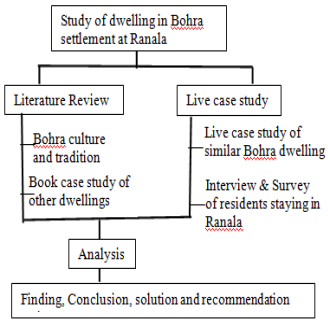


Chart 1: Research Design Structure

7. FINDING AND DISCUSSION

Plan for bohra settlement at Ranala showing location of public buildings.

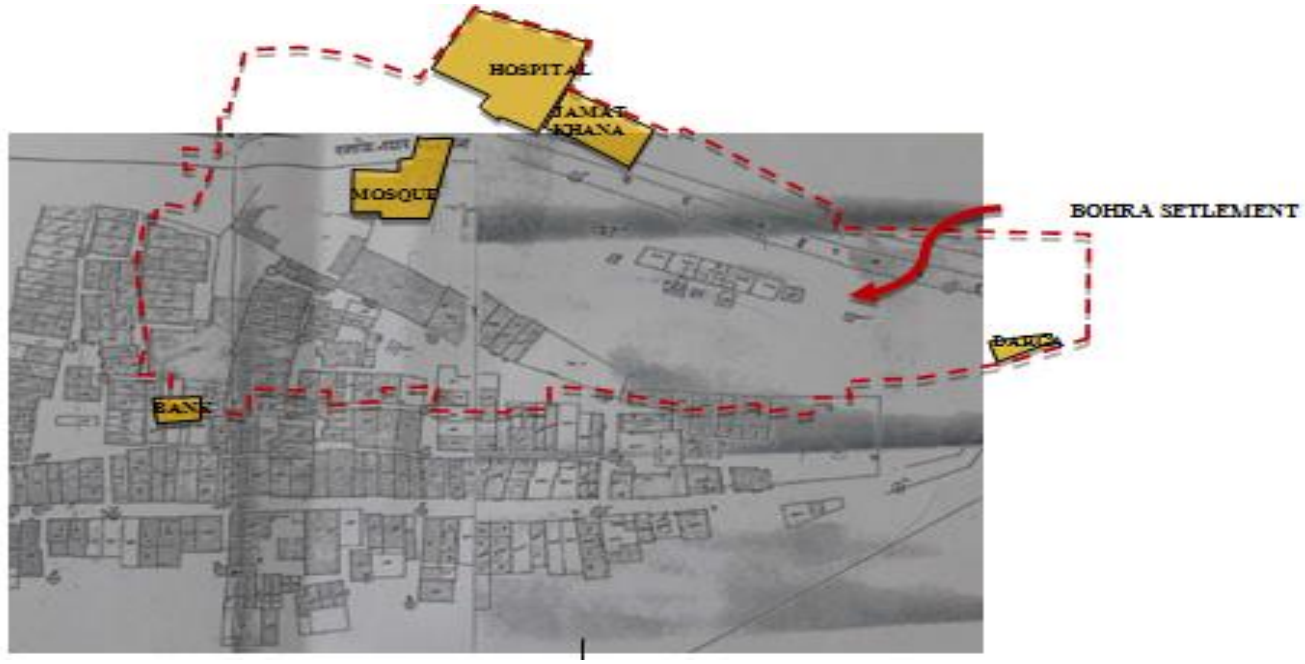


Figure 5: Image of Bohra Settlement Plan at Ranala
(*Source:* Land record Nandurbar)

Table 1: Typical Bohra House Heritage Management Proposal for Preservation

	Building Element	*Item and Material*	*Fault or Damage*	*Solution*
1.	**Structural Element**	1. Plinth	Damage of Plinth	Repairing the cracks
		2. Brick wall	Brick wall losing the strength	Reconstructing the brick work
		3. Wooden columns	Deterioration of columns	Same material & techniques should be used for repairing
		4. Wooden beams	Deteriorationof beams	Same material & technique should be used for repairing
2.	**Non- Structural Element**	1. Doors	Cracks in the door and colour fading	Painting polishing, and varnishing of doors
		2. Windows	Colour fading	Painting polishing, and varnishing of windows
		3. Wooden staircase	Broken staircase	Reconstruction of staircase
		4. Parapet wall Jaalis	Broken Jaaliwork	Repairing Jaalis
3.	**Finishes**	1. Floor	Cracks in floor	Repairing/replacing the flooring
		2. Internal facade	Grinning in internal paintings	Painting the spaces
		3. External facade	Fading in external paints	Painting the faded area
		4. Wall Niches	Loosen Bricks	Fixing the bricks
4.	**Infra-structure and services**	1. Pipe work for Drainage	Breakage and leakage of pipe work	Removal and installation of new pipes
		2. Water supply pipe fitting	Leakage and breakage of pipe work	Removal and installation of new pipes
		3. Electricity	No electric supply and broken lamps	Replacement of lights and other fittings
		4. W.C.	clog	Removal of clog

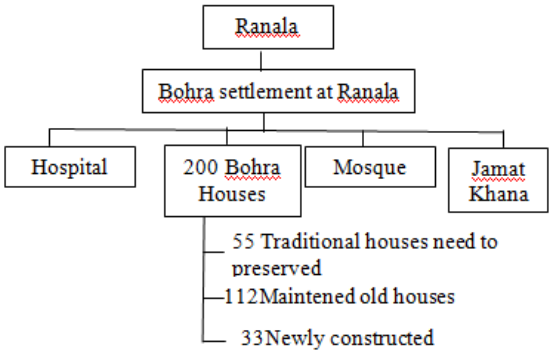


Chart 2: Structure of Bohra Settlement at Ranala

8. CONCLUSION

The major influencing factors on the dwelling of the Bohra community are socio-cultural and political factors. Due to social and political factors such as lifestyle and culture of the Bohra's, there is dissimilar segregation of area for the women, which have influenced the overall layout plan. Apart from climatic influence, there is the influence in terms of local building materials like wood. Today lots of Architects are turning to traditional architecture for inspiration as it satisfies their community's psychological need sex tremely better than other modern settlements do. These house forms need to be conserved for our future generations as it represents our heritage and rich culture. Adaptive reuse of these heritage buildings will help to conserve the heritage and culture of the place.

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A Sustainable Approach Towards a Net Zero Water Ice-Cream Factory in Bhopal

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ABSTRACT: The growth in industrial sector has put pressure on its water demand. At this point, it is important to minimize an industry's water demand and reduce its dependency on the water supply sources available. To achieve these goals, the concept of Net Zero Water Buildings can be adopted. The research focuses on an Ice-Cream Factory, located at Bhopal. A walk-in water audit is carried out to investigate its present water cycle, water usage and consumption patterns, water losses and the amount of wastewater generated. The research analyses and calculates water balance of the factory and identifies its optimum recycling potential for water. The research aims to propose a Net Zero Water Industrial Building through application of various water management practices that are applicable for on-site installation for the selected case. The research concludes with proposing the guidelines for a Net Zero Water Positive applications and innovations for the Industrial Building.

Keywords: *Net Zero Water Building, Water Demand, Water Consumption Pattern, Water Balance, Recycling Potential, Water Management Practices, Sustainable Buildings.*

1. INTRODUCTION & BACKGROUND OF THE STUDY

Water is a basic requirement that every human needs for all its activities throughout the day. When relating it in terms of Building Industry, water is required during all phases of a project: firstly, during construction phase and secondly, during the operational or the post-occupancy phase of a building. Globally, around 19% of total water withdrawals are used for industrial purposes. In India, industrial sector is the second highest consumer of water. Compared to the water for other uses such as agriculture, domestic water supply, health and sanitation, water for industrial sector has not been studied much.

Water is used for a wide range of industrial applications, including fabrication, processing, washing, diluting, steam generation, washing and cooling of manufacturing equipments, transporting a product, etc. Raw water entering an industrial plant often needs treatment to meet tight quality specifications for consumption and manufacturing processes. Meanwhile, consumed water also needs treatment to make it fit for reuse or even its disposal.

As Industrial water demands increases with increase in population growth, water stress and the risk of water scarcity becomes a major concern. To overcome these challenges, it is becoming the need of the hour to appropriately manage water consumption, in term of its demand, supply, consumption and reuse. And to do so, the concept of a Net Zero Water Building shall be encouraged and promoted in the industrial sector.

The approach for designing a Net zero water building is to minimize overall water consumption, promote alternative water sources and minimize wastewater discharge and return treated water to the original water source. The goal here, is to preserve the quantity and quality of natural water resources with minimal deterioration, depletion, and rerouting of water by utilizing potential alternative water sources and water efficiency measures to minimize the dependency on supplied freshwater.

This paper takes a case study of an existing Ice cream factory located in Bhopal to identify and address the existing situation considering its water demand, water quality, water consumption pattern, etc. and to propose various water management practices in order to achieve the targets of a Net Zero Water Industrial Building.

2. LITERATURE REVIEW

2.1 Net Zero Water Buildings

A net-zero water building is an innovative concept that helps you design a building to be self-sufficient and fully responsible for generating its potable water needs and treating all the wastewater generated at the site. In a NZWB, the

water demand is fulfilled by either harvesting water on-site or sourced from a closed loop system. Any wastewater generated on site never leaves the project site through city pipes; instead, all the wastewater is treated and reused or infiltrated within the property. The building is disconnected from the municipal water supply and sewer and storm water outlets; apart from the water supply for emergency fire suppression. It captures rainwater to meet potable water demand. These systems require a careful calibration between catchment areas, sizes, storage capacities and infiltration areas to achieve the performance goals. The system's resiliency is achieved through the precise interrelation of catchment area and infiltration capacity. The project also requires utilization of alternative sources to fulfil potable water demand. Integrated solutions are required to sustainably manage a building's water inputs and outputs for net-zero balance.

To better understand a NZWB, it is very important to understand a few key words in relation to the concept. Some of them are discussed below.

2.1.1 *Building Water Demands*

Each activity in a building requires water, which contributes to a building's water demand.

2.1.2 *Irrigation*

The amount of water required for irrigation is calculated based on the type of vegetation, area of the vegetation, vegetation characteristics, and evapotranspiration.

2.1.3 *Green Roof*

A green roof, which ideally should propose native and drought-tolerant landscaping, should optimally only require natural rainfall for sustainability. However, if irrigation is required, the water requirements are estimated as for the irrigation subsystem. Some amount of water may exit the green roof as runoff which can be collected in a cistern or storm water pond for use within the building system.

Sinks, showers, laundry machines, and drinking water fountains.

The above mentioned fixtures require potable water for the inflow and they produce greywater. Alternative sources can also be utilized to fulfil these needs. In a conventionally designed building, the greywater exiting these fixtures is sent to the sewer system, which instead can be collected and sent through a treatment system, such as an MBR, and can then be reused within the building system for applications such as cooling, toilet flushing, urinal flushing, or irrigation.

2.1.4 *Toilets and Urinals*

Water exiting from toilets and urinals is known as blackwater. The blackwater can also be tracked and collected as a separate recyclable source which can be combined with greywater, or released and lost into the sewer system. These fixtures hold a great scope for reduction in water demand, if they are either low-flow fixtures that use fewer gallons per flush or are waterless fixtures. The treated water can also be an alternate source of water for these fixtures.

2.1.5 *Recyclable Wastewater*

Recyclable wastewater sources include greywater and blackwater. Wastewater generated from indoor building water fixtures may be directed towards the recycled wastewater storage and reused to fulfil water demands within the building.

2.1.6 *Net-zero Water Assessment*

A net zero water assessment may be considered at various hydrological levels. Water circulation within the building creates a building water cycle unique to its interior structure. A building structure often consists of open spaces including the building site, which expands the hydrologic boundary. The building connects to the urban water cycle via infrastructure linkages, where municipal water and wastewater networks rely on natural water sources for both, water use and disposal.

2.1.7 *Building Water Cycle*

A Building's water cycle includes considerations for a building's water demand, the availability of water sources, influencing factors, uncertainties and system boundary.

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Water Balance calculations are then performed for a better understanding of usage of potable, non-potable water, wastewater generated and scope of reuse of treated water.

A net zero water existing building can be achieved when the amount of alternative water consumption and water returned to the original water source is equivalent to the building's water consumption. The original water source includes sources within the same local watershed and aquifer of the building's water supply. The goal of net zero water building is to reduce a building's water demand and in return, preserve the quality and quantity of natural water resources along with minimal deterioration, depletion, and rerouting of the original source of water. Alternative water sources and water efficiency measures can also be adopted to minimize the use of supplied freshwater.

A net zero water building's ultimate target is to completely offset the building's water use with maximized alternative water plus water returned to the original water source, represented by a very simple formula:

$$\text{Total Annual Water Use} = \frac{\text{Total Annual Alternative Water Use + Total Annual Water Returned}}{\text{Discharged to the Original Source}}$$

Design elements to be considered for a Net Zero Water Existing Building:

- Plan the renovation to be a water efficient building
- Meter the water usage and develop a water balance by end-use
- Maximize consumption of alternative sources
- Treat the generated wastewater on-site and then return to the original water source

3. NET ZERO WATER MANAGEMENT STRATEGIES/PRACTICES

A range of Net-zero water management strategies/practices can be adopted depending on the typology and scale of the infrastructure, water cycle, purpose of water usage, etc.

Some of the strategies are listed below:

3.1 *Integrated Water Management*

Integrated Water Management is an approach of management of water in all forms including drinking water requirements, storm water and wastewater collected and source water. These water management solutions include green infrastructure, water conservation, water efficiency and maintaining strong water quality and flow rate regulations and standards. Integrated water management is practiced through planned management of all water systems where waters are resources and are valued and put to use.

3.2 *Rain Water Harvesting Systems*

Rainwater harvesting system is a technology that enables collection and storage of rainwater for human use. Rainwater harvesting systems can be arranged using simple rain barrels or more elaborate structures with pumps, tanks, and purification systems. The non-potable water collected, can be used to irrigate landscaping, flush toilets, wash cars, or launder clothes, and it can even be purified for human consumption.

3.3 Storm Water Management Practices

3.3.1 *Green Roofs*

A green roof is covered with vegetation that enables rainfall infiltration and evapotranspiration of stored water. It can reduce the effects of atmospheric pollution, reduce energy costs, decrease the "heat island" effect and create an attractive environment, according to the US National Institute of Standards and Technology (US NIST).

3.3.2 *Rain Barrels and Cisterns*

Usually, Rain barrels and cisterns harvest rainwater from rooftops for reuse. Rain barrels are placed at roof downspouts, while cisterns store rainwater in larger volumes in tanks for use in non-potable applications such as toilet flushing.

3.3.3 *Permeable Pavements*

Permeable surfaces, such as asphalt or concrete, allow stormwater to infiltrate through the porous surfaces into the soil and groundwater.

3.3.4 *Bio-retention Areas*

Bioretention areas are shallow, landscaped depressions that allow runoff water to be collected in a designated area, then filter through soil and vegetation. Also known as rain gardens, when designed as a small-scale bioretention areas.

3.3.5 *Vegetated Swales/Dry Swales*

Swales are basically drainage paths or channels that are vegetated and are used to transport runoff water. Swales contribute to slow runoff, better infiltration and filtration of pollutants as runoff flows through the system.

3.3.6 *Curb and Gutter Elimination*

Curbs and gutters are designed to collect and transport runoff quickly to a stormwater drain without allowing for infiltration or pollutant removal. Eliminating curbs or adding curb cuts allows runoff to be directed into pervious areas and filtered through low impact development (LID) features. Swales can also be provided instead, for the same.

3.3.7 *Vegetated Filter Strips*

Vegetated filter strips are bands of dense vegetation, preferably on gently sloping areas, through which runoff is directed.

- Efficient Irrigation Systems
- Sprinkler Irrigation
- Hose-end Sprinkler
- Permanent Underground System
- Sprinkler with large guns
- Drip Irrigation
- Furrow Irrigation
- Seepage Irrigation
- Grey Water Reclamation & Reuse

Reclaimed Greywater can be utilized for many purposes, like, watering gardens, fire hydrants, field irrigation, toilet flushing and Cooling tower make-up, etc.

- Wastewater Management Practices
- Reed Bed Systems (RBS)

In the Reed Bed System, wastewater (grey or black) is fed via the roots of reed plants, where it is treated. The beds are shallow, gravel-filled, and Reed-planted. Sewage, agricultural wastewater, and even industrial waste water can be treated using this method. This method lowers BOD (biochemical oxygen demand), suspends solids in wastewater, and transforms nitrate to nitrogen.

3.3.8 *Soil Biotechnology (SBT)*

In soil biotechnology (SBT), soil is largely employed as a medium for wastewater treatment. Wastewater is pumped or sprayed on top of the sand bed in this arrangement. The bed is made up of a layer of stones, pebbles, and sand that has been properly nurtured. To reduce wastewater loss, the filtering materials are placed over a thick layer of plastic sheets. Using a pipeline network, wastewater is repeatedly pumped on top of the soil medium. The cleaned water is eventually channeled to a collection well, which also serves as an aeration tank, after collecting in the furrows between the soil bunds. This water is pumped out and can be used for irrigation. Locally available wild plants are cultivated on top of the soil to improve the treatment process. COD, ammonium, nitrates, suspended particles, bacteria, color, and odor are removed, and no sludge is generated.

3.3.9 *Membrane Bioreactor (MBR)*

Membrane bioreactors (MBRs) combine two different treatment processes: activated sludge and membrane filtration. Wastewater from the buildings is aerated in a bioreactor tank, which contains microorganisms in the form of suspended flocks. Following the bioreactor tank, a microporous membrane is installed to separate the solids and liquids in the wastewater. Secondary clarifiers are now not required. This is the most preferred wastewater treatment technology in India since it takes up less space and produces good quality treated water.

3.3.10 *Membrane Bed Bioreactor (MBBR)*

In aerobic, activated-sludge environments, MBBRs biologically treat wastewater by circulating moving media. A floating plastic substrate inhabited by a community of bacteria is used as the moving media. On the plastic surface, these bacteria form a biofilm. Biomass in the system exists in the form of suspended flocks. In India, MBBR tanks were discovered to be made of reinforced concrete, mild steel or even fiber reinforced polymer (FRP) at smaller scales.

3.3.11 *Sequencing Batch Reactor (SBR)*

The SBR's activated-sludge treatment work in a batch mode with secondary sewage treatment taking place in a single tank. The influent is added to the batch-reactor tank and aerated in the first stage of SBR treatment. The effluent is allowed to settle after aeration. Finally, a decanter valve, pump, or airlift tube is provided to extract the treated wastewater from the tank's top. SBR tanks are made of reinforced concrete or mild steel on a smaller scale in India.

3.3.12 *Wastewater Treatment & Reuse*

Treated wastewater can be applied to use to fulfil the water demand for flushing, irrigation, cooling water, boiler feed, process water and also for heavy construction works.

4. METHODOLOGY

After studying the concepts of Net Zero Water Buildings and understanding the application of various water management practices through secondary data collection, a live case of an Ice-cream Factory in Bhopal was considered for the further study. A walk-in water audit was performed to analyse and identify its water cycle, water consumption and usage pattern and the quality and quantity of water required depending on its entire manufacturing process.

5. CASE STUDY

A walk-in water audit was performed at Ramani Ice-cream Company Pvt. Ltd. (RICL Ice-cream Factory) at Govindpura Industrial Area, Bhopal. The factory has various spaces like reception, administration block, production units, cold storages, other storage spaces, etc. The site visit and audit contributed in identification of the entire manufacturing process and the water cycle involved for the production of Ice-cream. The present situation of water demand, water supply sources, requirement, water consumption and usage pattern along with the quality and quantity of water required, amount of wastewater generated and discharged of wastewater from site was also documented.

Figure 1 is a representation of the location and site plan of the factory set-up.

The site is located in Bhopal, which falls under composite climate zone, with an annual rainfall of 1110.1m. The total site area of the factory measures to be 5.75 Acres (23,270 sqm). There are total 6 built blocks within the campus, with a total built up area of 13,935 sqm. The number of fixed occupants during peak season are 200, while that during off-season are 150; with number of shifts varying as 3 and 1, respectively. To fulfil the water demand of the campus, the primary sources of water are the 2 Bore wells existing on site of 400ft (120m) depth each, while the secondary sources are the third-party sources that sell water. The water from bore wells is stored in an underground water tank of a capacity of 2 lakh litres of water. The total capacity of overhead tanks existing on site is 35,000 ltr. Figure 3 depicts a flow chart of the water usage cycle during the whole manufacturing process.

The total daily water supply during peak season is near about 50,000 ltr/day and that during off-season is recorded around 25,000 ltr/day. Out of the mentioned quantities, during peak season, 35,000 ltr of water accounts for the daily on-site usage. This quantity of water is further segregated for various usages as; Raw water (15,000 ltr/day), Soft water (15,000 ltr/day)

and RO water (5,000 ltr/day). The total potable water consumption depends on the production of ice-cream mix (2.5-3 ltr of water/ltr of mix). While the total non-potable water consumption majorly depends on the water evaporated as a part of working of the cooling tower (6–7 ltr/TR/hr). Nearly 10,000 ltr of soft water is also utilized in cleaning the machineries after every shift.

Figure 1: Site Plan (RICL, Bhopal)

The spaces demarcated within the site plan are listed as:

1. Security Cabin
2. Parking
3. Admin Block
4. Cold Storage – 1
5. Cold Storage – 2
6. Oil and Butter Storage
7. Production Unit – 1
8. Production Unit – 2
9. Underground Tank
10. Water Softener Unit
11. Boilers
12. Refrigeration Plant
13. Loading Dock

Figure 2 represents the classification of water consumed by the factory in the form of a flow chart.

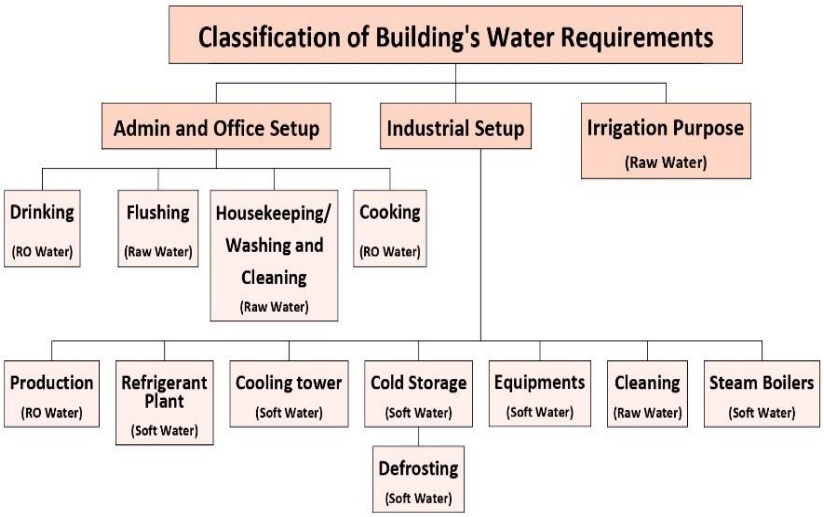

Figure 2: Classification of Water Consumed

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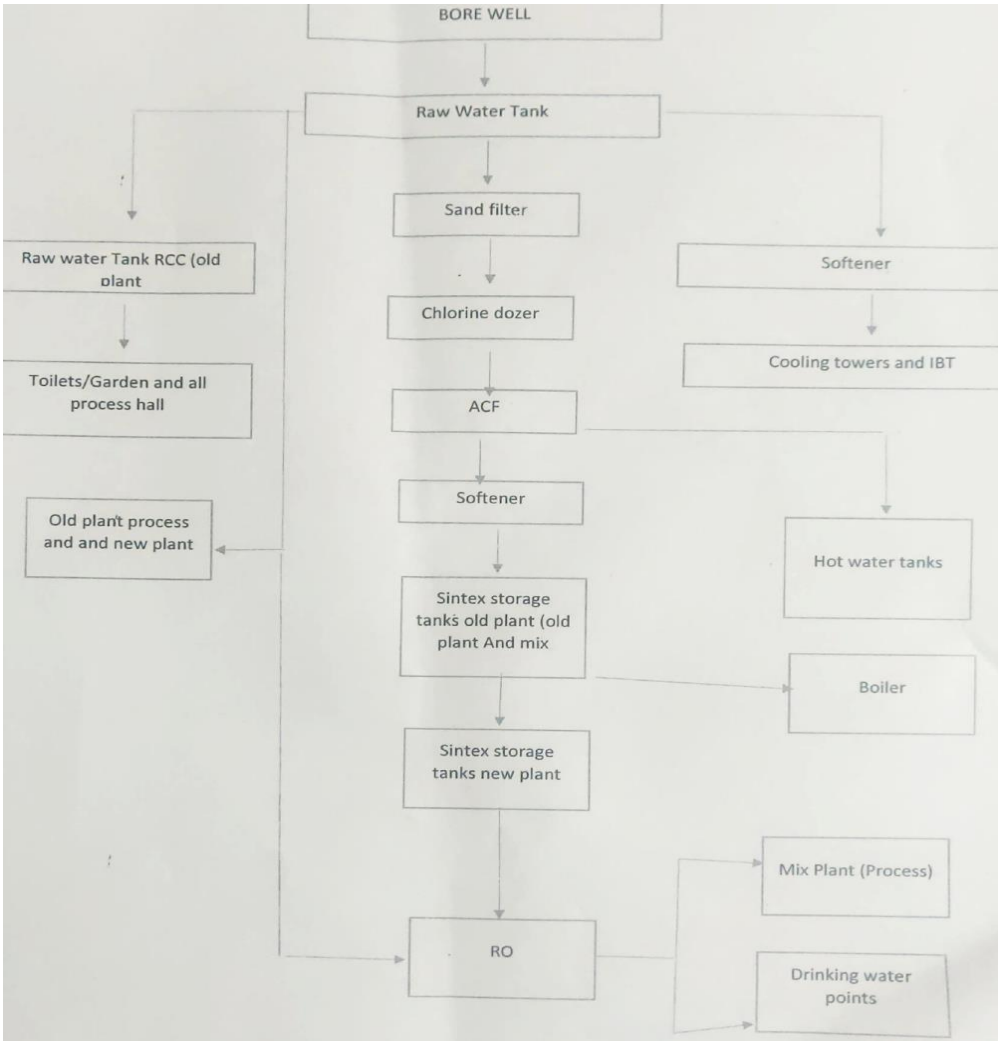

Figure 3: Water Usage Flow Chart

There are no water management systems installed currently at the factory, apart from metering for a few spaces.

Currently, all the wastewater generated at the campus is directed to a common ETP of the Govindpura Industrial Area, which treats the wastewater and releases the treated water into the channels/canals running into the nearby agricultural land. Due to lack of provisions, the rainwater is left unutilized. Almost 50% of the rainwater from the site gets channelized to the common ETP through the open drains.

6. RESULTS AND DISCUSSION

The factory utilizes a large amount of water at every stage of the manufacturing process. But, due to availability, easy access and low prices of water, there is negligence to some extent towards the water consumption and water management practices. Lack of awareness of such practices can also be one reason. To overcome these factors and achieve targets of Net Zero Water Building, this research paper offers a few solutions and further suggestions for the factory.

The scope of achieving the aforesaid targets majorly depends on two categories of water, firstly the water lost during defrosting of cold storages and secondly the wastewater generated at site. The first step taken by the factory recently towards reduction in water consumption was made by switching from conventional defrosting system to a closed loop system. This system enables to keep the water running within the system, instead of disposing the defrost water into the drains. Figure 4 suggests that in the year 2019, a reduction of 23% in wastewater disposal was recorded after installing a closed loop system for the process of defrosting the cold storages.

WATER DISPOSED IN LTR			
2018	2019	Difference	%
3087000	2100000	-987000	-47
4336500	3750000	-586500	-16
9775500	6375000	-3400500	-53
10075000	8600000	-1475000	-17
9250000	7975000	-1275000	-16
6975000	7075000	100000	1
3925000	3300000	-625000	-19
3800000	3175000	-625000	-20
3200000	2062500	-1137500	-55
3416000	1775000	-1641000	-92
1561600	1700000	138400	8
1073600	1225000	151400	12
60475200	49112500	-11362700	-23

Figure 4: Water Disposed (in ltr) for Year 2018 & 2019

Apart from the two categories of water mentioned previously, calculations were performed for the water for the water cycle. The first consideration was given to replacing the conventional fixtures installed with the low flow fixtures (flow rates referred from baseline flow rates mentioned in IGBC). Total occupancy, FTE calculations and number of usages is calculated in Table 1. While, Table 2 and 3 present the water calculations for actual and ideal cases, respectively.

Table 1: Total Occupancy and FTE Calculations

	Particulars	No. of units	No. Of Occupants					No. of Shifts		Total No. of Occupants	Working Hours	Zone
			Fixed	FTE (8 hrs/ shift)	Floating	FTE (8 hrs/ shift)	Total Population	Fixed	Floating			Private/ Semi-Private/ Public
A	ADMINISTRATION										10:00-18:00	
1	General manager with toilet	1	1	1			1	1		1		Private
2	Common Toilet near Reception Area	1	1	1	25	0.125	4.125	1	8	26		Public
3	Common Toilets for Staff (G+1)	1	50	1			50	1		50		Private
	TOTAL						55			77		
B	PRODUCTION AREA										10:00 - 18:00 off- season 24 hrs during peak- season	
1	Common Toilets for Staff	14	150	1			150	1		150		Semi-Public
	TOTAL POPULATION						205			227		

Table 2: Water Calculations for Present Situations (Actual Case)

	Particulars	Aqueous: Actual Case																			
		Total Population	Male	Female	WC (Full Flush) (LPF)		WC (Half Flush) (LPF)		Urinals (LPF)	Faucet Duration (sec)	Faucets (LPM)	Health Faucets (LPM)	Total Usage	No. of WC	No. of abulution taps	No. of Wash basins	No. of urinals	No. of Showers	NO.OF DRINKING WATER TAPS	Water required per day	Sewage Generation (KLD)	
					10		6		6	15	9	9									Flush Fixtures (Black Water)	Flow Fixtures (Grey Water)
					1	1	2		2	4	4	1										
					Male	Female	Female		Male													
A	ADMINISTRATION																			45 litre/ head = 2481		
1	General manager with toilet	1	1	0	6.50	0.00	0.00		6.00		9.00	2.25	23.75	1	1	1	-					
2	Common Toilet near Reception Area	4	2	2	26.00	26.00	24.00		24.00		37.13	9.28	146.41	1 Male; 1 Female	1 Male; 1 Female	1 Male; 1 Female	1 Male	-	2	1926	5.11	2.25
3	Common Toilets for Staff (G+1)	50	25	25	325.00	325.00	300.00		300.00		450.00	56.25	1756.25	2 Male; 2 Female	2 Male; 2 Female	2 Male; 2 Female	2 Male					
	TOTAL												1926.41									
B	PRODUCTION ARLA																			30 litre/ head = 4500		
1	Common Toilets for Staff	150	100	50	1300.00	650.00	600.00		1200.00		1350.00	337.50	5437.50	2 Male; 6 Female	2 Male; 6 Female	1 Male; 1 Female	8 Male	-	8	5437.50	3.75	1.69
C	MANUFACTURING PRODUCTION UNIT	2.5 - 3 ltr/ ltr of mix			Off-season: 20,000 ltr/ day; Peak season: 50-60,000 ltr/ day						Average Considered: (20kl x 9 months + 60kl x 3 months) / 12									30000	30	-
D	REFRIGERANT PLANT/ COOLING TOWERS	6-7 ltr/TR/hr			Off-season: 100 TR; Peak season: 1000 TR				Off-season shift: 8 hr; Peak season: 24 hr		Average Considered: (8 hrs x 9 months + 24 hrs x 3 months) / 12					= [7*100*8*9] + [7*1000*24*3]/ 12				46200	Evaporates	
E	DEFROSTING OF COLD ROOMS	(from the data collected for quantity of water disposed)																		30000	-	30
F	LANDSCAPED AREA	From the data collected during walk-in water audit																		5000	Percolates within the ground	
	TOTAL WATER REQUIREMENT (ltr/ day)												7363.91							118564	38.86	33.94
	TOTAL WASTE WATER GENERATED (KLD)																				72.80	
	ANNUAL WORKING DAYS																				365	
	ANNUAL VOLUME (KL/YR)																				26572.5	

Table 3: Water Calculations for Design Case (Ideal Case)

	Particulars	Aqueous: Ideal Case																			
		Total Population	Male	Female	WC (Full Flush) (LPF)		WC (Half Flush) (LPF)		Urinals (LPF)	Faucet Duration (sec)	Faucets (LPM)	Health Faucets (LPM)	Total Usage	No. of WC	No. of abulution taps	No. of Wash basins	No. of urinals	No. of Showers	NO.OF DRINKING WATER TAPS	Water required per day	Sewage Generation (KLD)	
					6		3		4	15	6	6									Flush Fixtures (Black Water)	Flow Fixtures (Grey Water)
					1	1	2		2	4	4	1										
					Male	Female	Female		Male													
A	ADMINISTRATION																			45 litre/ head = 2481		
1	General manager with toilet	1	1	0	3.00	0.00	0.00		4.00		6.00	1.50	14.50	1	1	1	-					
2	Common Toilet near Reception Area	4	2	2	12.00	12.00	12.00		16.00		24.75	6.19	82.94	1 Male; 1 Female	1 Male; 1 Female	1 Male; 1 Female	1 Male	-	2	1085	2.71	1.50
3	Common Toilets for Staff (G+1)	50	25	25	150.00	150.00	150.00		200.00		300.00	37.50	987.50	2 Male; 2 Female	2 Male; 2 Female	2 Male; 2 Female	2 Male					
	TOTAL												1084.94									
B	PRODUCTION AREA																			30 litre/ head = 4500		
1	Common Toilets for Staff	150	100	50	600.00	300.00	300.00		800.00		900.00	225.00	3125.00	2 Male; 6 Female	2 Male; 6 Female	1 Male; 1 Female	8 Male	-	8	3125.00	2.00	1.13
C	MANUFACTURING PRODUCTION UNIT	2.5 - 3 ltr/ ltr of mix			Off-season: 20,000 ltr/ day; Peak season: 50-60,000 ltr/ day						Average Considered: (20kl x 9 months + 60kl x 3 months) / 12									30000	30	-
D	REFRIGERANT PLANT/ COOLING TOWERS	6-7 ltr/TR/hr			Off-season: 100 TR; Peak season: 1000 TR				Off-season shift: 8 hr; Peak season: 24 hr		Average Considered: (8 hrs x 9 months + 24 hrs x 3 months) / 12					= (7*100*8*9) + [7*1000*24*3]/ 12				46200	Evaporates	
E	DEFROSTING OF COLD ROOMS	Can be circulated in a closed loop system																		0	-	0
F	LANDSCAPED AREA	Efficient irrigation system, reducing water demand by 50%																		2500	Percolates within the ground	
	TOTAL WATER REQUIREMENT (ltr/ day)												4209.94							82910	34.71	2.63
	TOTAL WASTE WATER GENERATED (KLD)																				37.33	
	ANNUAL WORKING DAYS																				365	
	ANNUAL VOLUME (KL/YR)																				13627.3	

REDUCTION IN WATER REQUIREMENT (ltr/ day)	(Base Case - Ideal Case)		35654
	In Percentage (%)		30.07

REDUCTION IN WASTE WATER GENERATED (ltr/ day)	(Base Case - Ideal Case)		12945
	In Percentage (%)		48.72

Reduction in Water Demand is calculated as below:

Water Requirement (Actual Case) = 1,18,564 ltr/day
Water Requirement (Ideal/Design Case) = 82,910 ltr/day
Reduction in Daily Water Requirement = 35,654 ltr/day
(30.07 %)

While, **Reduction in Waste Water generated** on site is also calculated as below:

Wastewater generated (Actual Case) = 26,572.50 ltr/day
Wastewater generated (Ideal Case) = 13,627.30 ltr/day
Reduction in Daily Water Requirement = 12,945.20 ltr/day
(48.70 %)

With respect to the suggested Design Case (Ideal case), water balance calculations were performed (Figure 5).

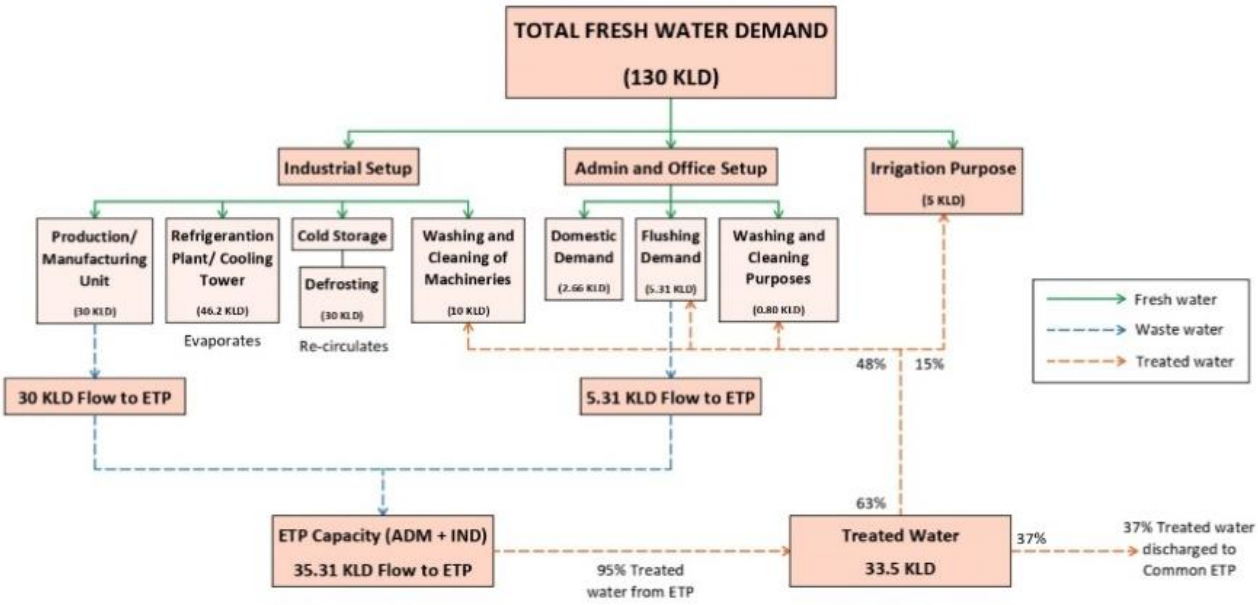

Figure 5: Water Balance Calculations

Figure 6: Location of Proposed ETP on Site Plan

By installing a suitable Effluent Treatment Plant, 63% of the waste water can be treated and used at the site to reduce the out sourced water demand. It will also reduce the quantity of water disposed to the common ETP to 37% of the current scenario, thus reducing the costs and huge expenses associated with it.

As per the collected documents for charges associated with disposal of waste water to common ETP, per m^3 rate is Rs. 75.36/-. The water balance calculated for the design case suggests that the treated waste water being disposed to the common ETP will quantify to around 48.1 KLD.

Monthly discharge of treated waste water to common ETP = 30 × 48.1 KLD = 1443 KL = 1443 m^3

Proposed Area dedicated to ETP on site is: 485m^2 in 3m depth, demarcated on the site plan below (Figure 6).

The total cost for 1443 m^3 = 75.36 × 1443
= Rs. 1,08,744.48/-

The cost is reduced to (monthly expenditure)

$$= \frac{1{,}08{,}744.48 \times 100}{1{,}97{,}437} = 55\%$$

A **cost reduction of 45%** is derived in terms of charges associated with disposal of treated water to common ETP.

7. CONCLUSION

In the current times, to achieve net zero water in a project is possible if, firstly, treated waste water is available to offset part domestic, flushing, irrigation, HVAC etc. water requirements and secondly, rain water is managed and treated in such a way to cater domestic demands to the maximum extent possible. This demand and supply management plan will play a vital role right from the design stage in order to attain self-sufficiency in a project.

Below mentioned are a few suggested proposals for the water management practices to reduce the water demand and the disposal of waste water from the selected case in order to achieve the targets for becoming a net zero water industrial building.

A suitably sized Rain Water Harvesting System should be installed to collect the maximum rainwater falling within the campus of the selected case; both, roof and non-roof.

In order to have an on-site wastewater treatment system, an ETP is proposed on a patch of vacant land within the site. Capacity and sizing of the required ETP has been calculated in the research study.

The design case has been evaluated by using desired flow rates of the proposed low-flow fixtures. Water calculations and reduction in water demand is also derived as a part of the study.

Monitoring of water consumption through metering and sub-metering is to be done for which advanced water management systems can be installed on site. This shall also result in optimization of the resource, efficiency in consumption resulting in reduced overall water demand for the selected case.

Alternative water sources (treated wastewater) can/should be substitute it to fulfil the water demand for purposes like flushing, irrigation, cooling tower make-up water, etc.

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Causes and Effects of Delay in Industrial Construction Projects in Pune Region

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Abstract: With growth in Industrial sector a huge number of industrial construction projects are setting up. However, industrial projects which service the above requirements are taken over by a phenomenon of "Delays & Cost Overruns". It has been a general observation that construction projects get delayed and so have substantial time over-runs have gotten delayed invariably. Thus, analysis of delays is vital study to quantify the severity of delay with relevance to time and cost over-run. Hence, there's a necessity of direct focus on the causes of the delays and their inference on the cost and time overruns. Survey will be done through a questionnaire form for stakeholders representing consultants, client and contactors with case studies of industrial projects. This paper will cover the various causes of delays in detail, as well as delays which are caused at various stages of the project and its effects on overall project.

Keywords: *Delays, Industrial Project, Make in India, Cost Overruns, Time Overruns, Effects of Delay.*

1. INTRODUCTION

Manufacturing in India has popped up as the highest and best growth sectors in India. Indian government, launched the 'Make in India' program to position India on the global map as a manufacturing hub and provide international recognition to the Indian economy. The industrial growth expansion is that the pillar of the country's economic progress and also the government has increased spending on the industrial projects. With such growth, opportunity and assist of this drive, India is on a path of becoming the hub for hi-tech manufacturing industries and plenty of international global giants are in process of setting up manufacturing plants in India.

Pune's industrial space has seen a significant wave of switch from pensioner's town to an industrial hub, and from supplementary firms to IT hub, every company has invested heavily in Pune. The setting up of recent well planned industrial estates by the MIDC in the last couple of years, Pune division accounted for the highest best investment and employment in Maharashtra in 2018–19. It has seen forty-two per cent year-on-year growth in warehouse sector that has benefited from the ever-growing demand in this sector. The city had reported the best growth in warehousing within country in the last 12 months. As per the survey, 12,761 units in operation from the MIDC areas in the Pune division attracted investment price value of Rs. 69,208 Crore and made employment for around five hundred thousand individuals. Pune is the centre for industrial investment, in big numbers investment are made in this sector.

So, more number of industrial projects are coming up. Although projects are planned and scheduled by experts with past experience still delays are caused in such projects due to complex coordination among everyone involved in the project, complex services & cost limitations, strict deadlines as commencement of manufacturing process which is more important factor as compared to time spent and cost invested in the building. Time management is an important aspect where the execution time for some industrial project is said to be 45 to 60 days. Therefore delays may have considerable effect on efficiency of the project. It is possible to minimize or eliminate the delay through their causes.

Aim: To study all the causes of delay and their effects on overall Industrial construction project.

Objectives:

- To identify the causes of delays in Industrial projects.
- To give suggestion for minimizing effects of delays on Industrial projects.

Scope & Limitations of the study:
Studying the industrial projects delays during execution phase only and projects which has scale of above 2 acres and shed having spans more the 30 M with structure in RCC or Pre-engineered building or hybrid system having roofing cladding system and industrial floorings.

Delays related to government regulation, weather condition and current pandemic or any other unprecedented conditions are not considered and studied in this research paper.

Figure 1: Basic Industrial Shed

2. LITERATURE REVIEW

2.1 Delays

Delay may be an amount of time by which something is late or delayed. Delay is outlined as difference in time between the date of actual completion of project and planned project completion as stated in the contract. In construction business, the starting date and date of completion of the project is mentioned in contract document .If any problem occur during construction, the completion time is extended beyond the agreed timeline, this time overruns are delays.

Delays in each construction project varies from project to projects. It occurs in every sector in construction industries such as residential, commercial and infrastructure as these sectors are dependent on customers and investors like builders or Government funds, but Industrial construction projects are funded by individuals or companies with this delays in this sector can be controlled, reduced and minimized by finding out the causes. Delays in construction projects are frequently expensive, since there is usually a construction loan involved which charges interest, management staff dedicated to the project whose costs are time dependent, and ongoing inflation in wage and material prices.

2.2 Types of Delays

A typical list showing delays events are categorised under general delay sources this list may vary from project to project, each category is given code and the list is given below:

D1 – Designand specification delays, D2 – Material Procurement delays, D3 – Communication delays, D4 –Decision making delays, D5 – Manpower/Labour delays, D6 – Onsite operation delays, D7 – Cost funding delays, D8 – Organizational delays, D9 – Environment delays, D10 – Legal delays, D11- Political and social delays, D12 – Financial and Economic delays, D13 – Force Majeure delays and D14 – Safety delays.

2.2.1 *General Delays*

From past reviews, study was to identify the major causes for delays in overall construction projects. The causes are identified and they can be avoided or minimized. Some of major and common reasons for delays in construction industry are listed below:

1. Client's changes of the design
2. Using lowest bid that lead to low performance

3. Changes in the extent of the project
4. Progress payments are not made in time by the client
5. Lack of early planning of the project
6. Shortage of the available utilities on site.
7. Time taken for decision making of project by client
9. Delay in delivering the site to the contractor

Contractor related delays which are uncontrollable and dependent on external factors.

1. Inadequate management and supervision by the contractor
2. Rework due to mistakes during construction
3. Technical problems faced by the contractor
4. Unethical/wrong construction methods used by the contractor
5. Cash flow problems suffered by the contractor
6. Non-availability of equipment and failure
7. Slow mobilization on site.
8. Too much working load by the contractor
9. Delay in material supply

To determine the effect and impact of delay on the project, types of delay responses and riskallotment of delay are categorized in four ways.

(a) *Critical or Non-critical Delays:* Delays which affects the completion duration of any project than planned schedule are critical delays. Delays which do not affect the timeline of the project such delays are non-critical delays.

(b) *Excusable and Non-excusable Delays:* Delay which is not predicted and not controllable for stakeholders and extension of time is given under contract is excusable delay such as Covid pandemic. Delay where the stakeholder is responsible for the extended duration and affecting completion of project are non-excusable delays.

(c) *Concurrent Delays:* It is a multiple common construction delays overlapping and affecting activities is concurrent delays. This kind of delay is the most difficult sort of delay as each parties can use this delay against each other.

(d) *Compensable or Non-compensable Delays in Construction Projects:* Delays where stakeholder is liable for cost compensation and time overrun are compensable delays. In non-compensable delay the stakeholder is at fault for delay and is not able to claim for compensation for delays.

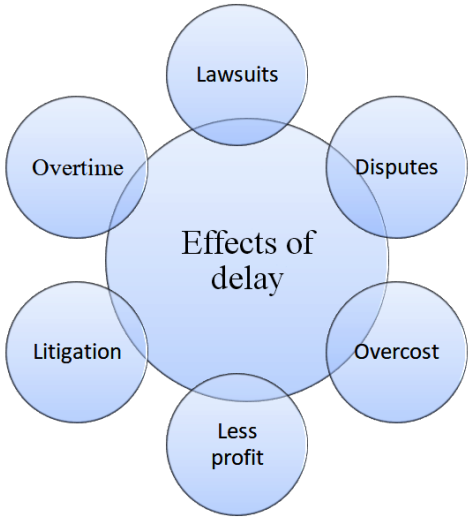

Figure 2: Effects of Delay

2.2.2 *Effects and Impact of Delays*

Construction delays are result of lack of co-ordination of people, material, machinery and many other events and this is risk to the projects. The general effects of delays are time and cost overrun, less profit, disputes, slow growth of the project,

negotiations, lawsuits, abandonment, termination of contract, etc. delays have negative impact on clients, contractors and consultants, their growth with project and bad relationships, mistrust and cash-flow problems.

2.2.3 *Reliability and Allocation of Risk*

The list below shows delays occurred due to which parties and assigning/ allocating delay to that party, so that they can control the risk and best accept the delay if it occurs.

R1 – Client Owner related, R2 – Contractor related, R3 – Designer related, R4 – Project Manager related, R5 – Consultant related and R6 – Other Factors.

3. METHODOLOGY

To achieve the aim of the research described in above section, a study based on literature review was done for collecting general reasons of delay in overall construction industry. The interview was done though questionnaire in two parts where in first part data was collected by already studied live industrial case study. These case study of industrial projects are individual live case studies conducted by March-SEM 3, 2021-22 at Allana college of Architecture—Industrial Project Studio. And remaining second part of survey was done by primary data through live industrial case studies from practising Architects and Engineers.

Questionnaire included general questions about factory type, project scale, type of construction, time of delay they experienced in their projects, type of delay, causes of it, role and responsibility group for delay and impact on project. The data collected through survey was analysed by using Risk Analysis Matrix technique described below and suggested recommendations to minimize delays and its effects on industrial project.

3.1 Risk Impact Matrix

The analysis was carried out by this method, where frequency of delay and impact of delay was rated in H = high, M = Medium and L = low for each cause of delay. Risk of each delay was specified by using chart below which indicates high, medium and low risk delays.

RISK IMPACT MATRIX		EFFECT		
		H	M	L
FREQUENCY	H	HH	MH	LH
	M	HM	MM	LM
	L	HL	ML	LL

Figure 3: Risk Impact Matrix

Understanding impacts of through colour coding used.

HH = Red = Very High Risk Delays. These are critical and delay and to be considered while planning and scheduling of a project which can minimize the delay.

MH, HM = Orange = High Risk delay.

MM, HL, LH = Yellow = Medium Risk delays.

ML, LM = Light green = Low Risk delays

LL = Green = Very low Risk delays. Such delays are non-critical and excusable ones.

4. CASE STUDY

All types of industrial project are considered for the research paper such as Mechanical Engineering industries, Metallurgical industry, etc. from project having shed having spans more the 30 M with structure in RCC or Pre- engineered

building or hybrid system having roofing cladding system and industrial floorings and scale of this industries above 2 acres of total land area in Pune and nearby Pune region such as Chakan industrial area, Hadpsar, Talegoan MIDC, Bhosari, Ranjangoan – Supa MIDC, Yevlewadi industrial estate, PCMC etc. With Industrial companies such as:

- Ross Industries (Phase 2).
- JBM Automotive Private Limited.
- Gedia India.
- Fenace Auto LTD.
- Pre cast factory.

And more similar projects type'stotal16 projects were studied.

5. ANALYSIS AND FINDINGS

Delay category of causes that were learnt from these case studies are D1 to D7 from the list above. This table shows analysis of delay categories, reasons, risk matrix and responsibility of delay are given below using method in figure 3.

Table 1: Reasons and Risk Analysis of Delays

Delay Code	*Reasons*	*Risk Matrix*	
D1	Inadequate Design Information	MH	R1
	Design alterations.		
	Addition of floor, new spaces and elements such as staircase, etc.		
	Unrealistic specification		
D2	Late supply of material for Roofing cladding and masonry.	HH	R2,R4
	Due to change in specification, New material procurement.		
	Extra material supply requirement, due to addition in Design		
	Material storage shortage		
D3	Wrong information from one consultant to other.	LL	R2,R5
	Lack of coordination.		
D4	Decision pending related to different architectural elements such as Retaining wall, etc.	LM	R1
D5	Low productivity	HH	R2
	Complex project for resource available		
	Non availability/shortage of labours		
	Extra manpower supply, creating confusion on site/Lack of coordination		
D6	Slow construction speed	HM	R2,R5
	Inaccurate soil investigation		
	Inadequate Information		
	Extra work variations		
D7	Cash flow problems	LH	R1
	Unavailability of funds		
	Incomplete assessment of project cost		

The table 1 shows that material procurement delays and manpower/Labour related delays are the most critical delays& can be high risk factors in these industrial projects if occurred can have high impact on any project and this should be considered will starting with a project. Other delay such as design decisions and on site operational delays also have high frequency with medium impact on project. Table above shows the delay reliability is high on contractor group and client group which has significant effect on performance of project.

Table 2: Effects and Recommendations

Delay Codes	***Effects on Project***	***Measures/Recommendation***
D1	Minimum cost overrun is 5% and maximum cost overrun studied was around 31% (2.8 Cr)	Proper project planning with design data formation which will not lead to change in proposal or specification. Change controls and specification standards. Design project review with people involved before starting the project.
D2	Cost variance with such delay can be from 2% to 20% of the project cost.	Vendor - Supplier pre - qualification. Tracking monitoring of the material and control process. Assessment of required materials before time and proper material estimation and classification.
D3	Disputes between consultants, contractors & sub-contractors. Loss of reputation. Time variance of 2–3 Days was seen.	Design review with all people involved before starting the project. Risk management with response planning. Priority meeting discussion & involvement with Architect/managers.
D4	Time and cost variance on the project. Other dependent elements also gets effected.	Top management support and collaborative coordination. Follow ups and regular management review meetings. Share/educate about effect on cost & time.
D5	Cost variance of 2% to 10%, can be more if it is for longer time period.	Forecast workers required. Classification of workers, productivity standards, labour incentive schemes and causes of labour productivity.
D6	Cost overrun is above 10% in case studies. Quality and safety of project also get impacted. Damages and wastages.	Detail investigation of sites before planning project. Use of On Site checklist templates and Risk management with identification, analysis, response planning and control. Labour training and performance reporting to management. Activity identification, duration estimation, tracking and controlling
D7	Stakeholders not comfortable with project. Revenue may fall short. Contractors not working properly and conflicts.	Project cost estimation, Construction stage wise funding planning and scheduled cash flow. Analysis of changing market. Identification of source of funding, investment analysis.

The Table 2 above shows delays have associated with negative effects. The effect of delay is mostly on cost factor which has cost overrun from 10% to 40% from estimated cost of the project. Direct or indirect consequence of delays can be disputes, loss of reputation of any reliable group, reduced or low profits on the project, loss of opportunity of future project from the client and can also be termination of current contract. To minimize or avoid contractor and onsite operation delays, client can also give percentage bonus for on time completion of project.

6. CONCLUSIONS AND RECOMMENDATIONS

The aim of the study was to recognize the major causes of delay and its effect on industrial construction project. Literature review was carried out to identify general causes of delay, its responsibility group in overall projects. Survey through questionnaire for practising Architects of 15 case of project were covered.

- The study shows two major causes of delay having highest severity such delays need more attention while construction and other five causes with medium and low severity.
- Study also reveals the effect on specific project due delays caused which have cost overrun on project in some big projects cost overrun is in crores per day delay.
- Delays can't be eliminated but can be decreased by using project management processes which are Project planning and scheduling, project execution, Project monitoring and control.
- In Industrial construction projects, with pre planning and scheduling of the project by the designer's and managers, delays should be expected and there should be strategy plan to accommodate such delays which may occur at any phase of project.
- Labour related issues, due to any unprecedented condition like pandemic also stand true.

6.1 Future Scope

By managing the delays by various people involved in project can bring timely completion, so further study of fast construction which results in early completion of projects its positive impact can be done.

In most of the case studies, Material management was effected and is the reason of delay, further study of materials used in industrial construction projects. So management plan can be studied for each material and that material can be material guide for owners, Architects and other stake holders.

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To Identify the Cause of Water Scarcity in the Bhukum Village

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ABSTRACT: Villages are an important part of India. And most of the villages are developed near the water bodies like river, lakes etc. but now a day villages are mostly affected because of lack of water. And this condition directly affected the economy and human lives of villagers. Bhukum has an origin of Ram River near Shree Rameshwar temple. In 19th century, water was getting collected near this temple and it was satisfying all needs of water for villages. In 2009, the condition of village was so they needed water tankers for fulfilling their water needs. In this study, we first have studied the Bhukum village, which is located near Pune, to understand groundwater change, factors influencing groundwater levels in the past few years.

The gap is to identify the cause of reduction in water level, so it is necessary to know the reason of reduced water level in the Bhukum village. So the study will focus on the cultural aspects and history of village, according to climate and water availability. Also identify the problems faced by the villagers. For this, the survey has been conducted through Stratified random sampling method. In which the villagers identified previous scenario of the village and current conditions faced by them. And to carry out a hydrology study and case study to identify actual reasons of decrease in water level in Bhukum village. The research will conclude with the identification of causes of lack of water in Bhukum Village.

Keyword: *Ground Water, Bhukum, Water Scarcity, Water Recharge, Causes of Scarcity.*

1. INTRODUCTION

Groundwater is directly or indirectly related to living organisms and the sustainable development of a society since it plays a vital role as a water resource. About more than two billion human beings in the world depend on groundwater for their daily water supply with a huge quantity of the world's agricultural and commercial sectors being subjected to water necessities which are catered through groundwater. Sustainable development and efficient management of this scarce resource has been challenging task in India. Rapid growth in urban, industrial, and agricultural water usage concerning groundwater requirements, in several countries, has especially resulted in those arid and semi-arid zones, which are experiencing water shortages thereby causing the imbalance between its demand and supply. Groundwater is not only influenced by climate change but also by human interventions. As per earlier studies investigating the response of groundwater systems to climate change has been a smart and productive move. Lower groundwater levels are a warning to the environment since its causing hindrance in economic development worldwide. In this study, we select one village which is located near Pune that is Bhukum. The growth rate of Pune city from the last 40 years is observed to be 40% and it has been estimated that it will be much more in the future. With a growing population, there is an increasing demand for water from agriculture, industry, and domestic use. In this study, we first have studied the Bhukum village, which is located near Pune, to understand groundwater change in the past few years. Also, we understand the problems that villagers are faced because of changes in groundwater levels. Then, we analyse variations in factors influencing groundwater levels and identify the major factors.

Background of the Topic: The location of Bhukum is in Mulshi Taluka in Pune District of Maharashtra State, India. It belongs to Pune Division. Bhukum gets water from Sarovar Lake and Khatpevadi Lake. All the rainwater flow from the west southwest to the east side of Bhukum. Mulshi has an average rainfall of 2000 mm. So the water table in that area is good. Because of heavy rainfall, Mulshi had many small lakes with very good water tables for the whole year. In Mulshi taluka, there are more than 10 lakes. The Ram River originates in the Western Ghats at an elevation of 957 m above mean sea level. It then flows in the northwest direction eventually merging with the Mula River at an elevation of 550 m. The Bhukum village is the main place where the ram river origin then the flow of the Ram River is through, Bhugaon and Pirangut along with the Bavdhan, Aundh, Pashan and Karvenagar suburbs of Pune lie in the Ramadi watershed (Kopal Kumar and Anargha Dhorde, 2013).

Bhukum has a beautiful origin of ram river near Shree Rameshwar temple this ancient historic temple tracing it back to the time of loard Rama (according by villagers). In 19th century water was getting collected near this temple and it was satisfying all needs of water for villages. It was core attraction of this village. So people come at there from other villages. It was <1000 and hence this water body was sufficient for their needs.

History: The conditions of water after 2006, near Shree Rameshwar temple, in Bhukum contaminated and people could not use for daily needs because water collected here was filled with mud clay. It was due to force of water reduces drastically. In 2009, the condition of village was reversed in such a way that they needed water tankers for fulfilling their daily water needs. There was only one well in this village in 2010 near Ram River origin. Villagers took the initiative cleaning the well and reusing this water for their daily needs. During this cleaning drive of well, villagers had found two water streams which had very good force of water and also very clean water. The rain water from western Ghats has a way to these villages where people never experienced water shortage, but as there is development of the areas in villages as well as surrounding of the village, the water flow has changed its direction and so the water scarcity is experienced by the villagers now a days.

Need of the Research: The water from the Western Ghats was previously collected in Khatpevadi Lake and then the overflow water was supplied to the villages, but after some days it was observed that there is much development near the Ghats which restricted the flow of water from the Western Ghats. As the result, the water level of Khatpevadi also decreased. According to the primary survey 2022 done of Bhukum village, 90% of people said that water was available for almost 12 months in the historic scenario and the water was used for drinking, domestic purposes, agricultural purposes, and some other uses. 84% of people said that the water level of Bhukum was reduced by a certain level such that from November to January, there was water scarcity and near April May month, villagers needed tankers for their daily needs. At present condition, there are three wells, in the village in front of the temple. But still, this water is insufficient for the villagers. The water system which was working earlier is not working efficiently in present date. At the time of well cleaning, many environmental awareness societies and activists are working on the river origins. They are working on how this water table can be reached again. But to date, villagers have not found any solution on their level. So this can be the scope of the present study, i.e.to give solutions to increase water table.

Research Gap: To identify the cause of decrease in ground water level in Bhukum village.

1.2 Probable Research Questions

- Why there is water scarcity in Bhukum village at present compared to earlier condition?
- Why Bhukum area is receiving less and polluted water?
- Why ground water table is decreased in Bhukum despite of Ram River origin?
- What mitigation measures can be taken by the villagers to get sufficient water?

Aim: To identify the cause of water scarcity and decrease in ground water level of Bhukum village.

1.2.1 *Objectives*

- To study the cultural aspects and history of village according to the climate and water availability in the area.
- To identify the problems/issues faced by the villagers.
- To carry out a hydrology study and a case study to identify the reasons for decreased ground water level in Bhukum village.

1.2.2 *Scope*

- To enhance and inculcate natural water recharge of the village.
- To achieve the conservation of water in the area.
- To enhance the biodiversity with the help of water recharge and conservation.
- To fulfil the daily water demand of village.
- To provide solutions and the proposal which can be achieved at village level so they can contribute towards the water recharge of Ram River origin.

1.2.3 *Limitations*

The research will focus only on identifying the reasons of the decreased ground water level in Bhukum village.

2. LITERATURE REVIEW

Several Case studies were studied to identify the important parameters for research studies on water scarcity related to different contexts and to study the problem-solving methodologies for the same. More focus on highly contextual studies is chosen to identify the parameter because of its similarity in structure of research and solution, the paper is focusing on.

The causes of the water crisis in India were particularly identified after studying the contextual studies of the water crisis in Haryana and West Bengal and also the neighbour country of Nepal, it was observed that much of the water crisis is due to severe mismanagement of water resources, poor governance and lack of awareness among the citizens. Also, rapid urbanization played a major role in climate change in some parts of the country leading to changes in rainfall patterns and an increase in temperature. Some human interventions including dams and water diversion for various purposes also have a significant impact on the overall natural water ecosystem. Also, India is highly dependent on groundwater and hence a reason for accelerated drying of aquifers. Lack of policy on water usage, conservation, and utilisation is also one of the big reasons for the same. Several international studies also are being reviewed and analysed considering various other horizons of water crisis and restoration and other ways to prevent the same. It is observed that water have social and cultural aspect on human life apart being a necessity and hence all the human intervention on natural water resources should be in accordance to social and cultural aspect also.

Over the past 5 decades, demand of natural resource has increased; land use pattern has particularly changed ecosystems and which is the primary cause of change in ground water levels. Due to urbanization or infrastructure development, large number of agricultural lands have been converted to build- up or urban land uses. For this, remote sensing and Geographical Information system (GIS) provide fundamental tools; with the help of GIS, synoptic view and multi-temporal LCLU data are beneficial in the investigation at the village district as well as the city level.

The built-up land class shows a total increase of 26 sq.km, expanding from just 3 sq.km in 1992, to 8 sq.km in 1999, and then to 29 sq.km in 2011. Generally, the trend observed in the urbanization of Mulshi is that the commercial and industrial expansion is done on flat ground, while tourist hubs have been developed on hill slopes which have direct effects on the water flow and water levels of the Mulshi. (1Reza Ravanshad, 2018) The area under forest cover has decreased by 21 sq.km, i.e. from 312 sq.km to 291 sq.km. The degradation of forests into scrub lands seen near the edges of the forests. There is a huge change in land use pattern in the Pune district, especially in Mulshi. Almost 3 to 5 sq.km is covered with built up area. 1 to 3 sq. km area decreased from forest area. Almost 53% of natural vegetation has been change from 1991. As per the undertaken study, analysis of assessment of surface run off in the Ram River catchment, in the last 2 decades has been observed. (1Reza Ravanshad, 2018)

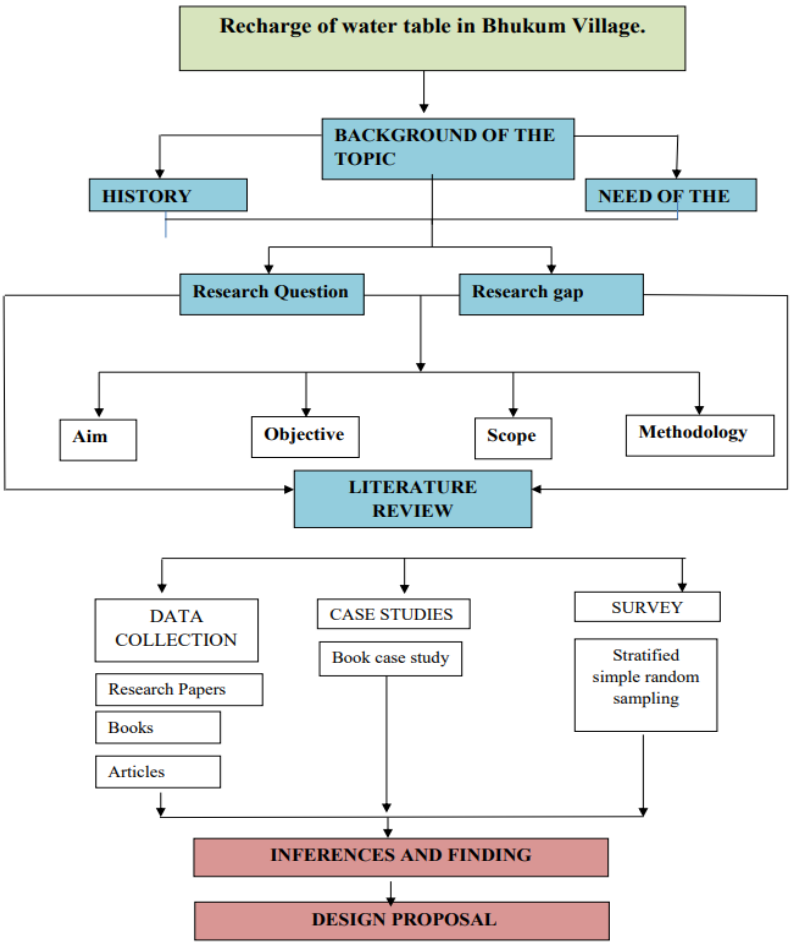
Patches of vegetation along the course of Ram River earlier are now under urban land use and attributing to the development of the IT industry and a number of communication links in the region. Areas experiencing human intervention in the form of construction activity appear to have increased in the past decades, leading to an overall increase in the impervious cover. The estimated surface runoff for the entire catchment, yielded a runoff volume of 4.0592×108 m^3 in 1989, which increased to 5.2503×108 m3 in 2011, whichindicates that there is direct impact of urbanization on surface runoff where an increase in the amount of surface runoff was generated within the Ram River catchment during the study period (1989 and 2011) is clearly evident for all the rainfall criteria. (Dhorde, Estimation of Runoff from Impervious Surface using, 2013)

As per the Ram River case study which is tributary of Mula river which flows in a north-easterly direction finally confluence with the Mula river near Baner. The total watershed area is about 63 km^2. (Gurudas Nulkar, March 2021) The highest point is situated near Bhukum (800 m above MSL) whereas the lowest point is situated near Baner (560 m above MSL).Half of Bhukum has hilly terrain, which lies off shoot of Sahyadri range. From Manas Lake to Bhugaon Village, this river flows like a minor stream, with sewage and construction debris being deposited into the stream along its connection between ground water flow and LULC. (Gurudas Nulkar, March 2021) This change has affected groundwater level very badly. There is an abrupt change in the landscape pattern which is indicated by the degree of slope which gently decreases towards the confluence. (Dhorde, 2013)

The longitudinal profile of the river clearly explains that anthropogenic activities have altered the landscape according to human needs. Due to saturation and unavailability of plain land there are some settlements which lie between 90 to 300

slope regions. Although these slopes are not favourable for settlements, slopes are altered to form settlements and this type of development which were observed in early years from confluence to source of rive.

3. MATERIAL AND METHODOLOGY



4. RESULTS AND DISCUSSION

In the hydrology study, the rainfall of the Mulshi (Pune) is approximately 2000 to 5000 mm in 2020 according to the climatic study. As there is a huge change in climate around the year, rainfall is experienced unevenly in Pune. The groundwater level depends on the rainfall of the area. It has been observed that the rainfall of Bhukum for the last 10 years was sufficient. So the groundwater of Bhukum was also sufficient according to the groundwater book of Maharashtra. In Pune district, Depth to water level was observed varying near ground level in Mulshi. Decade analysis of rainfall concerning groundwater level is also satisfactory. But during May, the groundwater level reduced by almost 2 to 3 meters, and this can be a cause of water scarcity in villages. (INDIA, 2021)

Table 1: Analysis of Depth of Ground Water Level

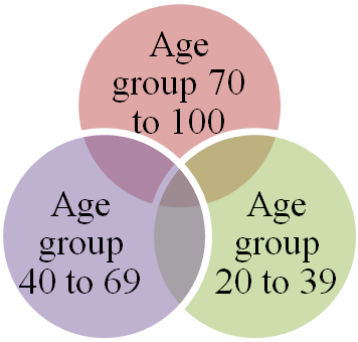
Month	*Depth of Ground Water Level (mbgl)*	*Observation*
May 2020	2 to 5	Water level decreased
October 2020	<2	Water level increased
January 2021	<2	Water level increased

(Source: Government of India)

Table 2: Ground Water Level Fluctuation

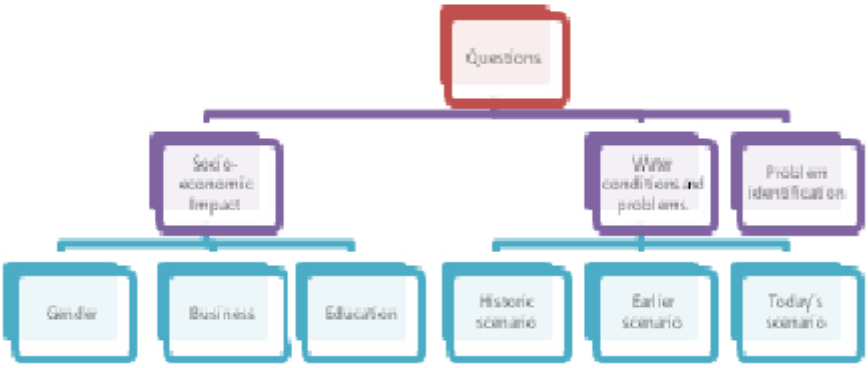
Month	***Fluctuation of Ground water level(M)***	***Observation***
October 2020, may 2020	0-2 RISE	Water level increased
May 2020 w.r.t May2019	0-2 RISE	Water level increased
October 2020 October 2019	2-0 FALL	Water level decreased
May 2020 w.r.t decadal mean 2010-2019	2-0 FALL	Water level decreased

Table 3: Age Group for Survey (Source: Primary survey 2021)



The pre-monsoon decadal groundwater level trend (2011–2020) in the Bhukum is almost low. The declining trend during the Pre-monsoon season indicates that the aquifer is being de-watered every year either due to deficient rainfall recharge or due to the groundwater developmental activities in the area. Pre-monsoon depth changes from 2 to 3 m to 8 to 10 m in May month the village. The post-monsoon decadal groundwater level trend (2011–2020) in the Bhukum is Almost 90% of the area in Pune has a very good groundwater level after a monsoon and hence the water problems are not there in Pune till January February.

Table 4: Questionnaire Strategy for Survey



A survey has been conducted for 80 people in the village with different age groups. Simple stratified random sampling method is used for the survey. Villagers are facing water scarcity problems in the summer months. The hydrology study and case studies also conclude that in summer, the groundwater level of Bhukum has decreased. In recent years, the number of bore wells has increased than earlier. Almost 80% of people use bore wells for their agricultural and domestic use. So the groundwater flow changes drastically. This can be a major issue in the area. Almost 80% of people said that large amounts of vegetation are cut during the development. The settlement study also concludes that 58% of vegetation is cut in Bhukum and surrounding areas also. 78% of people said that climate change, changes in flora fauna, soil erosion, reduction of water in streams and lakes are responsible for water scarcity in the village. 98% of people said that deforestation is the major issue in the Western Ghats and that can affect water scarcity in the village. Land use Patten study also concludes the same. Major reasons found from the survey change in increased water pumping (bore wells) drastic change in land use pattern, change in

flora fauna, deforestation, infrastructure development, reduction of water in streams and lakes, and decrease in the different groundwater holder tress, poor groundwater management. All these causes are also seen in the hydrology study and literature study. This can be the main reason

5. CONCLUSION

Considering the aim of this research paper based on the importance of groundwater and the current scenario at Bhukum village area have been observed and compared with eight cases and literature. This research paper involved the possible problem of water scarcity verified at Bhukum village (Near Mulshi in Pune) with a manageable solution that can be a future scope. study of above data and analysis from the above study I have concluded that factors which were observed for Bhukum village were identified correctly and also been checked. Dumping waste like construction waste, household waste, etc. in natural waterways is also a major problem in the area. Considering the Hydrology of the selected area which has been affected by major water scarcity due to tremendous change in surface runoff almost 1.1911 ×108 m^3 as Bhukum is also an important part of ram river watershed. Though the groundwater of Bhukum is sufficient during monsoon and winter it is important to look for the decreasing depth of the water during summer like February to May which goes down up to 3 to 4 m. The fluctuation range is almost the same for the last 3 to 4 decades hence Bhukum faces scarcity in summer.

Due to drastic changes in land use, pattern and nearby the Bhukum village is equally responsible for decreasing the water level. Almost 70 to 80% of agricultural and forest land is covered with built-up land this has majorly effect on surface runoff in the last few years.

Excessive groundwater pumping from surrounding villages has affected the groundwater of the Bhukum village. Clay near natural water streams also causes the reduction of water in streams and lakes. Disturbance in catchments and watersheds of Ram River may be responsible for the change in groundwater table e.g. dumping construction waste, deforestation, etc. Vegetation can be one of the reasons for water scarcity as vegetation differs of surrounding areas from 2006 to 2021 is almost 88% and 80% of people around village said that demolition of vegetation for development happened within last decades. From the above study from the history of chosen area hydrology research, case study, and analysis from survey to verify all above concerns covered that there is a sudden change which reflected on the groundwater level of Bhukum village which carries the impact of last few decades. Some other reasons like water logging, agricultural use of water, rapid urbanization, poor and unsustainable water management, a variety of urban perturbations such as damming, water extraction, point, and nonpoint source pollution, sand dredging, the connection of water level and vegetation, global warming, change in rainfall, extreme groundwater usage, construction of dams, catchments, and watersheds, deforestation, etc. it is possible to give manageable solutions to villagers for recharging water level in Bhukum village. It is important to conserve water which can impact the economy and other resources.

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Impact on Construction Activities of Residential Projects in Pune Due to Lack of Labor in a Pandemic Situation

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ABSTRACT: The coronavirus disease 2019 (Covid-19) pandemic has resulted in significant delays and cost overrun in construction projects. One of the most essential ways for reducing risk is to implement health and safety (H&S) technologies the adverse impacts of Covid-19 on the construction industry and help the industry adapt to the new normal. There is much ongoing research available on workforces and workplaces to be modified in new designs. However, there are no studies that would address the challenges faced in managing labor on sites for various construction activities that were impacted due to the lack of labor in the residential buildings of Pune. A case study approach was selected to identify the issues faced during construction in a pandemic situation.

Keywords: *Construction Activities, Pandemic Management, Labors, H&S Technology Cost, Timeline.*

1. INTRODUCTION & BACKGROUND OF THE STUDY

The coronavirus, commonly known as COVID-19, is caused by the coronavirus 2 (i.e., SARS-COV-2), a serious acute respiratory disorder (O. (O) and Coronavirus, 2020). The virus can be passed from person to person and causes symptoms such as fever, dry cough, exhaustion, and shortness of breath, according to reports. The virus had spread to over 200 countries by January 2021, affecting 91.5 million people and killing 1.96 million people. The outbreak's rapid spread and long incubation period have been the most crucial aspects (Hendrickson and Rilett, 2020).

In addition, to this health and emergency, the outbreak has resulted in global economic decline. Construction, like many other industries, has been impacted in a variety of ways. Since the pandemic has begun there has been a lot of chaos in managing the labors, on-site, providing the labors regularly with work, and withholding them, from achieving the milestones of construction activities on site. With increasingly disrupting supply chains, contractor workforces, and the availability of governmental personnel for project inspections, safety measures such as travel restrictions, social distancing, and quarantines have resulted in unprecedented delays, disruptions, increased construction costs, and uncertainty on construction projects. Construction is a high-risk industry, with several hazards and uncertainties to contend with throughout the process. The effects of the COVID-19 epidemic, as well as continually changing and often inconsistent state, county, and city orders, have generated a whole new set of dangers and uncertainty in every construction project, resulting in limited activities or project halting (gould + ratner, 2020). While navigating this moment of uncertainty, all parties involved, including owners, contractors, and project managers, are expected to identify and manage all such risks, and risk analysis and management will be more important than ever for the construction sector and project managers.

In addition, numerous new publications about COVID-19 and coping strategies are being released. The construction industry has always had labor. Because COVID-19 spreads mostly through interpersonal contact, contacts between construction workers have played a significant part in the delays in restarting projects. shortage, but the pandemic has exacerbated it because a substantial percentage of construction workers have apparently tested positive for the coronavirus. As the propagation of COVID-19 is largely related to individual contact, encounters between construction employees have played a major role in the delays in reopening projects. Physical separation measures aimed at reducing viral spread have had an impact on the number of people allowed to work in a given location, how employees handle their jobs, and how project managers anticipate the working environment (Araya, 2021). Although recent research has focused on the effects of COVID-19 on the construction industry, little information on the construction workforce has been published.

As a result, the goal of this research was to:

1. identify and categorize the obstacles that construction workers faced during COVID-19, and
2. to analyse the opportunities and challenges for the construction health and safety technology under the covid-19 Pandemic situation of Pune.

The findings of this study will help in understanding the impacts on construction activities due to lack of labor for residential buildings in Pune. It will also help in establishing safe work environments. The result will indicate the external influence factor – the Covid19 Pandemic, which could drive the use of Health & Safety technologies. The present result will be useful to industry stakeholders and researchers interested in developing H&S technology for combating Covid-19 Pandemic and future crisis.

2. LITERATURE REVIEW

2.1. Literature Review 1:

Construction Industry from Perspective of Force Majeure and Environmental Risk Compared to the COVID-19 Outbreak:

Mohammad Omar Alfadil, Mukhtar A. Kassem, Kherun Nita Ali and WaelAlaghbari

"Construction Industry in Covid-19 Outbreak"; the author expressed several approaches, in design interface for covid -19. He is in the opinion that Covid-19 outbreak has caused direct impact on project objectives, hence exceeding in cost estimates and delayed implementation. The financial impacts in the pandemic has affected in many ways. To begin with, the revenue generating. Contract cancellations or delays have had a significant impact on revenue values. The Working capital is also one the negative impacts of pandemic, that suffers severe pressures affecting the liquidity situation. And the most important is financing, in which it takes longer than expected to support new supporting capital, financiers' questions companies, ability to repay loans on time ability to repay loans on time and risks rise, resulting in higher borrowing rates and the exposure of financial vulnerabilities that may have built up over time. In order to confront all the repercussion in a proactive way, companies must carry out proper assessment and planning work assessment and planning work for administrative procedures in these specific sectors. Clauses referring to force majeure, emergency situations, government action, or legislative changes should all be carefully considered. Customers must also be informed that constant communication with employers is critical for managing expectations and minimising negative consequences in project management and implementation. In the employment sector, special care is required in managing personnel costs and participation in the face of business disruption, as companies must evaluate the process of reducing personnel costs, wages, and expenses during the period of suspension of activity; this can be accomplished by finding alternatives to cash payment and through good planning, assessing staffing requirements, and working to retain key skilled staff during the period of suspension of activity.

2.2 Literature Review 2

Future of construction industry: COVID-19 and its implications on construction projects and risk management

Kushal Adhikaria, Lochana Poudyala

The author has published the overall uncertainty on construction projects, which generated the disruptions and delays. The author tries to explain the risk to be managed on site, using varied technologies, including AI based technologies, drones, robots, autonomous heavy equipment, connected equipment, augmented reality (AR), virtual reality (VR), and 3-D printed buildings have now been employed as augmentation tool to humans. In the construction industry, collaborative technologies and platforms such as telematics, mobile apps, zooming, and skype sessions have become the new means of communication. Furthermore, following the COVID-19 epidemic, the construction sector is projected to change dramatically in terms of technology use, with most future projects relying heavily on current technologies. The author attempts to express the possibilities in the construction business in normal reducing all problems and proposing digitally aligned choices that will aid in mitigating the effects of Covid-19 on construction activities. The workplace of the future will not be the same as it was previously; it will consist of some members working in real locations and others working in virtual surroundings, with technology and collaboration tools/platforms being employed to enable this (Deloitte, 2020d).

2.3 Literature Review 3

Opportunities and challenges for construction Health and Safety Technologies under the Covid -19 Pandemic in Chinese construction Projects.

Yang Yang, Albert P.C. Chan, Ming Shan, Ran Gao, FengyuBao, SainanLyu, Qingwen Zhang.

The author highlights the impacts of Covid-19 on construction projects and the issues affecting the use of H&S technologies under the pandemic. The study aims to evaluate the adoption of H&S technologies for Pandemic management in construction sector. The application of health and safety measures would reduce, mitigate and control the risk of the pandemic. The identification of driving forces and constraints to adoption of diverse technologies in the construction industry. Most specifically, these technologies will improve project performance, concerning cost-time performance, productivity, and safety performance. The government favors the policy and regulations, to drive for health and safety technologies in construction. Besides, poor policy support, poor information and communication technology (ICT) infrastructure, and conservative culture may impede the use of technologies in the construction industry.

Diffusion of innovation theory is a process in which an innovation is communicated through certain channels over time among members of a social system. This theory implies the diffusion of innovation in an organization driven by internal and external factors. External factors are the one that exists outside adopting organizations' policies, regulations, advertisement, markets demand, and competitive advantage, benefitting the innovation. Through incentives, subsidies, and grants, regulations can compel businesses to adopt innovation. This theory has been widely used in the to adoption, implementation, infusions, and diffusion of these innovations. This theory will help to explain the underlying factors affecting the adoption of Health and safety technologies in the study.

Many different procedures and methods have been adopted on-site to carry out work with more precaution, the main research gap was to understand the health and safety measures through technology, which helps in having overall control of site activities and labors safety as well to carry out construction activities more efficiently and effectively.

3. METHODOLOGY

Qualitative research serves to analyze complex social phenomena in by exploring the views and experiences of Project Managers, Architects, Site engineers, and Labors. This approach is appropriate when researchers are limited in their knowledge of new phenomena. Hence, qualitative research was applied to gain fresh information about the phenomenon and facts about the studied topic. This approach offers an opportunity in dealing with the study context about the impacts of Covid-19 on residential projects of Pune and adaption of various and Health & Safety measures for laborers to carry out construction activities on site. Firstly, various case study projects which have been selected, ongoing projects or projects that were in the mobilization stage in Pandemic situations were carried out to collect the primary data. To understand the impact of Covid-19 on construction activities, certain interviews were carried out. The semi–structured interview was carried out listing open-ended questions. Interview was carried out from different professionals and organizations, such as owners, contractors, and technology firms. The Research Process as follows.

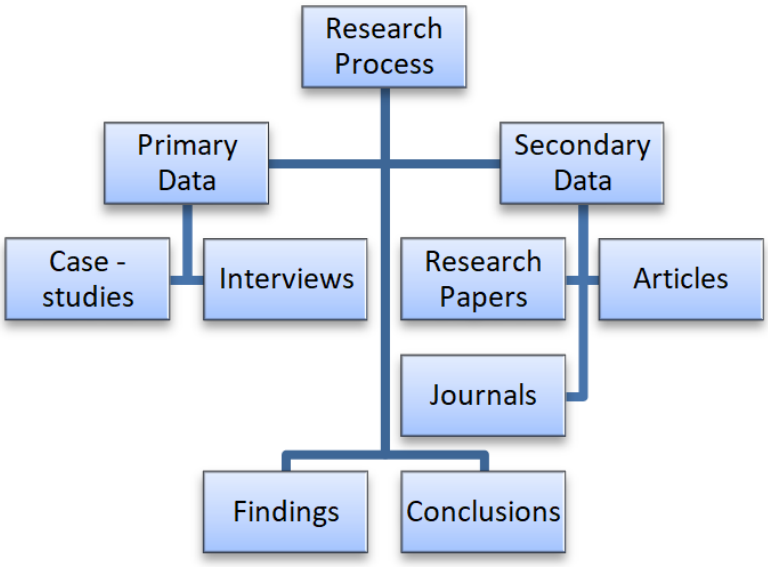

Figure 1: Showing the Research Process

3.1 Case Study Glimpse

The case study taken, here is of residential projects of an area approximately of about 5 to 7 acres of area. The Case study was done on basis to understand the impact of Covid-19 on ongoing residential projects of Pune. The study was done in respect to detailed work break down structure of a project and understand the health and safety measures for labors, and with its respect to the material and quality of work done. The study also aims at understanding the reasons of delay in work executed. The precautions taken for the labor to execute the work.

3.2 Interviews

The Standardized interview questions facilitated, an approach to discuss about the impact of covid-19 on construction industry. Interviews with adequate experience, were conducted, of the project case study. The participants position, year of experience, and their organizational background are given in the Table 1.

Table 1: Background Information about the Interviewees

Company
Job Position
Work Experience
Developer (Private)
Project Manager
28 Years
Developer (Private)
Assistant Architect
18 Years
Consulting Firm (Private)
Architect
30 Years
Technology Consultant
Managing Director
15 Years
Developer (Private)
Project Engineer
12 Years
Developer (Private)
Site Engineer
8 Years
Developer (Private)
Owner
20 Years
Contractor
Safety Engineer
14 Years
Technology
Consultant
Senior
Engineer
12 Years

4. RESULTS AND DISCUSSION

The case studies and interviews provided relevant information based on their views of impacts of Covid-19 on their construction Projects, the adoption of health and safety measures under the pandemic, and the driving forces and issues associated with implementation of health and safety measures for labors, respective of construction activities taking place on-site. As the Site was maintained with its health and safety measures for labors on site, there was due lack in tracking of the labors well-being.

4.1 Impacts of Covid-19 *on construction of residential projects of Pune*

The study showed us how the construction activities were impacted due to the lack of labor in the Pandemic situation. Major activities on sites were on halt. This has affected the time overrun, and cost overrun of the project.

In the first phase of lockdown, the site was completely shut, as labors had gone back to its native place and there were no health and safety measures for labors, that were put up. But eventually, as the spread of the virus was known and labors were called back, eventually, all labors on site were provided with centralized labor camps, isolation wards, duty timings for labors were changed, thermal scanning, washing area. Labor camps are sanitized twice a week. Furthermore, if the labors were hired on-site, they were asked for antigen tests and then hired for work. They were also provided with PPE kits for effective working conditions of labors. To improve overall construction activities on-site and to cover up the delay in completion of the project also, the breach in cash – flow and revenue generation. These all factors were taken into consideration for the execution of the project efficiently.

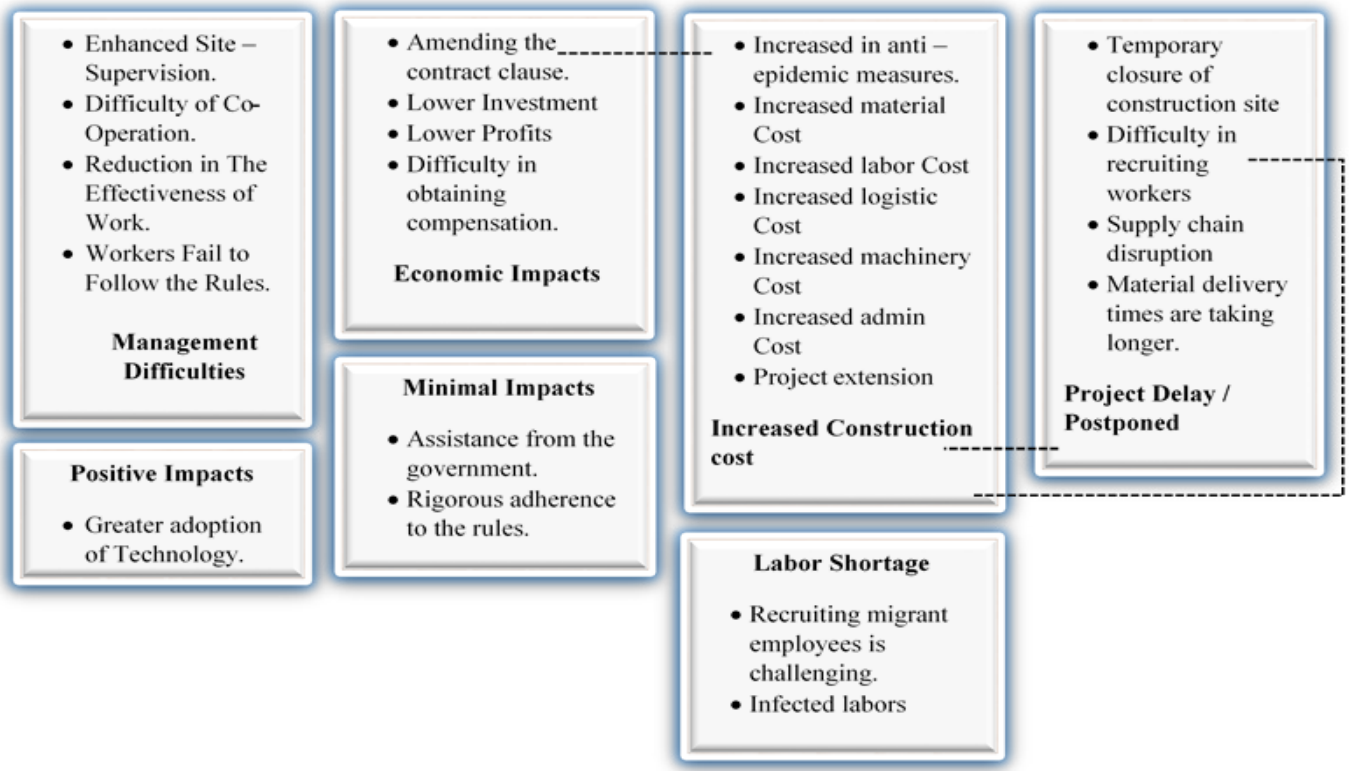

Figure 2: The Impacts of Covid-19 on Residential Projects. Dotted Lines Imply the Relationship based on Interviews Responses

4.2 Anti- Pandemic Measures

The Anti-epidemic measures are categorized as Personal, Managerial, and technological measures. Personal measures included wearing masks, daily disinfection, vaccinations, health screening, temperature checks, regular nucleic acid tests, and quarantine wards. On-site, there were many mobile samples collection stations where workers may get free COVID-19 nucleic acid testing. To deal with the issues, the management team developed work procedures in the epidemic of COVID-

19. To avoid crowding, the project team implemented task rotation and set up small-group work for laborers. They also improved site supervision and safety management to guarantee that all employees and contractors followed the COVID-19 regulations. Employers provided workforce education programs to improve the application of epidemic prevention measures. The last category is of health and safety technology approach in which, the construction siteaccess control system is there which consists of fever monitoring, facial recognition, labor information, for health screening purposes. The QR code system could monitor and track probable contact cases and so aid in the prevention of the virus's spread on construction sites. These Surveillance and monitoring technologies have shown to be effective in combating the pandemic. This has been confirmed by the interviewees of the study.

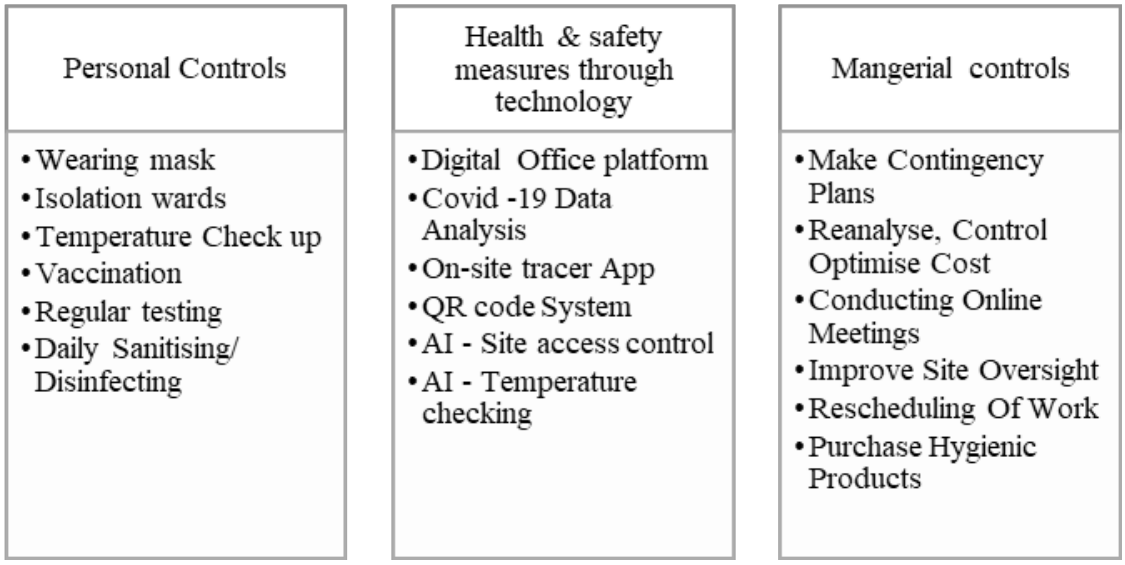

Figure 3: Anti-Pandemic Measures

5. CONCLUSION

The study highlights the impact of Covid-19 on residential projects of Pune and the issues affecting the precautionary of health and safety measures through technology under the pandemic. The impacts of the pandemic include remarkable delays on projects, labor and materials are difficult to come by and increased construction costs. The Personal, managerial, and technological anti-epidemic methods are the most extensively used anti-epidemic strategies. Online meetings and health screenings have proven to be partially effective in avoiding the spread of pandemics while preserving normal work practices. The health QR code system, AI-powered fever monitoring, and construction site access management system were among the primary H&S technologies deployed. Other technologies including BIM, drones, AI-powered video surveillance, and robotics were rarely used in the projects investigated. The respondents discussed a number of issues related to its execution on the ground. Hence, the use of this type of technology will help to carry out construction activities in an effective way.

6. RECOMMENDATIONS

The health and safety measures through technology will help us to carry out construction activities on site more affectively. Different protocols that are followed to carry out the construction activities on site are more time – consuming, hence, each site having standardized health and safety measures controlled through technology, will allow the smooth run of the project creating lesser hindrance in completing the project. This can further be used in Post-pandemic situation as well, for betterment of labors and employees for smooth running of the project.

7. FUTURE SCOPE OF WORK

Certain cost effective anti-pandemic measures for labors through technology can be proposed to labors, to ascertain the labors, for any further future crisis.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. Zoher Siamwala. for his valuable guidance, inspiration and encouragement. His unwavering dedication to this task enabled me to arrive at an unquestionable conclusion.

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Assessing the Impact of Mandating the Utilization of Recycled Aggregate in Construction with Cost Implication

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ABSTRACT: The anticipated growth of the Indian construction sector is projected to exceed upto 7% by year 2025 and is accompanied with waste that threatens the environment. United Nation's SDG 12 addresses 'Responsible Consumption and Production' and targets to reduce waste generation through prevention, reduction, recycling and reuse. Despite several guidelines, implementation has been challenging hence there is a need for a more mandatory role to better address sustainability. To reduce the negative environmental impact sustainable development practices along with positive cost implications for the project must be employed. Utilization of recycled construction waste materials in lieu of new products would in turn minimize the heavy burden on the nation's landfills. This reinforces the intent to consume responsibly along with manifesting cost savings though at a small percentage to the total project cost. Formulating such Sustainable construction clauses with validated positive cost implications, and incorporating them in construction contracts would guarantee their implementation and the results will be felt throughout the industry.

Keywords: *Material Alternatives, Construction Clauses, Responsible Consumption.*

1. INTRODUCTION AND BACKGROUND STUDY

A careful study of various research papers, with the intent to examine the integration of sustainability principles into construction project contracts, leads to the deduction of the relationship between sustainability and better project performance, through the integration of sustainability principles.

On a global standpoint, such strategies are being implemented in developed countries, more so, than in developing countries. Their successful implementation can be attributed to the standardized processes followed, leaving less room for disputes and arbitrations. Ascribing accountability to the stakeholder lends clarity to the process flow and the deliverables to be met. A comprehensive study of the construction contracts implemented in India would shed light on what practices are currently followed in the industry, identifying the inadequacies (pertaining to sustainable construction practices) and ways to amend them. The construction industry has not been completely receptive to this "sustainability aspect" proactively. However, this effort and participation must come from all the professional bodies of the industry, related institutions, academicians, firm patronage and concerned government bodies. Although there are many regulations and government policies in place to support sustainability issues, it has been mentioned in several research papers and by experts that such regulations and policies may be insufficient. The need to adopt a more mandatory role to address sustainability becomes the need of the hour.

Exploring the usage of recycled aggregate in construction projects (residential typology – superstructure only) and computing its cost implications would not only reinforce environmental sustainability but also economic sustainability for the project as a whole. With this holistic intent of improving resource efficiency, such a measure can be translated into a contractual clause and incorporated in Construction contracts, for its results to be widely felt.

2. LITERATURE REVIEW

In developing countries, various obstacles have been observed that hinder the adoption of sustainability into construction practices. Research indicates that professionals feel reluctant to adopt new technologies, systems and methods of construction due to fear of wastage of time and suffering additional cost along with reliance on demonstrative examples encompassing those of culture, unreliable information, lack of coordination and lack of measurement standards for

sustainable construction. There are ways to overcome such obstacles. Education and training in sustainability parameters is often neglected. (i) (Ogunmakinde, 2016)

For this particular study the research carried out that encompasses sustainable construction can be characterized into five different categories. The first being the one that explores the negative impacts on the triple bottom lines of sustainability. The second category of research attempts at finding more sustainable practices and methods of construction management. Such studies tend to be region specific as demography, culture, norms, background and standards of a community play an important role in this study. The third category of research focusses on developing a strategic planning framework for sustainable development implementation. The fourth category of study emphasizes on developing sustainable assessment systems. Finally, the fifth category of research investigates major barriers to sustainable construction. (ii) (Karji, 2020)

Another such study inspects the various issues of sustainability in project contracts such as those of AIA, CSI, FIDIC, EJCDC and Consensus Docs for the best suitability of sustainability parameters such as sustainable design principles, environmental design tools, assessing product sustainability and assessing facility sustainability. Upon analysis of the chosen parameters, the Consensus Docs appears to be the best alternative amongst the five contracts while FIDIC seems to be the worst standard in terms of sustainability as it does not have any clauses that assign accountability to any stakeholder for implementing sustainability in projects. Translating this quantitatively also gave the same results. The AIA contracts, EJCDC contracts and CSI contracts are on the right path to incorporating sustainability into construction contracts but they do still lack clarity. It is emphasized as to why it is necessary to include sustainability as clear and methodical information in construction contracts. This study presents the relationship between project management, sustainability and construction contracts. (iii) (Gonnon, 2019)

Despite the various perspectives, the literature referred to, underlines one thing - the importance of incorporating sustainable parameters in construction. There are obstacles to implementing sustainability parameters into construction practices but if those can be ingrained in a construction contract then implementing them will be a part of the construction process thus making a huge difference.

2. MATERIAL AND METHODOLOGY

Firstly, conducting an overview of the sustainability measures adopted in the construction industry in India was done. Understanding the policy environment in the construction sector in India was the next step. Referring government websites for matter related to selected topic and reading research papers (written in the past 5 years) and published works for conducting Literature Review was imperative to understanding national as well as global perspectives. Green building guidelines formulated by non-government bodies or research institutions were referred to.

National Building Code – NBC - Ch 11: a national instrument provides guidelines for regulating building construction activities across the country. CPWD**,** that has nationwide presence**,** has published guidelines for sustainable habitat in 2014 and the parameters for choice of materials for a sustainable habitat construction depending on the weightage given to materials. Guidelines on Reuse and Recycling of Construction and Demolition Waste are also mentioned in the same document. It provides simple guidelines to be followed for waste segregation on site itself and its recycling.

Central Public Health and Environmental Engineering Organization (CPHEEO), a technical wing of the Ministry of Housing and Urban Affairs, not only supports the Ministry in policy formulation but also handhold States by way of technical advice, guidelines, scrutiny and appraisal of schemes and propagation of new technologies in the field of water supply and sanitation including municipal solid waste management.

Table 2: Properties of Aggregate

S. No	Properties	Natural Coarse Aggregate	Recycled Coarse Aggregate
1	Specific Gravity	2.84	2.45
2	Impact Value	15.20	19.30
3	Water Absorption	0.95	5.62
4	Crushing Test	20.5	22
5	Size of Aggregate	20mm	20mm

Table 1 showing the comparison of Natural vs recycled coarse aggregate (iv) (Daniyal, 2020).

Inferences from studies conducted led to defining the scope of research to usage of recycled material in Residential Building Construction. This further led to analysis of the use of recycled aggregate from C&D waste. A case study was needed to put forth this premise. Hence identifying such a case study for computing the total aggregates needed in a similar project, superstructure only, was done. Computing the cost implication for replacing natural aggregates with recycled, by a percentage, on such a structure was carried out. The above process not only addresses the subject of sustainability but validates the economic benefits it can bring to a project. The author feels that its assimilation in Indian Construction Contracts will be beneficial for construction projects.

4. RESULTS AND DISCUSSION

The study of the three most prevailing rating system in India LEED, IGBC and GRIHA exhibits that maximum points have been devoted to Energy Section and minimal points to Waste Management and Building Material making them neglected and of lesser significance. (Himanshu Agarwal *et al.,* 2017, Volume 5 Issue 3).

Construction and demolition waste is generated whenever any construction or demolition activity takes place. It consists mostly of inert and non-biodegradable material such as concrete, plaster, metal, wood, plastics etc. Recycling of aggregate material from construction and demolition waste may reduce the demand-supply gap in both these sectors. This calls for a different kind of study that encompasses the use of recycled material along with the other conventional materials and study its cost implications on the project cost. This attempt needs to be made so that it encourages the developer and/or builder to implement the sustainable principles in the project.

The case study selected for computing the volume of aggregates is of residential typology, high rise structure (G+30) located in the suburbs of Mumbai region. The total volume of aggregates was calculated and then a computation was done where 20% of the aggregates were substituted with recycled aggregates.

Table 2: Showing the Computation of Case Study

	Computation for the case study #1:			
	Total Volume of Aggregates		2495	m3
	80%		1996	m3
	20%		499	m3
A	Total of Aggregate (with NO recycled agg	2495 X ₹ 660	₹ 16,46,700.0	
B	Total of Aggregate	1996 X ₹ 660	₹ 13,17,360.00	
	(with recycled agg (20%)	499 X ₹ 420	₹ 2,09,580.00	
	Total		₹ 15,26,940.00	
	Difference in A & B = savings		₹ 1,19,760.00	
	Percentage of savings in total cost of aggregates		**7.27%**	

As seen in Table 2, there is a cost savings of 7.27% in the total cost of aggregates and can be utilized on other activities of the project.

5. CONCLUSION

The computation done for the case study validates the premise that there are cost savings associated with utilizing recycled aggregates, though nominal in percentage as compared to the entire project cost. Also, the fact that there is a positive environmental impact associated with such an action, cannot be undermined.

The validation of such benefits carries weightage only if implemented in projects. Hence an effort to ingrain these in the construction process becomes very important. This can be achieved by making the contract as an enforcement and proactive management tool. Further more research could be carried out in the area of construction contracts as to how the implementation of sustainable principles can be done. If the process be standardized, its effects could be felt on a larger and much needed scale.

Incorporation in contracts could be the inception for implementing sustainable development practices in construction.

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I would like to express a deep sense of gratitude from the bottom of my heart to my guide Prof. Alka Tawari for her valuable guidance, inspiration and encouragement. Her keen and unrelenting understanding in this work helped me to write this paper.

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Investigating and Suggesting Guidelines for Sustainable and Integrated Energy Management at Jivdani Temple Virar, India

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ABSTRACT: As pilgrim tourism grows in India, the government is becoming more interested in developing key pilgrim sites. The main concern is to improve the user experience by providing various amenities and creating recreational activities. This development also creates jobs for people, generates foreign exchange earnings, and contributes to the growth of the Indian economy. When building these types of areas, the environmental impact of the development is often overlooked. As a result, the ecosystem is degraded, and natural, non-renewable resources are being abused. Jivdani temple, Virar is one of the most significant and oldest temples in Mumbai's suburbs, having a daily footfall of at least 5000 people. Improving infrastructure, impending amenities, and tourism expansion will raise the need for energy in the temple complex, resulting in a gap between demand and supply of energy in the temple, which will have an impact on the natives' day-to-day lives. The main objective of the study is to propose an effective energy management plan for the Jivdani temple which is transitioning from conventional practices to a more sustainable approach. There is a need to implement Sustainable and integrated energy management to realize social, environmental, and financial gains. To determine the existing situation of energy consumption for various activities, consumption patterns, and energy demand a detailed walk-in energy audit is conducted to study the selected case. The research proposes effective measures and guidelines for sustainable and integrated energy management plan applicable as long-term and short-term solutions to be undertaken by the selected case.

Keywords: *Pilgrim Tourism, Energy Management, Sustainable and Integrated Energy Management, Jivdani Temple, Virar.*

1. INTRODUCTION AND BACKGROUND OF STUDY

As pilgrim tourism is increasing in India, government is taking interest in developing important pilgrim places. Enhancing user experience by providing different facilities around; creating recreational activities is a primary concern. This development also produce employment for locals, foreign exchange earnings, and help boost the Indian Economy. While developing this kind of places environmental impact of the development is often neglected. Which result in degradation of environment as well as abusive use of natural, non-renewable resources.

As awareness of sustainable use of resources spreads due to global impact; The government's as well as private authority's approach to the projects has changed. They are opting for more sustainable methods and practices. We can see some examples for such development in Sai temple in Shirdi as they have solar energy system for whole project, Golden temple in Amritsar for water management and waste management, and now BEE is proposing energy efficient management system for The Tirupati Balaji temple in Andhra Pradesh.

Jivdani Temple is located approximately 60 kilometres north of Mumbai in Virar. Which experience huge footfall of devotees every day. Due to huge number of increasing devotees which is affecting the financial sector of temple. Because of which temple is in the process of transitioning to more sustainable methods and practices.

The aim of this paper is to investigate the current situation by identifying various integrated and sustainable methods and practises, as well as to recommend guidelines for energy management in the case of Jivdani Temple in Virar.

The following are the objectives for achieving the aim of this research paper:

- Investigating Energy requirement, consumption pattern and current infrastructure.

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- Identifying methods along with practices of sustainable and integrated management system for energy.
- Challenges faced and current situation of Jivdani temple.
- Studying various methods of integrated and sustainable energy management through case studies.
- Proposing guidelines for conservation and substitution of the energy consumption at Jivdani Temple.

The scope of the study will look into current practices and propose guidelines for implementing integrated and sustainable energy management. Analysing various sustainable energy management techniques and interpreting the project's environmental impact and financial gains. The study makes no mention of the temple's solid waste management system. Furthermore, the social impact of energy management is not considered.

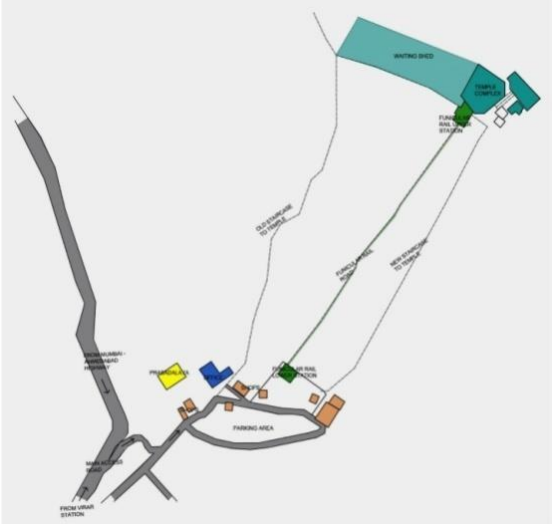


Figure 1: Jivdani Temple Complex Plan: Author

2. LITERATURE REVIEW

2.1 Pilgrim Tourism

Pilgrimage tourism has arisen as a tool for creating jobs, fighting poverty, and promoting long-term human development. Pilgrimage tourism fosters global understanding and supports local handicrafts and cultural activities. It is a major element of the country's economy, particularly in terms of foreign exchange profits, additional income generation, and employment generation.

The Indian tourism department used to focus primarily on recreational and business categories, but they've been trying to focus on the sustainable development of pilgrimage tourism.

Primary tier temples like golden temple of Amritsar, Tirupati Balaji temple, lotus temple are the examples of governments initiative to develop pilgrim places in sustainable method so that social, economic as well as environmental gain can be achieved. Second tier temples are not under government authority but the footfall of devotees is increasing at same rate. Shirdi Sai Baba temple in Maharashtra, for example, is under private administration, yet they have managed to develop sustainable and integrated methods of energy management to accommodate the temple's increasing energy consumption.

Private authorities, NGOs, as well as government of India should come forward to help these temples to become more independent and sustainably efficient so, they can easily incorporate increasing population and reduce exhaustion of resources.

2.2 Energy Management

The term "energy management" would not have existed if it hadn't been for the global need to save energy. We must conserve energy globally in order to reduce the harm we are causing to our planet and to reduce our reliance on fossil fuels, which are becoming increasingly scarce.

Energy is essential to economic development. The majority of energy produced in India is derived from traditional fuels such as coal, oil, and gas. The resources are non-renewable and harmful to the environment.

To sustain economic growth and reduce poverty, developing countries must make significant investments in their power sectors.

The Indian government is taking steps to promote renewable energy generation systems by subsidising solar panels, enacting rules and regulations to reduce energy consumption, and establishing organisations such as the Bureau of Energy Efficiency (BEE).

Energy management is the process of monitoring, managing, and conserving energy in a building or organization when it comes to energy savings.

For this project ISO standard are taken into consideration to accomplish the following goals:

- Establish a baseline for energy consumption and improve data on energy consumption.
- Management that is active
- Reduce the environmental footprint.
- Constantly increasing the intensity of energy
- Set aside funds for internal and possibly external use.

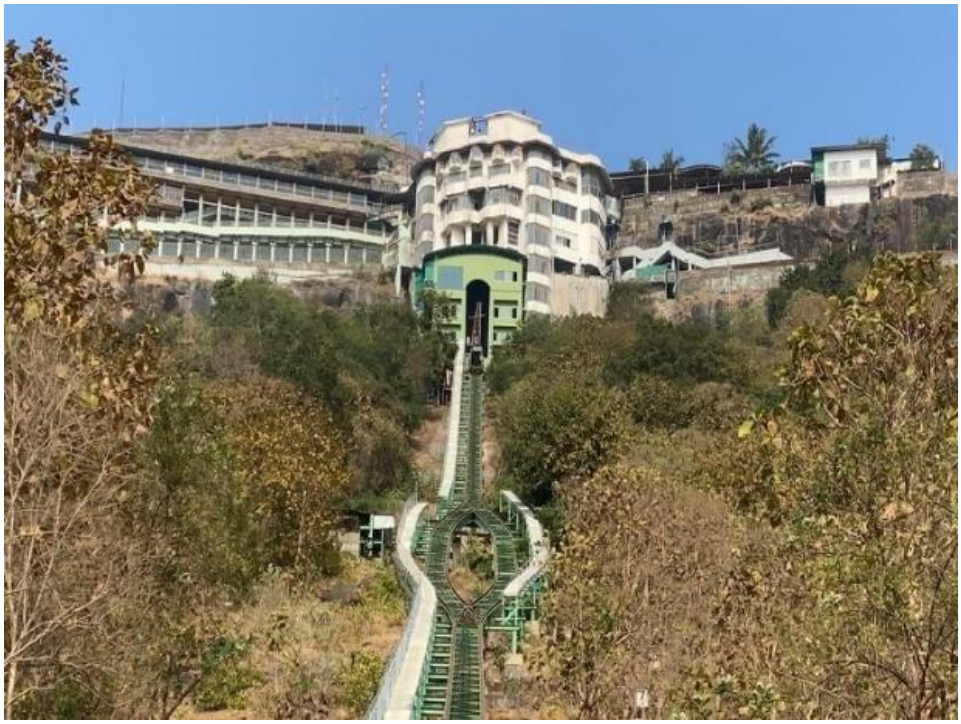


Figure 2: Jivdani Temple: Google Image

3. ABOUT JIVDANI TEMPLE

The temple of Jivdani Mata is located on a hill nearly 222 metres above sea level, 1465 steps above the ground on a hill that is part of the Satpura range in Virar.

Jivdani translates as Goddess of Life. She is an incarnation of the Goddess Adi Shakti. Jivdani temple is more than 150 years old. Goddess Jivdani is a Kuldevi of Mangayle, Koli and Bhandari community. The temple houses a beautiful white marble idol of Goddess Jivdani. There is also a temple consecrated to Lord Krishna.

On top of the hill, the main structure is a G+7 storey building with a built-up area of 5000 sq.m and ancillary functions such as the administration office, Prasadalaya, and the newly proposed Funicular rail stations at the bottom of the hill.

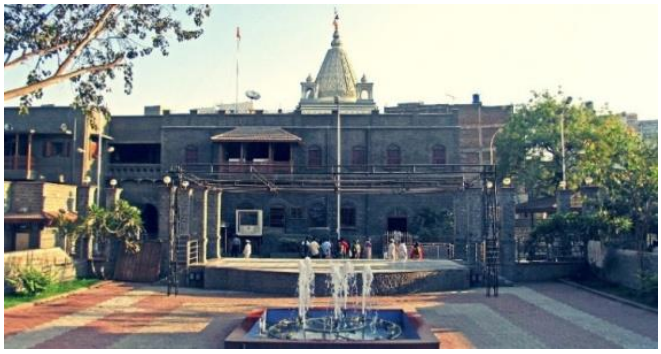


Figure 3: Parabolic Concentrators Solar Panels, Shirdi Temple: Google Image

4. CASE STUDY

4.1 Shirdi Sai Sansthan, Shirdi

Shirdi, a small town in Ahmednagar Dist. of Maharashtra boasts of owning this famous temple where almost 30000 devotees visit daily. The temple has one of the largest kitchens in India and the largest cooking systems in the world, which caters to the food needs of the devotees at subsidized rates.

Figure 4: Shirdi Sai Baba Temple, Shirdi: Google Image

Aside from blessing devotees, the temple also practises environmental responsibility by employing solar cooking systems. It is also looking into innovative ways to reduce its overhead costs, such as installing solar water heaters in its Dharmashalas/dormitories, where devotees take shelter.

They have also switched to solar street lighting in their pumping complex, significantly lowering the temple's fuel and electricity costs.

Shirdi's solar steam cooking system consists of 73 parabolic concentrators/dishes (Scheffler dishes) mounted on the roof of the Sai Prasadalaya Building. Scheffler reflectors can successfully heat water by utilising the non-uniform distribution of solar energy on the cylindrical absorber surface. The portion or cylindrical absorber in most of these systems is thermally insulated to reduce heat losses in the storage tank.

All 73 dishes rotate in unison with the movement of the sun, focusing solar rays on the receivers at all times. Tracking refers to the continuous movement of concentrators, which is controlled by a fully automatic timed mechanism. Only once a day, in the early morning, do the dishes need to be manually turned back to their original position before the automatic tracking takes over.

The solar cooking system is intended to generate approximately 3500 kg of steam per day at 180° (and 9 bars), enough to cook meals for over 20,000 devotees. The total cost of the system is estimated to be around 133 lakhs. The temple contributed 71.67 lakhs to the overall cost, with the Union Ministry of Non-Conventional Energy Sources providing the

remaining 58.4 lakhs as a subsidy. Foreign organisations have also provided a carbon credit subsidy of 2.94 lakhs to the project. The most significant savings are approximately 263 kg/day (LPG), which adds up to 29 lakhs/year, with a payback period of 2 to 4 years and a life span of 25 years. It also helps to reduce pollution by preventing the emission of approximately 2000 metric tonnes of CO per year.

Initially, steam produced by gas-fired boilers provided the energy for cooking at the Sansthan. The Sansthan set the following goals:

- The use of solar energy reduces LPG gas consumption by 50%.
- Solar energy that is clean and renewable is used for environmental protection, conservation, and rejuvenation.
- Popularize and encourage the use of solar energy.
- Energy Audit for the Jivdani Temple

Table 1: Energy Consumption Pattern of Jivadani Temple

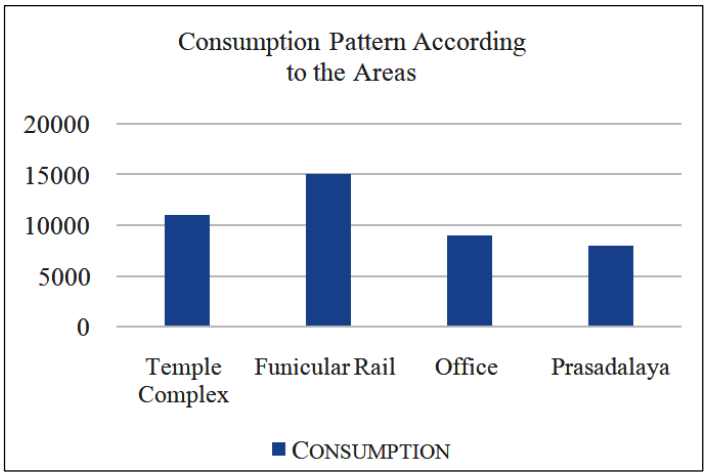
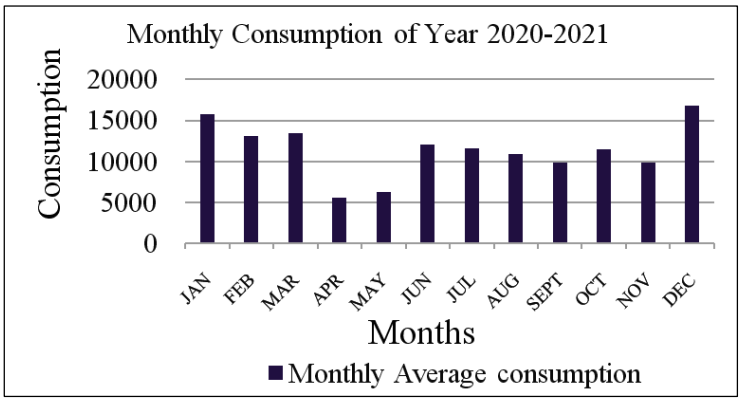


Table 2: Monthly Consumption of Energy at Jivdani Temple



5. CONSUMPTION PATTERN

According to an energy audit, the funicular rail station and roadway consume the most energy. Huge equipment and heavy load motors and backup system for funicular rail require huge energy supply which is about 35%.

Temple complex which is on top of the hill consist of G+7 story building and other amenities around the building such as 2 temples, bird cage, staff canteen, etc. which consumes around 25% of total consumption of project.

Office and prasadalaya respectively consume 21%, 19% of the total project consumption.

Power Cuts: Virar – Vasai municipal corporation faces load shading/ power cuts on Friday.

5.1 Monthly Consumption:

Due to lockdown in 2021 April and May consumption of those month is considerably very less.

All other months show almost same consumption pattern as most consumption is occurred due to lighting and heavy regularly used machinery and motors. Such as funicular rail motors and prasadalaya kitchen equipment.

6. ISSUES AND OBSERVATION

- Electronic appliances (computers, printers, and so on) are still turned on even when they are not in use.
- Appliances in STANBY MODE use a lot of power even when they aren't doing anything.
- Faulty light fittings that are left without a bulb, as well as faulty bulbs, consume energy.
- It has been discovered that there are numerous unnecessary lights in a single room.
- There are too many lights assigned to a single switch.
- When the lights are turned on, the ballast of a faulty light will draw power even though it is not working.
- The brand and model are not consistent throughout the building, which makes maintenance costly. The windows and doors of the air-conditioned rooms are not properly sealed.
- Most office equipment is typically left on after working hours without being turned off, consuming electricity as Vampire loads.
- When connected to a power outlet, electronic appliances (computer, printer, etc.) remain turned on even though they are turned off.

7. SITE LEVEL ISSUES

- 1 of 2 staircase to temple are not is used at night. But still all street lights on that staircase are ON.
- Funicular rail road is shut at night still upper station and rail road are lit up.
- Parking light are not shut till late in the morning as it is done manually.
- Too much lighting is provided in some areas and not intersecting lighting are creating some dark zones on the site.

7.1 Energy Management Issues

- There is no present system established in campus for energy management.
- Energy loss is not observed by operators.
- Single metering system restrict us to gain detail information about individual consumption of the equipment in the different buildings and spaces.

8. RECOMMENDATION AND GUIDELINES FOR ENERGY MANAGEMENT

8.1 Short Term Energy Management Recommendation

- Implement energy-saving measures. When not in use, isolate or unplug equipment from power.
- Remove faulty light holders and bulbs or remove live wire from socket inside the light holder.
- Remove any faulty appliances located in the building.
- Isolate or unplug faulty air conditioners if found within the building (working but no cold air coming out) and, OR service the air conditioner units quarterly.

8.2 Long Term Energy Management Recommendation

- Form an Energy Efficiency and Conservation steering committee to take the lead on the project's EE and C in the long run.
- Renovate or improve lighting control, for example, by adding more switches to existing rooms/spaces where only one switch controls more than ten lights, particularly the lights in the conference/meeting room.
- Replace all lights with energy efficient light bulbs such as LEDs.

- Replace old existing out-door air conditioner units with efficient ones.
- Use fans in places where possible rather than Air conditioner.

9. Guidelines for Energy Management

- The existing Energy Management system on site includes monthly electricity meter readings, and energy consumption monitoring.
- The current energy cost, which is significantly lower than the original, only necessitates a simple energy management programmed to ensure effective monitoring of energy consumption and cost.
- Start taking weekly meter readings to ensure that any anomalies, if any exist, are identified early on, eliminating the possibility of the source of energy waste being left unattended for an extended period of time.
- Distribute weekly energy consumption and specific energy consumption information to all critical departments.
- Appoint someone to be in charge of energy issues on the job site. Prioritize the implementation of the measures proposed in this report.
- Proposal for Energy Management.

10. Solar Energy Proposal

- Currently project has 187 kw of solar panel at site. which generates around 21% of total energy required by project.
- This panels are on roof top of temple complex, office and prasadalaya.
- As energy consumption rises due to increased footfall, the project suffers from the need to generate more energy and, as a result, ends up with a hefty energy bill that has a financial impact on the temple.
- To increase generation of solar energy at site to reduce financial pressure from project and more importantly to use more clean and renewable energy so that we help reducing environmental impact.

11. Propose Location of Solar Panels

- The new staircase constructed from right hand side of the mountain is ideal for solar panel.
- It receives the most sunlight throughout the day because it is on the south side, and the sloping terrain and lack of vegetation around the site make it more suitable for uninterrupted radiation.
- The staircase is approximately 350 m long with nearly 1800 sq.m of surface area to install solar panels capable of producing approximately 360 kw of energy. As a result, total existing and proposed energy generation accounts for 75% of total consumption.

Proposed solar panel installation on site

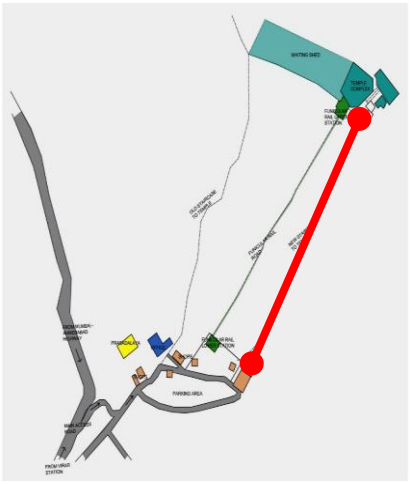


Figure 5: Proposed Location Google Maps Image

12. CONCLUSION

The future is in energy efficiency. The world is rapidly moving toward energy sustainability. Governments, private authorities, environmental organizations, and non-governmental organizations (NGOs) are promoting sustainable and integrated energy management methods and practices. New rules, regulations, and benefits are being implemented to maximize sustainable energy management systems in order to help reduce global warming and the depletion of renewable resources such as coal, fossil fuels, etc. by government.

The main exceptions of this project were to build on the project's current energy consumption, analyze it, and further increase the project's energy efficiency.

The project's focal point was reducing energy consumption and costs in order to gain both environmental and financial benefits.

A thorough walk-through energy audit was performed to collect data on consumption patterns, usage, and any energy management systems that were present. The findings of the audited data show that the loss of electricity due to negligence is significant, and as the temple authorities transition from traditional methods to more sustainable methods to improve the entire temple complex, they are unable to utilize the sources present on site.

After investigating energy sources and opportunities to make campus more energy efficient, a proposal for solar panels was made, along with short term and long-term energy management plan.

As a result of the solar proposal total existing and proposed energy generation accounts for 75% of total consumption.

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The Development and Prospects of Agricultural Waste Used as Insulation Material

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ABSTRACT: Agriculture is an important sector in India. On an average about 70% of the households and 10% of the urban population is dependent on agriculture as their source of livelihood. Because of these agricultural operations number of agricultural wastes is produced. It includes manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run- off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields. India generates about 350 million tonnes of agricultural waste every year. These agricultural wastes are indiscriminately dumped or burnt in public places, thereby resulting in the generation of air pollution, soil contamination, a harmful gas, smoke and dust and the residue may be channeled into a water source thereby polluting the water and aquatic. In addition to being potentially damaging to the environment, agricultural waste may expose workers to harmful biological material (biohazards). Storing agricultural waste can multiply the hazards associated with it since stored waste can release harmful gases. We can use these agricultural wastes in different applications. One of the applications is we can use these wastes as a thermal insulation. The research focuses investigate prospects of agricultural waste as insulation material mainly straw bale and sugar bagasse. Study Includes thermal properties of these wastes. A survey on availability and production of these waste material in the study area. It also focuses on study of climate data for Pune city and investigation of thermal properties of straw bale and sugar bagasse. Study concludes with the investigation of thermal properties of straw bale and sugar bagasse with the help of pilot model.

Keywords: *Agricultural Waste, Straw Bale, Sugar Bagasse, Sugar Bagasse Bricks, Pilot Model, Thermal Insulation.*

1. INTRODUCTION AND BACKGROUND OF STUDY

1.1 Agricultural Waste

Agricultural waste is waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run- off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields.

India generates about 350 million tonnes of agricultural waste every year.

1.2 Effect of Agricultural Waste

In our country, agricultural solid wastes are indiscriminately dumped or burnt in public places, thereby resulting in the generation of air pollution, soil contamination, a harmful gas, smoke and dust and the residue may be channeled into a water source thereby polluting the water and aquatic. In addition to being potentially damaging to the environment, agricultural waste may expose workers to harmful biological material (biohazards).Storing agricultural waste can multiply the hazards associated with it since stored waste can release harmful gases.

Therefore, utilization and management of agricultural waste is important. These agricultural wastes used in various applications. Therefore, in this research we need to analyse how to do treatment for this waste and how to use this waste indifferent applications.

One of the applications is thermal insulation material. (htt1)

1.3 Thermal Insulation Material

Thermal insulation is the method of insulating the material from transferring heat between the materials that are in the thermal contact. Thermal insulation is measured by its thermal conductivity. Low thermal-conductive materials are used for thermal insulation. Also, thermal conductivity, density and heat capacity are also important factors and properties of thermal

insulating materials. Thermal insulation is used to heat transfer through conduction which required objects to be direct contact with another. Some of the types of insulation utilize reflective coating to prevent heat transfer through radiation.

Properties of thermal insulation material:

- Density
- Specific heat capacity
- Thickness
- Thermal bridging

1.4 Agricultural Waste Used as Thermal Insulation Material

Agricultural materials/waste used in different applications. These agricultural material/waste widely used in building construction. These material/waste used as thermal insulating material in building construction. The three main qualities of a thermal insulation material derived from agricultural waste are resource availability, physical properties and environmental impact.

There are many agricultural wastes used as thermal insulation material for building designing purpose. In this research we mainly study following material.

- Straw bale
- Sugar bagasse

Aim

To investigate feasibility of agricultural waste as insulation material mainly straw bale and sugar bagasse.

Objectives

- To review agricultural waste suitable for thermal insulation.
- To locate the availability of these agricultural waste in our study area.
- To understand the utilization and management of agricultural waste.
- To evaluate the thermal performance of agricultural waste namely sugar bagasse and straw bale with the help of pilot model.
- To observe and compare this agricultural waste material to other non-agricultural waste material in context to heat gain.

Scope

A study will focus on agricultural waste like straw bale and sugar bagasse and investigate the prospects of these waste used as thermal insulation material. Also, the study will focus on strength, durability and thermal conductivity of these agricultural waste material. Research area is Pune and climatical condition is composite. Readings of pilot model taking in October and December months.

Limitations of the Study

In this research we mainly study only two agricultural wastes. The study does not focus on fruits, vegetables, meat, poultry and dairy products waste material.

Also, we are not study cold and cloudy, hot and dry, cold and sunny, moderate climatic conditions.

Readings were recorded for October and December months. The study is limited to climate of Pune.

2. LITERATURE REVIEW

2.1 About Agricultural Waste

Agricultural wastes are defined as the residues from the growing and processing of raw agricultural products such as fruits, vegetables, meat, poultry, dairy products, and crops. They are the non-product outputs of production and processing of agricultural products that may contain material that can benefit man but whose economic values are less than the cost of

collection, transportation, and processing for beneficial use. Their composition will depend on the system and type of agricultural activities and they can be in the form of liquids, slurries, or solids. Agricultural waste otherwise called agro-waste is comprised of animal waste (manure, animal carcasses), food processing waste (only 20% of maize is canned and 80% is waste), crop waste (corn stalks, sugarcane bagasse, drops and culls from fruits and vegetables, pruning's) and hazardous and toxic agricultural waste (pesticides, insecticides and herbicides, etc). Estimates of agricultural waste arising are rare, but they are generally thought of as contributing a significant proportion of the total waste matter in the developed world. (Obi & B. O. Ugwuishiwu, 2016). These agricultural materials/waste used in different applications. These agricultural material/waste widely used in building construction. These material/waste used as thermal insulating material in building construction. The three key qualities of a thermal insulation material derived from agricultural waste are resource availability, physical properties and environmental impact.

2.2 Importance of Thermal Insulation in Building Envelopes

Volatile and increasing energy prices, concern over environmental impact, and occupant health and comfort – these are the drivers of green building today. In fact, these trends have become of paramount importance for commercial, institutional and residential building owners. Thermal insulation in buildings is an important but largely ignored factor to achieving thermal comfort for its occupants. Insulation reduces unwanted and expensive heat gain or loss and can decrease the energy demands of cooling and heating systems. Different types of insulating materials in use today include rigid polyurethane foam, polyurethane spray, expanded and extruded polystyrene foams, glass wool; rock wool etc. Thermal insulation also involves a range of designs and techniques to address the main modes of heat transfer: conduction, radiation, convection and evaporation, condensation.

2.3 About Agricultural Waste Material

The spread of eco-architecture is getting intensive nowadays because of environmental and economic reasons. A new era started with the birth of sustainable architecture that resulted in renewable energy utilization and use of eco building materials. This is why thermal insulation of buildings has become especially important in the 21st century. Eco building materials are also very popular today.

There are many agricultural materials/wastes used as thermal insulating materials.
There are many agricultural materials/wastes used as thermal insulating materials.
Mainly used two agricultural waste materials is straw bale and sugarcane bagasse.

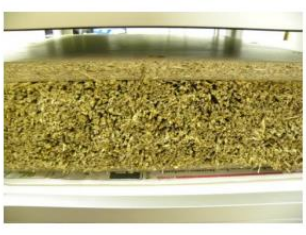
2.4 Straw Bale

Straw is an agricultural by product consisting of the dry stalks of cereal plants after the grain and chaff have been removed. straw is a traditional material. It makes up half of the yield of cereal crops such as barley, oats, rice and wheat. Straw is usually gathered and stored in a straw bale. It has a number of different uses. Straw bale is widely used in India for construction. In many parts of the world straw is used to bind clay and concrete. A mixture of clay and straw known as cob, can be used as a building material. (Vejeliene, Albinas Gailius, & Giedrius Balciunas, 2011)

To check the thermal conductivity for the given material they done some tests.

2.5 Straw Bale Test

1. For thermal conductivity made from straw bale.
2. For thermal conductivity made from straw roll.

3. For thermal conductivity made from perpendicularly oriented straw to the heat flow.
4. For thermal conductivity made from chopped straw.
   (Vejeliene, Albinas Gailius, & Giedrius Balciunas, 2011)

2.6 Sugarcane Bagasse

Sugar is one of the main substrates of human diet. The five top sugar producing countries in the world are India, Brazil, Thailand, Australia and China. Their production accounts for 40% of the total global sugar production out of the 115 countries producing sugar in the world, out of these countries, 67 produce sugar from sugarcane, 39 from sugar beet and 9 countries from both cane and beet. Thus, 70% of the sugar is produced from sugarcane and 30% from sugar beet and cassava Sugarcane is considered to act as a solar cell, converting solar energy to chemical energy. In 2009-10, it was estimated that 1683 million tons of sugarcane was planted worldwide, amounting approximately to 22.4% of the total world agricultural production.

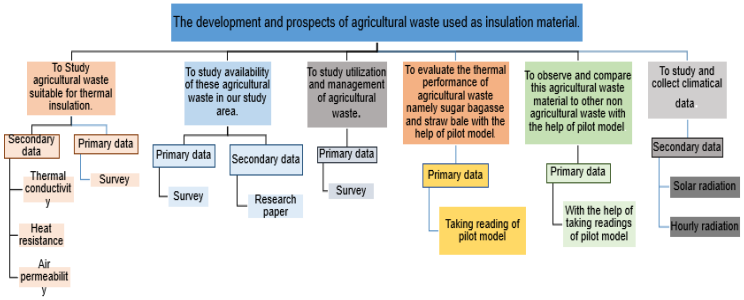
Sugar production depended mainly on sugar cane until 1981 when sugar beet was introduced to cover the increasing local demand for sugar. Sugarcane bagasse are also used as thermal insulating material in building construction. Sugarcane bagasse are used in production of insulating fired clay brick. (Ali.M. Hassan & M.F. Abadir, 2018)

2.7 About Pilot Model

Evaluate the thermal performance of waste with the help of pilot model:

- Experimental set up for the urban living lab and text cubes.
- Building process for the different roof solutions.
- Monitoring process.
- Comparative analysis for insulation performance and cost. (ZACHARIA)

3. METHODOLOGY



4. RESULT AND DISCUSSION

4.1 Readings

In this research we took readings of October and December month readings.

October and December are the winter months but in October month there is high solar radiations. Actually, winter season start in November and after mid-November. Therefore, there is no cold climate in October. Therefore, we take reading of October month as a base case 1 for high solar radiations.

In December climate is cold therefore we taking readings of December month as case 2 for cold climate.

And then we compare the readings of these two months with respect to agricultural waste material.
October – for high solar radiation
December – for cold climate.
About Comparison

Part 1 (for roof) –

Compare agricultural waste material to non-agricultural waste material (coba).
For part 1 the material is – sugarcane bagasse ash, straw bale, coba.

Part 2 (for wall)

The study compares sugar bagasse bricks to non-agricultural waste material (normal bricks).

October Reading
Taking Reading at 8:00 AM–12:00 PM–4:00 PM

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Date	Material	8:00 AM	12:00 PM	4:00 PM
16/12/2021		Roof	Roof	Roof
	Straw bale	26°	34°	30°
	Without material	24°	32°	32°
		wall	wall	wall
	Sugar bagasse bricks	27°	38°	30°
	Without material	25°	36°	32°
17/12/2021		Roof	Roof	Roof
	Straw bale	24°	40°	30°
	Without material	21°	36°	32°
		Wall	Wall	Wall
	Sugar bagasse bricks	26°	45°	39°
	Without material	24°	42°	40°
18/12/2021		Roof	Roof	Roof
	Straw bale	22°	38°	30°
	Without material	19°	35°	33°
		Wall	Wall	Wall
	Sugar bagasse bricks	30°	47°	41°
	Without material	29°	44°	44°
19/12/2021		Roof	Wall	Wall
	Straw bale	23°	38°	36°
	Without material	20°	35°	38°
		Wall	Wall	Wall
	Sugar bagasse bricks	32°	45°	42°
	Without material	30°	42°	44°
20/12/2021		Roof	Roof	Roof
	Straw bale	24°	38°	30°
	Without material	21°	36°	32°
		Wall	Wall	Wall
	Sugar bagasse bricks	34°	40°	34°
	Without material	31°	37°	37°
21/12/2021		Roof	Roof	Roof
	Straw bale	32°	45°	35°
	Without material	29°	41°	38°
		Wall	Wall	Wall
	Sugar bagasse bricks	32°	47°	36°
	Without material	30°	45°	38°
22/12/2021		Roof	Roof	Roof
	Straw bale	33°	44°	30°
	Without material	29°	42°	33°
		Wall	Wall	Wall
	Sugar bagasse bricks	34°	47°	35°
	Without material	31°	44°	37°
23/12/2021		Roof	Roof	Roof
	Straw bale	22°	38°	35°
	Without material	19°	36°	38°
		Wall	Wall	Wall
	Sugar bagasse bricks	32°	40°	36°
	Without material	30°	37°	34°
24/12/2021		Roof	Roof	Roof
	Straw bale	25°	39°	36°
	Without material	23°	36°	38°
		Wall	Wall	Wall
	Sugar bagasse bricks	27°	39°	41°
	Sugar bagasse	25°	37°	38°
25/12/2021				
	Straw bale	27°	42°	34°
	Without material	30°	40°	36°
	Sugar bagasse bricks	30°	44°	36°
	Without material	28°	42°	35°

Date	Material	8:00 AM		12:00 PM		4:00 PM	
		Roof	Flooring	Roof	Flooring	Roof	Flooring
26/10/2021	Straw bale	28°	24°	36°	30°	30°	29°
	Sugar bagasse	30°	26°	43°	33°	32°	31°
	Without material	32°		49°		32°	
27/10/2021	Straw bale	27°	25°	34°	29°	28°	27°
	Sugar bagasse	31°	27°	42°	30°	30°	29°
	Without material	34°		47°		31°	
28/10/2021	Straw bale	29°	25°	38°	31°	31°	29°
	Sugar bagasse	31°	27°	45°	32°	33°	31°
	Without material	33°		50°		35°	
29/10/2021	Straw bale	29°	25°	34°	31°	30°	26°
	Sugar bagasse	30°	28°	41°	33°	32°	28°
	Without material	32°		48°		34°	
30/10/2021	Straw bale	29°	26°	34°	31°	30°	27°
	Sugar bagasse	30°	28°	40°	33°	31°	29°
	Without material	32°		47°		33°	
31/10/2021	Straw bale	27°	25°	35°	29°	28°	27°
	Sugar bagasse	30°	26°	38°	30°	29°	28°
	Without material	28°		38°		31°	
01/11/2021	Straw bale	28°	26°	34°	28°	28°	27°
	Sugar bagasse	30°	26°	37°	30°	29°	28°
	Without material	32°		39°		31°	
02/11/2021	Straw bale	29°	26°	36°	30°	30°	28°
	Sugar bagasse	31°	28°	39°	34°	32°	30°
	Without material	33°		42°		32°	
03/11/2021	Straw bale	27°	25°	39°	28°	29°	27°
	Sugar bagasse	30°	26°	42°	30°	30°	28°
	Without material	29°		44°		32°	
04/11/2021	Straw bale	27°	25°	35°	29°	28°	27°
	Sugar bagasse	30°	26°	38°	30°	29°	28°
	Without material	32°		39°		31°	
05/11/2021	Straw bale	24°	23°	33°	27°	30°	29°
	Sugar bagasse	25°	24°	27°	29	32°	29°
	Without material	26°		38°		34°	
06/11/2021	Straw bale	26°	23°	30°	26°	27°	26°
	Sugar bagasse	27°	23°	34°	25°	31°	28°
	Without material	30°		36°		35°	
07/11/2021	Straw bale	30°	24°	32°	23°	31°	27°
	Sugar bagasse	32°	25°	49°	29°	35°	28°
	Without material	27°		41°		34°	
08/11/2021	Straw bale	30°	22°	33°	26°	30°	27°
	Sugar bagasse	31°	22°	46°	28°	36°	28°
	Without material	23°		40°		35°	

5. ANALYSIS

After taking readings of agricultural waste material pilot model and non-agricultural material. It is clearly seen that thermal conductivity of agricultural waste model is better than non-agricultural waste material.

For October (high radiation):

In October due to high solar radiation.

Straw bale and sugar bagasse ash receives less radiations compare to concrete(coba). Straw bale receives radiations up to 39°Cwhich is low and concrete receives up to 50°C at different time intervals which is high.

Sugar bagasse ash receives radiation up to 46°C which is low and concrete receives up to 50°C at different time intervals which is high.

In December (cold climate):

Straw bale and sugar bagasse bricks receives more radiations compare to concrete and normal bricks (after processing).

Straw bale receives radiation up to 45°Cwhich is high and concrete receives 38°C at different time intervals which is low.

Sugar bagasse bricks receives up to 47°C which is high and normal bricks (after processing) receives 44°C at different time interval which is low.

After taking readings we clearly seen that both the straw bale and sugar bagasse are work as thermal insulation in both hot and cold climates.

Also seen that sugar bagasse ash are not technically directly placed on building as thermal insulation material.

6. CONCLUSION

Straw bales and sugar bagasse are a natural material (agricultural waste material) unlike many manufactured building products. They do not contain any toxic ingredients. They are environment friendly. Importance of thermal insulation in building is very important. Sustainable materials and sustainable building techniques are important aspects to how the building industry can contribute towards creating a sustainable society for generations to come.

The pilot model made of sugar cane bagasse and straw bale presented thermal behaviour compatible with its characteristics of low density and thermal conductivity.

After taking readings we clearly seen that both the straw bale and sugar bagasse are work as thermal insulation in both hot and cold climates.

There is prospect that we can use this material as thermal insulation material.

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ANNEXURES

- ***Agricultural Waste:*** Agricultural waste is waste produced as a result of various agricultural operations. It includes manure and other wastes from farms, poultry houses and slaughterhouses; harvest waste; fertilizer run- off from fields; pesticides that enter into water, air or soils; and salt and silt drained from fields.
- **Thermal Insulation:** Thermal insulation is the process of insulating material from transferring heat between the materials that are in thermal contact. Thermal insulation is measured by its thermal conductivity. (corrosionpedia, n.d.)
- ***Straw Bale:*** Straw bales are made from the stalks of cereal grain crops. It's the material left over after the grain has been harvested.
- ***Sugar Bagasse:*** Bagasse is another by-product of the sugar production process. It is a dry and pulpy residue left behind when sugarcane stalks are crushed.(science direct, n.d.)
- ***Sugar Bagasse Bricks:*** Application of bio-fuel by-product sugarcane bagasse ash (SBA) as a principal raw material for the manufacturing of bricks was studied. The bricks were developed using the quarry dust (QD) as a replacement to natural river sand and lime (L) as a binder. (Mangesh V. Madurwar, Use of sugarcane bagasse ash as brick material, 2014).
- ***Temperature:*** Temperature is the measure of hotness or coldness expressed in terms of any of several scales, including Fahrenheit and Celsius. Temperature indicates the direction in which heat energy will spontaneously flow.
- ***Pilot Model:*** An early production model of a product used to debug the manufacturing process.
- ***Infrared Thermometer:*** Infrared thermometers are temperature sensing devices that use electromagnetic radiation to make non-contact surface temperature readings. This allows for fast, touchless measurements from a safe distance. (instrumart, n.d.)

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Post Occupancy Evaluation of Green Certified Eco-resort

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ABSTRACT: A green certified eco-resort is designed with an aim, of achieving comfortable indoor environment quality, with reduced environmental impact. After an occupancy of few years, some changes are expected to happen, which needs to be measured and managed. Thus, the aim of the study was to evaluate SVA GRIHA rated eco-resort in terms of environmental quality, post occupancy. A theoretical base was developed by understanding, criteria under SVA GRIHA rating system; parameters affecting environment quality; adaptive comfort and post occupancy evaluation. For research conduction, a mixed methodology was adopted. The study was limited to evaluation of thermal and visual parameters affecting occupants comfort. On-site physical measurements were taken to diagnose Predicted Mean Vote and Predicted Percentage Dis-satisfaction. These values were compared with the occupant survey, focused group interviews and overall energy consumption. The research concluded that, post-occupancy the selected SVA-GRIHA rated eco-resort provide thermal and visual comfort with optimized environmental impact.

Keywords: *Post Occupancy Evaluation, Adaptive Comfort, Eco-resort, SVA GRIHA Rating System, Building Occupants Survey, Environmental Impact.*

1. INTRODUCTION

An eco-resort is a lodging facility that satisfies occupants needs without compromising environmental and social sustainability. (kitts, p. 6). The Grape County eco-resort, situated in Nashik City, Maharashtra State was launched in the year 2013 to offer its occupants with luxury and experience of nature. The resort was designed by Ar. Sanjay Patil and Ar. Shabbir Unwala. It is a SVA GRIHA 5 star rated structure. The total site area is 21,433 sq.m and built up area is 1475 sq.m. For Small Versatile Affordable Green Rating for Integrated Habitat Assessment (SVA GRIHA) certification, building meant for dining and banquet hall and two cottage structures had been considered. Special efforts were made to design and construct the structure to maintain sustainability, which includes designing strategies to avoid contour disturbance, optimized façade design to promote cross ventilation and uniform daylight distribution in regularly occupied spaces. After eight years of achieving green certification, some changes are expected to happen in operational measures as compared to the designed structure. Thus, there was a need to evaluate the changes done and gauge, if the retrofits are affecting occupant comfort.

The aim of the research was to evaluate a green certified eco-resort in terms of environmental parameters.

The study was focused on architecture and energy criteria of SVA GRIHA rating system. The scope of architectural boundary for the research covered reception, staffroom, waiting area, dining hall, kitchen and banquet hall of the resort premises. The study was limited to only thermal and visual parameters for environment quality analysis. Other limitations included availability of resources to carry out Post Occupancy Evaluation (POE).

To achieve the stated aim, research was divided into following objectives:

- To understand strategies applied in the selected resort design during certification, to attain thermal and visual comfort.
- To analyse status of the applied strategies, post occupancy.
- To evaluate occupants thermal and visual comfort.
- To analyse the results under subjective and objective parameters.

Hypothesis: A green certified building provides thermal and visual comfort to all occupants.

2. LITERATURE REVIEW

SVA GRIHA certification system is developed to evaluate environmental impact of small buildings with a built-up area of less than 2500 sq. m. (SVAGRIHA, 2011).Criteria for rating system include; Landscape; Architecture and energy; water and waste; Sustainable building material; Lifestyle.

3. POST OCCUPANCY EVALUATION

A post occupancy evaluation in architecture is the process of analysing how the building performs in terms of function and comfort after occupancy. The methods for POE can be classified in three different levels, starting from a quick, Surface review to a more in-depth Investigative analysis, to a Diagnostic review that correlates physical measures with occupant perceptions (HEFCE, 2006). The POE method used in this research was of a mixed type including, investigative and diagnostic review. The process of POE follows three distinct steps of planning, conducting and analysis.

Survey

Occupant surveys act as a valuable source of information to evaluate the performance of buildings. The different types of survey are; The Center for the Built Environment (CBE); The Building Use Studies (BUS). The survey captures all the possible complexities and highlight both good and less favourable building performance. The following process was followed to prepare survey questionnaire:

- Demarcating the best way to carry out survey. It had to be intent based.
- Data collection by distribution of the questionnaire amongst selected sample.
- Filling questionnaire comprising both quantitative and qualitative questions.
- Result: there are number of ways to represent it, using statistical tables, graphs, plots. Anonymised narrative comments should be reported.

Environmental parameters affecting occupants comfort:

Thermal comfort: ASHRAE defines thermal comfort as that condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation. (ANSI, 2020) It is stated that various external factors affecting heat gain in the given environment are air temperature, wind speed, humidity and solar radiation. Heat is generated by human due its metabolic activity and clothing.

Thermal comfort indices: Predicted Mean Vote (PMV) by Fanger: This method is an analytical method, which is carried out in laboratory.

Adaptive Comfort Model: This method considers occupants perception about comfort. Adaptations can be behavioural, physiological and psychological.

Center for the Built Environment (CBE) Thermal comfort tool: Launched as a free online tool for thermal comfort calculations and visualizations that complies with the ASHRAE 55–2017, ISO 7730:2005 and EN 16798–1:2019 Standards. The tool incorporates the major thermal comfort models, including the Predicted Mean Vote (PMV), Adaptive Model, Standard Effective Temperature (SET), local discomfort models, Solar Cal, and dynamic predictive clothing insulation. (Center For The Build Environment, 2019)

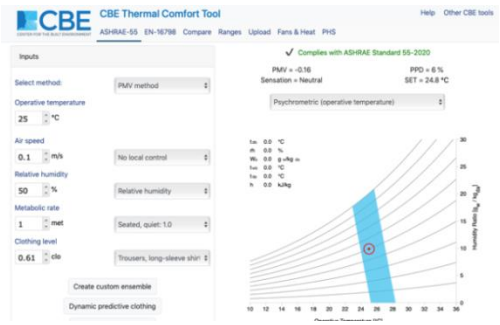


Figure 1: The CBE Thermal Comfort Tool

Visual Comfort

Visual comfort is defined through a set of criteria based on the level of light in a room. It depends on the physical structure of human eye, the source of light, distribution of light in space and geometry and finishes of the space. The parameters used for assessment of visual comfort are, quantity of light, uniformity of light, quality of light and illumination ratio.

Thermal Comfort and Energy Use

The thermal parameters change from time to time, it is difficult to achieve static ideal comfort condition throughout the occupancy period. Architectural design and passive design strategies help in achieving thermal comfort to some extent. But, due to extreme conditions, passive strategies may fail that leads to use of HVAC systems. These systems are energy dependent. Assessment by Bureau of Energy Efficiency in 2016, states that about 80 % of energy in commercial buildings is consumed by lighting and air conditioning.

Visual Comfort and Energy Use

To carry out the varied tasks by the occupants in a resort, appropriate illumination of spaces is essential. The natural daylight may be insufficient or may cause glare condition if the building is not oriented properly, for the specific function. Dining and kitchen spaces with late night operating schedules, have no daylight access post sun set. In these situations, the building spaces are majorly dependent on artificial light. Thus, leading to energy consumption.

The National Building Code of India 2005, specifies the different illumination requirement for different types of tasks and spaces.

Table 1: Required illumination Level

Space	***Required Illumination Level (LUX)***
Entrance corridor	50-100-150
Reception	300-500-750
Dining area	150-200-300
Kitchen Preparation area	300-500-750
Kitchen	200-300-500
Banquet hall	200-300-500
Staff room	150-200-300

Location of Measurement

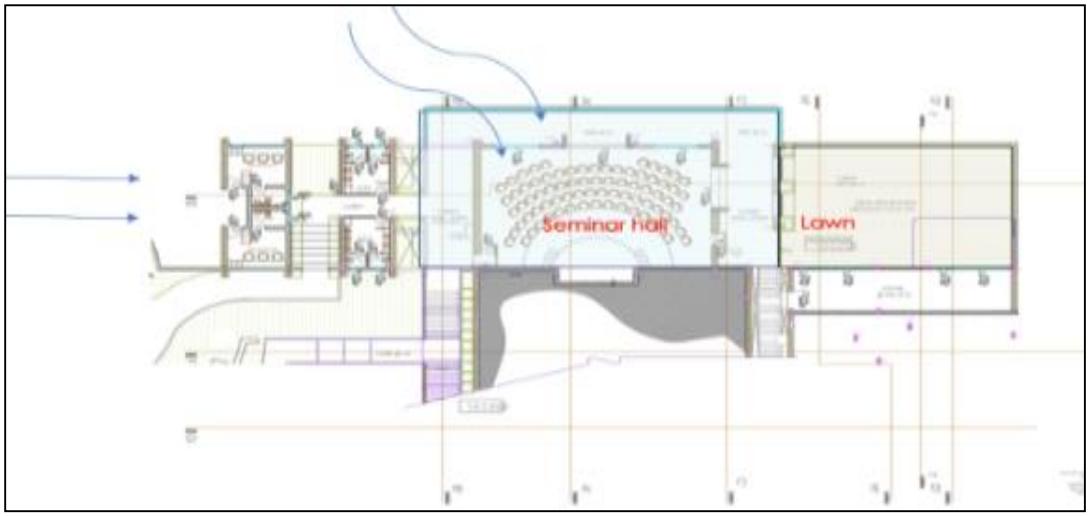


Figure 2: Basement Floor Plan of Grape County Resort, Nashik

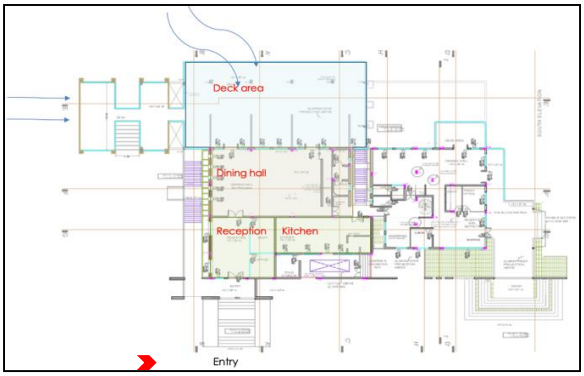


Figure 3: Ground floor plan of Grape County Resort, Nashik

Figure 4: Section HH' of Grape County Resort, Nashik

Data collected from the Indian meteorological department states that the temperature for the Nashik city is minimum in the month of December. Thus, the stated parameters were measured in December month at 15:00 hour and 22:00 hours. The location of measurements were decided according to the activity. The metabolic rate value was dependent on the type of work conducted by the individual. The CBE Thermal comfort tool specifies metabolic rate and clo value according to the requirement. Indoor Operative Temperature was calculated as (0.28 x outdoor temperature) + 17.87. (SVAGRIHA, 2011)

Lux level on the table and in ancillary area that is 1m away from task location were measured, to understand illumination ratio with the surrounding.

4. METHODOLOGY

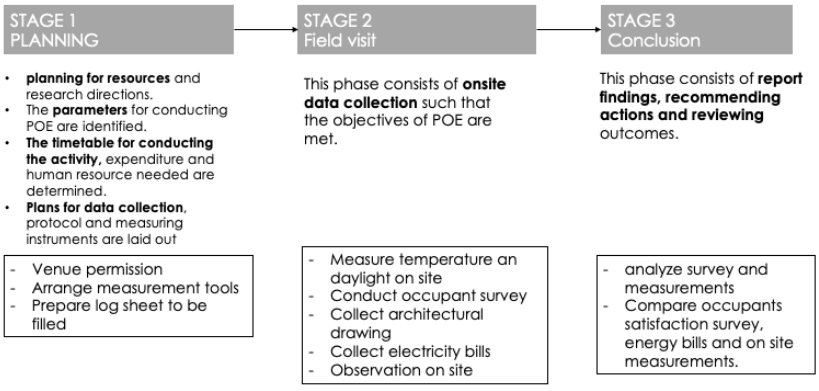


Figure 5: Methodology of Research

Planning: This phase included granting venue permission. The first walkthrough helped to understand the parameters for conducting POE. Further planning was done for resource management. A quick interview with the Architect helped to understand, insights of the project, aim and various strategies applied to attain occupants comfort. Interview with the

facility manager helped to understand peak and off-peak occupancy hours, which dictated the visit schedule for data collection. Instrument wise log sheets was prepared for entering the data.

Conducting: All the primary data and secondary data was collected. On site measurement of temperature of all sided walls were taken, from inside and outside, with the help of surface thermometer. Ambient temperature was measured in different rooms. Measurement of illumination, on table, in circulation area and serving table was done, with the help of lux meter. Air velocity was measured in indoor and outdoor areas, with the help of anemometer. Survey form was filled by the occupants simultaneously.

Applying: All the primary data (site measurement, interview, survey), and secondary data (energy consumption bills) was analysed to understand relationship between physical parameters, occupants comfort survey and energy consumption.

On Site Data Collection

Table 2: Measured Parameters for Thermal Comfort on Site

At 15:00 hrs										
Location	Measured			Calculated					Diagnosed	
	Ambient room Temperature	Relative humidity	Wind Velocity	Operative temperature	Metabolic rate	Activity	Clothing level	Attire	PMV	PPD
	°C	%	m/s	°C	Refer CBE Thermal Comfort Tool					
Reception	26.7	42%	0.02	25.35	1.1	Typing	0.61	Trouser, Long sleeve shirt	0.18	6%
Waiting area	26.7	42%	0.02	25.35	1	Seated and reading	0.61	Trouser, Long sleeve shirt	-0.05	5%
Staff room	24.16	47%	0.25	24.63	1.1	Typing	0.61	Trouser, Long sleeve shirt	-0.47	10%
Dining hall	25.05	56%	1.5	24.88	1	Seated and reading	1	Sweat pant and Long sleeve shirt	-0.45	9%
Kitchen	27.5	58%	1.9	25.57	1.8	Cooking	0.61	Trouser, Long sleeve shirt	-0.34	7%
Banquet hall	26.05	42%	0.03	25.16	1.7	walking	0.73	western formal with blazer	0.64	14%
Deck area	30.38	57%	1.62	30.38	1	Seated and reading	0.57	Trouser, short sleeve shirt	-0.22	6%
At 22:00 hrs										
Location	Measured			Calculated					Diagnosed	
	Ambient room Temperature	Relative humidity	Wind Velocity	Operative temperature	Metabolic rate	Activity	Clothing level	Attire	PMV	PPD
	°C	%	m/s	°C	Refer CBE Thermal Comfort Tool					
Reception	23.3	57%	0.15	24.39	1.1	Typing	0.61	Trouser, Long sleeve shirt	-0.23	6%
Waiting area	23.3	57%	0.15	24.39	1	Seated and reading	0.61	Trouser, Long sleeve shirt	-0.46	9%
Staff room	23.5	57%	0.08	24.45	1.1	Typing	0.61	Trouser, Long sleeve shirt	-0.03	5%
Dining hall	22.5	56%	1.7	24.17	1	Seated and reading	0.96	Winter wear	-0.35	8%
Kitchen	37.8	58%	2.8	28.45	1.8	Cooking	0.61	Trouser, Long sleeve shirt	0.32	7%
Banquet hall	21.1	55%	0.18	23.78	1.7	walking	0.73	western formal with blazer	0.47	10%
Deck area	20.6	55%	2.5	23.64	1	Seated and reading	0.96	winter wear	-0.92	23%

Table 3: Measured Parameters for Visual Comfort on Site

Location		At 15:00 hrs		At 22:00 hrs	
		Measured	Calculated	Measured	Calculated
		Illumination (Lux)	Illumination Ratio with	Illumination (Lux)	Illumination Ratio with surroundin
Reception	On table	335	1.40	238	1.61
Waiting area	Above seating	250		167	
	Passage area	239		148	
Staff room	Table	250	1.39	245	1.61
	Passage area	180		152	
Dining hall	On dining table	330	1.01	79	1.16
	Passage area	328		68	
	Buffet counter	215	0.66	49	0.72
	Display area	182	0.55	16	0.24
Kitchen	On kitchen platform	280	1.22	230	1.35
	Passage area	230		170	
Banquet	On floor	352	352.00	210	210.00
Deck area	On dining table	632	1.05	52	0.74
	Passage area	600		70	

The data for total energy consumption was collected for the year 2018.

Table 4: Energy Consumption for the Year 2018 by Grape County Resort, Nashik

ENERGY CONSUMPTION FOR THE YEAR 2018			
MONTH	UNITS	MONTH	UNITS
January	9406	July	13587
February	8572	August	12349
March	13603	September	14385
April	19381	October	11020
May	19895	November	8551
June	13050	December	9444
Total			153243
Total area in sq.m.			2413
EPI			63.51

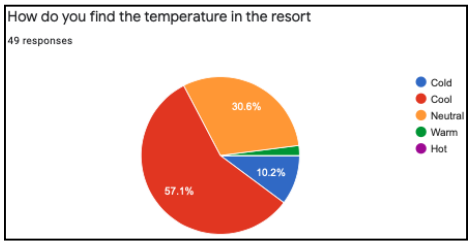
The annual energy consumption of the resort is 1,53,243 units (Kwh). It is observed that the maximum energy consumption occurs in the summer season that is from March to June and then declines further with least in January. In the resort, lighting remains constant annually. The only difference is in the use of ventilation systems. From the given data we can conclude that the maximum ventilation requirement for the resort is in the month of May, and starts declining in monsoon season. The energy consumption is least in January with 9406 units (Kwh) as the ambient temperature is least in January.

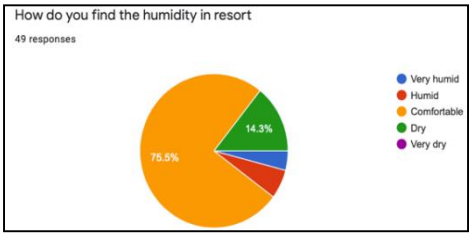
Occupants Satisfaction Survey

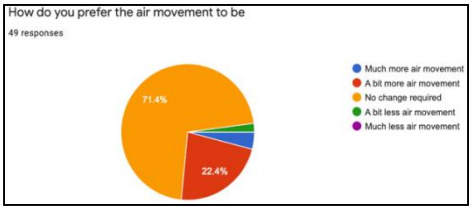
Sampling

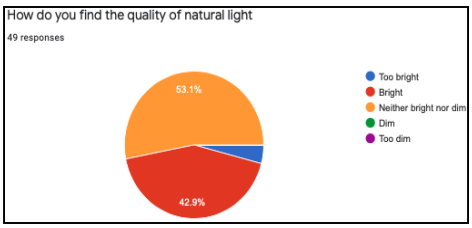
Random sampling was done for fifty guests who visited the resort. The survey was filled by people accommodated in indoor dining hall and outdoor deck area. The age group ranged from 20 years to 45 years. For other spaces like staff room, reception, waiting area, banquet hall and kitchen focused group interviews were taken

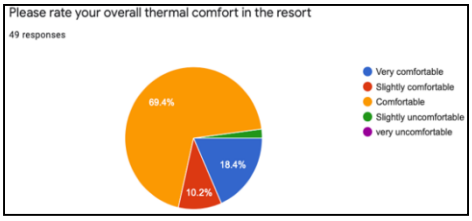
Thermal Comfort



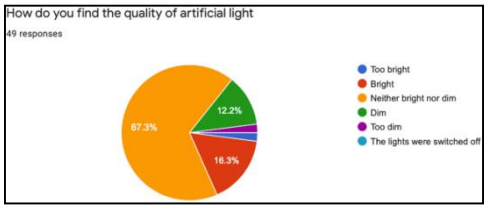


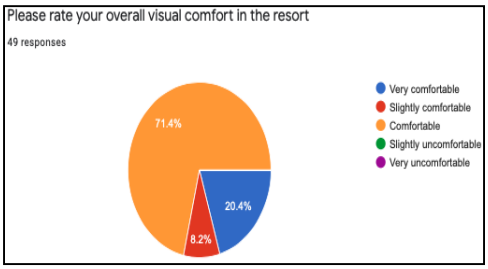






Visual Comfort:





Findings and Discussion

Thermal Parameter

Dining hall and Deck Area:

At 15:00 hours, the outdoor temperature reached up to 30.38°C with relative humidity of 57%. The diagnosed PMV value was -0.22 and PPD was 6%, stating to be the most comfortable situation for users.

The ambient temperature gauged for the indoor dining area was 25.05°C with relative humidity of 56%. The PMV was diagnosed to be -0.45 and percentage of dis-satisfaction was 9%. According to the survey it was observed that guests seated in the dining hall felt very comfortable.

At 22:00 hours, the outdoor temperature dropped to 20.6°C with relative humidity of 55%. The diagnosed PMV value was -0.92 and PPD was 23%, stating to be the condition to be un-comfortable for users.

The ambient temperature gauged for the indoor dining area was 22.5°C with relative humidity of 56%. The PMV was diagnosed to be -0.35 and percentage of dis-satisfaction was 8%. According to the survey it was observed that guests were comfortable seating in outdoor deck are as well as indoor dining hall.

Reception and waiting area:

At 15:00 hours, the ambient temperature in waiting and reception area was 26.7°C with relative humidity of 42%. The diagnosed PMV value was -0.05 and PPD value was 5% stating to be in comfort range.

At 22:00 hours, the ambient temperature in waiting and reception area waswas 23.3°C with relative humidity of 57%. The diagnosed PMV value was -0.46 and PPD value was 9% stating to be in comfort range.

Kitchen:

At 15:00 hours, the ambient temperature in the kitchen was 27.5°C with relative humidity to be 58%. The PMV was diagnosed to be -0.34 and percentage of dis-satisfaction was 7%.

At 22:00 hours, the ambient temperature in the kitchen was 37.8°C with relative humidity to be 58%. The PMV was diagnosed to be 0.32 and percentage of dis-satisfaction was 7%.

Visual parameters:

At 15:00 hours, the natural illumination levels in reception area, waiting area and indoor dining hall were nearly equal to the required illumination level.

At 22:00 hours, the artificial lights satisfied the requirements in reception area, waiting area and indoor dining hall.

The illumination level measured for the deck area was low in comparison to the required illumination levels.

According to the survey and interviews, it was observed that the 71% of the guests are comfortable and satisfied with the illumination level.

Due to lack of openings; the staffroom, kitchen and banquet hall are always illuminated with the help of artificial lights.

Analysis:

Thermal Parameters:

At 15:00 hours, according to diagnosis it was more comfortable in outdoor deck area. But, due to harsh solar radiation and thick clothing value (Sweat pant and long sleeves shirt), guests preferred to be seated indoors. In dining hall, due to thick thermal mall, the temperature dropped by 5°C. People with thick clothing felt very comfortable, whereas people wearing thin clothes (trouser with half sleeves shirt) felt a little uncomfortable.

At 22:00 hours, according to diagnosis, as compared to outdoor deck area the indoor area was within the comfort range. The same situation is observed in the survey results.

In the given space, the thermal comfort varied only due to variation in clothing factor and metabolic rate. From interviews with the working staff it was understood that they feel comfortable indoor as well as outdoor. This was mainly because, the metabolic rate was high for workers as compared to guests.

In waiting area and reception, the calculated PMV, PPD value and from focused group interviews it was understood that, the thermal condition were quite comfortable in the reception and waiting area, during monsoon and winter season.

In peak summer season, there is a need to use mechanical ventilation system. The air conditioning system in all the rooms are BEE 3 star rated.

The values diagnosed for kitchen area as well as from the interviews it was understood that kitchen area was thermally comfortable.

According to the chef, in kitchen, chimney and turbo ventilators worked efficiently for ventilation system. But there was a need to repair chimney after every 6-8 months.

Visual Parameters:

At 15:00 hours, the natural illumination level in the uncovered deck area was high. Thus, people preferred to be seated in shaded area or in dining hall. People seated near the large window side, felt the lighting levels to be bright.

At 22:00 hours, it was observed and measured that the illumination levels are low in the outdoor deck area. But, these levels helped to create a dim light restaurant ambience.

The survey, interview and observation states that in all the areas, artificial lights were switched on even during the daytime, in the presence of sufficient natural illumination.

5. CONCLUSION AND SUGGESTIONS

The aim of selected eco-resort in Nashik city is to optimize energy consumption and promote environmental sustainability. From the post occupancy evaluation, it was observed and gauged that the Grape County eco-resort attains thermal and visual comfort with efficient energy use. The major area of the resort premises is ventilated by passive systems, which leads to reduction in energy consumption for cooling and ventilation. From the on-field data collected, it is understood that, December month experiences minimum temperature at night. From survey it was perceived that, users felt slightly uncomfortable in outdoor areas and comfortable in an enclosed space. The major factor dictating the perceived comfort was the exterior skin design, occupancy rate and clothing insulation. The annual EPI benchmark stated by BEE for a 5 star hotel is 279 kw./sq.m/year. The EPI achieved by the selected resort is 63.51 kw/sq.m/year. To further reduce this energy consumption, it is suggested to switch off the artificial lights when the space is not in use or immense natural light is available to illuminate the space.

ACKNOWLEDGEMENT

I would like to express my gratitude to following individuals for their crucial role in the completion of my project. I am thankful to my mentor Ar. Madhura Deshpande, Assistant Professor, M.Arch (S.A). Also, I would like to thank Ar. Aditi Lanke, Associate Professor, M.Arch (S.A), for her valuable guidance and time to time reviews throughout the duration of the project.I would specially like to thank Mr. Kiran Chavhan (Owner of Grape County resort) and his staff members, for generous co-operation and prompt action during this project.

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Study and Analysis of Cost Effective Alternative Construction Systems

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ABSTRACT: Indian construction industry is one of the largest in terms of economic expenditure, volume of raw materials/natural resources consumed, volume of materials and products manufactured, employment generated and environmental impacts. The initial era of 20th century saw Portland cement with steel bringing ground-breaking changes in the construction practices. Although, it is difficult to meet the ever-growing demand for buildings by adopting traditional construction methods. This Research Intends to Study, Investigate and Analyse Cost-Effective Construction based on Alternative Building Construction Systems. The Outcome of this exploration would articulate us to comprehend about the Alternative Construction System and its Cost Effectiveness which will help us in long run to achieve a justifiable development with reference to demand of Mass Housing.

Keywords: *Alternative Construction Systems, Cost Effective Construction, BMTPC, Mass Housing, Housing for All, Alu Form, Tunnel Form.*

1. INTRODUCTION

Indian real estate market by 2040 will grow to Rs. 65,000 Crore from Rs. 12,000 Crore in 2019. Real estate sector in India was expected to reach Rs. 20,000 Crore in 2021 and contribute 13% to the country's GDP by 2025.

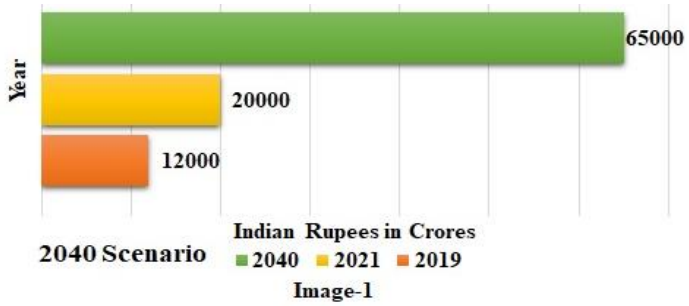

Image-1

To match this demand and Speed of growth, we need to embrace newer technologies which are Cost-effective as well as which save our time. To do so Cost- Effective Construction based on Alternative Building Construction Systems are one of the solutions. The Aim of this research is, To Study, Investigate and Analyse Cost-Effective Construction based on Alternative Building Construction Systems. The Objective of this research is to adapt Modern Construction Technologies, Smart Innovations and advocate a Construction and Financial Solution and to reduce overall Project Cost through existing Innovative and enriched Construction Technology without losing the strength, performance and life of the structure. The Scope will be studying and analysing the Alternative Construction Systems certified by the Building Materials and Technology Promotion Council (BMTPC).The research will be limited to its application in construction of High-Rise Residential Buildings.

2. LITERATURE REVIEW

2.1 Conventional Construction System

This is typical and traditional way of constructing a building which involves clearing and levelling of land and laying the foundation of the building. The RCC frame along with the superstructure is built on this foundations. This conventional system comprises Columns and Beams which support the whole structure. All this activities are done on site including the concreting which is also done in-situ. Further the internal and external walls are constructed as per the drawings. The

finishing works are then completed to accomplish the project. This established construction method comprises of formwork prepared from timber, plywood, Steel Plates and once steel reinforcement and formwork is ready concreting is done. This process involves lot of Labours, Raw Material, transportation which become major challenges and impact on the Time, Quality and cost of the Construction Project.

2.2 Alternative Construction Systems

The Construction Techniques which are Cost Effective, Significantly Time Saving, Deliver Quality Construction products and are exceptionally Unique from traditional Construction methods can be defined as Alternative Construction Systems. These systems are out of the box solutions which involve high speed of construction, with optimum construction cost and achieve the required standard of Construction Quality.

It has become need and demand of the Profession:

- To achieve progressively high standards of Construction Quality.
- To match the exponential Real Estate Market plus Social demand of completing Mass Housing Projects in reduced Time schedule that too with optimistic Project Cost and Quality.

The most appropriate way to achieve this is through the adoption of entirely different methods of construction which can be sufficed by Alternative Construction Systems.

2.3 Types of Alternative Construction Systems

The Alternative Construction Systems can also be called as technologically advanced systems which reduce the construction time and produce quality, resilient and sustainable structures. BMTPC has certified these emerging systems which are broadly classified into following categories:

- Monolithic Concrete Construction System comprising of Formwork System Which replaces Conventional formwork.
- Precast Sandwich Panel system which replaces brick-mortar with dry wall.
- Light Gauge Steel Structural System which replaces cast-in-situ RCC frame and brick-mortar.
- Steel Structural System which replaces cast-in-situ RCC frame with rolled steel sections.
- Precast Concrete Construction Systems which replaces cast-in-situ construction with factory made RCC components.

This Research emphases on the Monolithic Concrete Construction System with Alternative Formwork Systems focusing on Aluminium Form Work (AluForm) and Modular Tunnel Form.

2.4 AluForm

In this system, columns, beams including all walls, floors, slabs, stairs and any other structural elements are cast monolithically with requisite grade of Concrete. The Door and Window openings are kept in advance as per the design in the Aluminium formwork. These Aluminium formwork panels which is used for monolithic concrete construction are made of high strength aluminium alloy. As the system is prepared of aluminium, it is light weight and does not require the use of cranes and normal workers can move and place the elements of the formwork. This made to order and custom designed modular formwork is prepared from either Aluminium or Plastic or a composite Panel made from Aluminium and Plastic. Now as the system is modular it facilitates to do the construction of multiple units with greater speed. The Concrete can be poured for the large as well as small panels at one go depending on the design and need of the form work. This formwork can be used for large number of repetitions which can be in the range of 250+ repetitions. Based on the concept of Economy of Scale, these large number of repetitions makes the Aluform system economical and saves the significant cost and time of the Projects.

2.5 AluForm Concept and its Features

This formwork system is prepared from aluminium alloy. The panels are held in the required location by Pin and Wedge system (Figure 1). Bracing is not required in Pin and Wedge System. Wall Ties hold together the wall panels. Beams and Props support the Deck Components. It's a Custom made formwork as per the drawings given for a particular project. This Monolithic System facilitates concrete to be poured for all the elements of the building like slabs, beams, walls, columns, staircases, balconies, the masonry work is not required. Nomenclature of Panels is done at site for easy handling and

understanding purpose. This system comprises mainly of Beam Components (Figure 2), Deck Components (Figure 3), Wall Components (Figure 4) and Other Components (Figure 5).

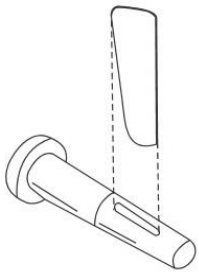

Fig.1 Pin and Wedge System

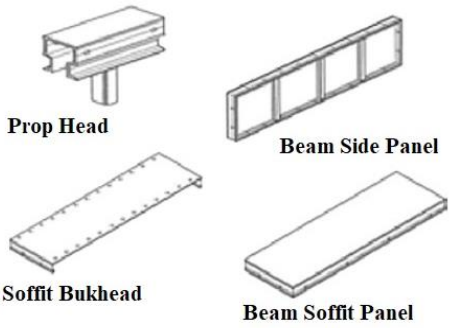

Fig.2 Beam Components

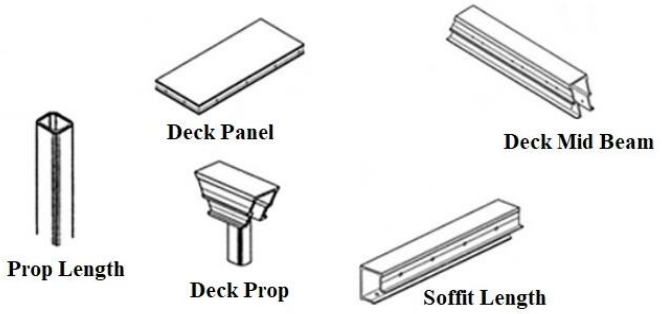

Fig.3 Deck Components

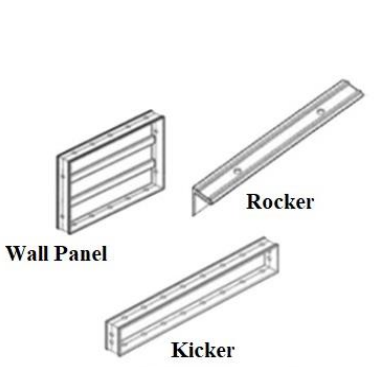

Fig.4 Wall Components

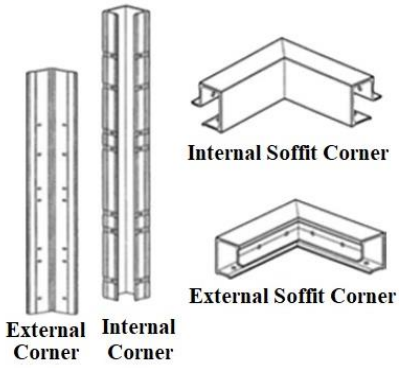

Fig. 5 Other Components

2.6 Tunnel Form

This formwork system has two inverted “L” shaped formworks bolted together to form a tunnel. It has wheels and the jacks which help the formwork move in and out of the position and are adjusted to the required final height. The tunnel form can be moved in and out, the alignment of shear walls has to be according to the walls of formwork. We cannot provide grooves, sunshades or other decorative features in the walls in this system, which is a major disadvantage. This is a mechanical system which works for that particular cellular structures. When two half shells are placed together we form a single room or cell, accordingly several shells are composed to form a single unit or House or an apartment. In this System we can cast walls and slab in one pour in single day. The Construction of a structure is classified into different phases by categorizing the areas of the erection which can be cast in a single day. The formwork for the selected phases can be organized in the morning and reinforcement along with Services is positioned accordingly, then in the afternoon concreting is done in one single pour. This single pour gives us a monolithic structure. De-shuttering of formwork can be done immediately on the next day morning. Similarly the next phase can be undertaken for further concerting.

2.7 Tunnel Form Concept and its Features

To form an actual Tunnel Two inverted "L" are put together. Two of such tunnels are placed together leaving the space for walls in which reinforcement is placed prior to placement of tunnel forms. To cast the wall third half tunnel is placed. Accordingly here two and half tunnels are casted at a time. The inbuilt hot air blower's boosts the setting time of the concrete to achieve 24 hours cycle of casting of one slab.

The Tunnel Formwork Elements are as follows:

- It has Vertical panels, Deck and back panel to retain fresh concrete until it gets set and cured.
- The important features are Stripping platform, gable end platform and working platform which facilitates labour working movement along with machinery and also for stripping out completed tunnels.
- To achieve perfect line and level of tunnel, Push Pull Props and Wheeled Props are provided.
- To Pick/ Lift by a tower crane a Lifting triangle is provided at centre of tunnel form deck panel.
- It has Kicker form which serves as starter formwork at slab level to facilitate the position of next level of tunnel form.
- Slab stop end, wall stop end to provide as stopper to retain fresh concrete up to wall and slab line.
- Vertical panels have block outs which facilitate Openings like doors, and windows in walls.

The formwork which is made of steel can be reused up to 600 times suiting to a variety of module sizes as its applicability is for large repetitive modular types of works. The construction is faster as the tunnel formwork allows a 24-hour construction cycle to be achieved.

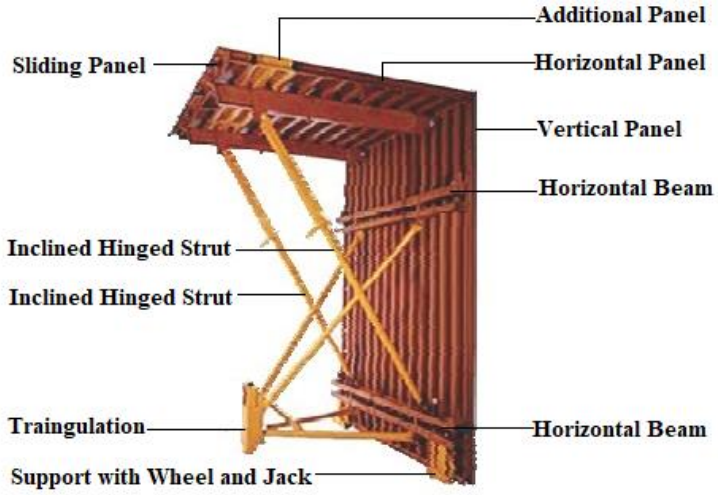

Image-2

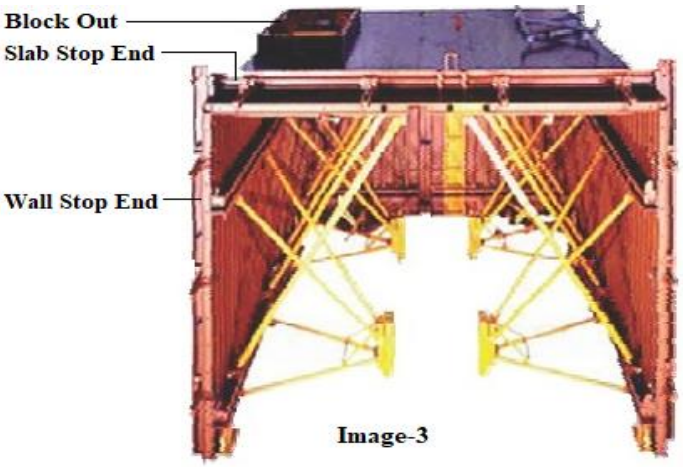

Image-3

3. METHODOLOGY

Study, Analysis and Cost effectiveness of both the Alternative construction system can be made by making apple to apple comparison between two different projects which have implemented the Aluform and Tunnel Form System in their projects. Further it's also more important to understand the Advantages and limitations of both the Alternative Construction Systems. The Pragmatic Comparisons between the Conventional Construction System and Alternative Construction Systems will benefit us to comprehend the difference between the implementation of respective Systems.

4. RESULTS, DISCUSSION AND COMPARISON

4.1 Advantages of Aluform System

- Heavy Machine and Cranes are not required for Placement of the formwork.
- This formwork is easily handled by semiskilled or unskilled workers.
- Speedy construction compared to Traditional construction.
- Cost Effective because of number of Repetitions of the formwork due to economy of scale, size of project.
- Good Construction Quality and Plaster may not be essential, also has better seismic resistance.
- Time saving in completion of project.
- Increased durability with lesser number of joints.
- Less Thickness of Wall/Shear wall gives us higher carpet area with the same plan or design.
- Uniform quality and less manual labour.
- This system can be used for construction of low rise as well as to high rise structures.

4.2 Limitations of Aluform System

- Post construction changes are not feasible.
- RCC Walls have less thickness which facilitates less insulation.
- RCC Walls have less sound absorption than brick walls.
- It's absolutely not economic for non-repetitive works.
- 3 months lead time is required for formwork fabrication.
- All the services are to be planned in advance and cannot be changed at a later date.
- Nails cannot be easily hammered or holes are not easy to make due to strong shear walls.
- Repair and rehabilitation in coastal area of shear walls may be difficult in case of corrosion in multi-storeyed construction.
- Initial cost of formwork is high.
- Very limited architectural features feasible.
- We can have restricted spans because maximum spacing between cross walls allowed is 1.5 times the floor height if supported on two edges and 2 times the floor height when supported on all four edges.
- Finishing lines are seen on concrete surface.
- It is difficult to handle large numbers of formworks for different components of Building.
- Aluminium is very costly metal, possibility of form work theft is very high and on the other hand repair cost also becomes expensive.

4.3 Advantages of Tunnel form System

- This system is very cost effective for repetitive works based on principle of economy of scale.
- No plaster is required as the concrete finish is good.
- Extremely fast construction activities.
- As the structure is Monolithic it has high Seismic Resistance.
- Very Less joints because of the type of formwork.
- High Rise Construction with repetitive units can be done.
- We can repeat this formwork 500+ times.
- Due to lesser thickness of Shear walls we achieve Higher Carpet Areas.

4.4 Limitations of Tunnel form System

- Machineries like cranes are required.
- The Design and form of structure has to be compulsory of box type which is a major criteria for design options of the building.
- Design of Grooves, Niches and such features are not possible on the walls to get an ornamental look.
- Before pouring of concrete, all Services like plumbing and electric conduits have to be done in advance and placed in position as per design.
- We cannot construct the Basements with this technique.
- We cannot make changes in design post construction.
- RCC Walls have less thickness which facilitates less insulation, hence this system is less energy efficient in hot climate.
- Due to Tunnels we cannot provide shafts on outer side of the buildings and Less Architectural features can be implemented due to limitation in designs.
- Dimensions of formwork limits span of the Slabs and room sizes.
- Highly Skilled workers are required.
- We can cast only three sides and slab in one go and generally front façade side is to be left out for removal of the formwork.
- It is very difficult to cast sunken slabs and such areas.

4.5 Comparison of the Systems

Table 1: SWOT Analysis for Alternative Construction Systems

Activity	*Conventional System*	*Aluform System*	*Tunnel Form System*
Capital Cost	Less	High	Very high
Casting System	Separate Structural Components	Monolithic Structure	Monolithic structure
Accuracy and Quality	Less	Good Accuracy	Good Accuracy
Internal /External Plastering	Required	Plaster not required	Plaster not required
Design Changes	Flexibility in design	Difficult to incorporate.	Difficult to incorporate.
Speed	Slow	Moderate	Very Fast
Cycle Time for RCC work	20 days	10 -15 days	1 Day Cycle
Repetition No. of Shuttering Material	12 to 15	250+	500 +
Advantages	Very Low cost and easy to operate	High cost with low manpower.	High cost, Long lifespan, Speedy Construction.
Limitations	Short lifespan, Slow Speed Poor Quality	Moderate lifespan, Moderate High speed, High Quality, High investment	High Lifespan, Needs Tower cranes, Needs skilled Workers, Needs ancillary machineries.
Cost of shuttering	Between Rs 400 to 500 /sft of Slab area.	Between Rs 5000 to 6000 /sft of Slab area.	Between Rs 9000 to 10000 /sft. of Slab Area.
Labour Cost	Between Rs. 85 to 100 /sft of slab area	Between Rs. 175 to 250 /Sft of slab area	Between Rs. 250 to 300 /Sft. of Slab area.

5. CONCLUSIONS

It can be concluded that the Alternative Construction Systems of construction such as Aluform and Tunnel Form Systems are the key to meet the massive mandate of Housing, which demand High Speed, High Quality and are Cost-Effective. The Mass Housing Project scale plays a vital role in adopting these systems as the whole concept of the adapting these systems is dependant of the principle of Economy of Scale.

Aluform and Tunnel Form Systems not only helps in improving the quality and efficiency of the work but also is Cost effective if worked based on economy of scale. The major challenges to the adaption of Alternate Construction Systems for mass housing in India:

- Initial Investment is very high.
- Economy of Scale of Project for project feasibility.
- Design Concepts dependant on the type of Alternative Construction System.
- Logistics and Shipping of construction elements components for example Precast Panels etc.
- Need of Highly Skilled Professionals and Workers.
- Re-orientation of end users towards the acceptance of these systems.

Strengths	**Weakness**
High Construction Speed Quality Construction Preplanned and Scheduled Work Timely Completion of Works High Returns based on Project turnaround time.	High Initial Investment Massive Repetition of works needed Economy of Scale Skilled Workers and Professionals needed Lead time required to manufacture custom-made formwork.
Opportunities	**Threats**
It can have Major share in Mass Housing Projects Innovative Technology and welcomed by Construction Industry Extremely lucrative Business for System Providers and Manufacturers	Diversion to Traditional Systems for: High Investment Limited Design options Skilled Workers Acceptance of Systems by End-users Lead Time for the Setup

6. RECOMMENDATIONS

The adaption of Alternative Construction Systems will resolve the issues related to the Time, Cost and Quality. The initial cost of implementing Alternative Construction Systems and similar smart innovations are quite high nevertheless the total amount saved at the end of the project life cycle is substantially valuable than the project delay and the turnaround time of the project vis-à-vis to the Conventional Construction System.

The Union Budget 2022–2023 for the Mission of “Housing for All” has allocated Rs. 48, 000 Crore for completion of 80 Lakh houses in 2022–23 under Pradhan Mantri Awas Yojana. This task is very challenging to achieve with the Conventional Construction System.

Alternative Construction Systems serves as an efficient tool to solve the problems on Mass Housing fronts not only in India but all over the world. These systems have a great potential to provide high Quality Construction at unbelievable Speed and at Reasonable Cost. On the grounds of principle of Economy of Scale, to achieve the gigantic task of Mass Housing it is highly recommended to use Alternative Construction Systems over the Conventional Construction System.

ACKNOWLEDGEMENT

My deep Gratitude to Architect and Professor Zoher Saimwala Sir, for his humble guidance, precious time and patience. I am very thankful for his inputs from time to time on the subject matter.

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Minimization of Material Waste during Construction

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ABSTRACT: Construction Industry plays a vital role in the infrastructure development of the country. This operates on a large scale as a result, huge amount of resource is consumed and wasted. Threat caused to the environment due to generation of waste has further led to the development of waste management strategies and policies. But in-spite of it, the concern continues to grow with time. Under waste management, Reduce is the most significant tool for waste minimization. This research focuses on minimization of material waste where the targeted potential area is material procurement, handling and storage. The study explores contributing causes of material waste. Attributes that generate wastes on building projects were identified and waste management principles were used to formulate ways to further minimize material waste. The strategies developed through research are based on the gap between existing waste management strategies and lack of implication of those strategies on site.

Keywords: *Waste Minimization, Material Procurement, Material Handling, Waste Management Strategy.*

1. INTRODUCTION

The Construction Industry plays a crucial role in a developing country (i). The development impacts the living conditions, health, and social well–being, which in return generates employment opportunities and further uplifts the nation's economy (ii). Despite all these contributions, the fast-paced development has led to a negative impact on the environment. The waste generated out of construction sites are dumped into landfills. When left unattended, landfills cause land pollution, andit has become aglobal health issue since the toxins are released directly into the soil.

The focus of this study includes waste generated during material procurement, handling and while it is being stored on site. Through this study, an attempt is made to identify the causes of waste generation and minimize it. Construction waste is defined as the products or materials that are unused or generated as a result of construction activities during different phases of construction (iii).

As per the waste management hierarchy, the concept of waste management are reduce, reuse and recycle, the material waste is disposed to the landfill at the end, once it's passed through the process(iv). Reduction is given the first priority in the hierarchy and hence it's vital to effectively use the material resources to minimize the overall waste generation.

Aim of the study is to minimize construction material waste at material procurement, material handling and material storage phase during construction. Objective of the study is to identify the source and causes of material waste generation. Identifying loop holes in the use of waste management techniques. To propose waste management strategies under the material procurement and handling stage. However the focus of the study is limited to material procurement, material handling and material storage being done on site during construction, where the case study covers only conventional residential standalone construction sites.

2. LITERATURE REVIEW

2.1 Why Minimization?

As per the study done by R. Wang, and S. Li, the second most preferred way to manage construction waste is by minimization. This will ultimately reduce the pressure on landfills and reduce overall construction costs. Minimization at early stages of the project will further optimize resource utilization and reduce transportation trips(v). Hence, minimization needs to be practiced for reducing the overall wastage from its initial source.

2.2 Material Procurement

In order to carry out the activities of construction, a proper supply of material is required on the site. Material procurement involves the entire process of finalizing and delivering these materials to the site. But improper management at this stage can lead to waste generation. A study by Karim and Marosszeky (vi) states that improper material handling and storage has lead to waste generation. This is the targeted source where the material is at its freshly procured state and once it's damaged it cannot be used further making it inefficient.

2.3 Reduce, Reuse and Recycle Waste Strategies

Strategies used for minimization of material waste are the 3R's of waste management, Reduce, Reuse and Recycle .As per the hierarchy, the reduction of material waste is given priority. If the waste generated cannot be reduced then the waste generated should be reused as much as possible. The stage of recycling comes after the material waste has no further scope of being reused (vii). This study is inclined towards the reduction of material waste at its source before it reaches the point of disposal. Hence further reducing the risk of sending the unfit material into landfills. During construction, one can avoid activities causing wastage by being responsible and applying the concepts of waste management. Hence, it's important to identify the activities at their initial stage through proper planning so as to implement the waste management strategies throughout the timeline of the project.

2.4 Causes of Waste Generation

For managing waste it is vital to understand the cause of waste. Factors causing material waste were grouped into four categories according to their sources as shown below (viii).

- ***Design & Documentation:*** Changes to design, document problems, design errors, construction drawing errors, complicated design.
- ***Material and Procurement:*** Improper material storage, material quality problem, material ordering problems, improper material handling, material transportation problem, packaging problem, defective materials, damaged materials.
- ***Construction Methods & Planning:*** Coordination problems, control and supervision, construction methods, Poor waste management, tools and equipment misuse/malfunction, misuse of material, rework, wrong teams/subcontractors selection, by-process waste, construction errors, ineffective planning and scheduling.
- ***Human Resources:*** Incompetent workers, designer's inexperience, inattentive working attitudes and behavior, lack of suppliers involvement.

2.5 Barriers for the Adoption of Waste Management Strategies

A study by Wildermuth (ix) further helps in understanding the barriers in adoption of waste management strategies:

- ***Lack of awareness in the Industry:*** The labors, local contractors and architects play a vital role for a project to be completed. It is important for them to be aware of the waste management techniques and approaches so as to avoid poor handling and bad techniques, in order to avoid material wastage. Non- experienced labors need to be trained.
- ***Lack of interest from clients:*** Client being the investor prioritizes economic benefits over material management practices. Leading to least importance given to activities not offering tangible benefits.Timeline preferred over potential of significant cost saving.
- ***Lack of proper training and education:*** Most of the laborers and contractors on-site learn from their peers on-site through experience. Social consequences of material waste are not thought of, hence we see a lack of proper training amongst most of them. Imbibing proper training and educating them about the consequences can benefit the project as a whole.
- ***Lack of skilled labor:*** Maximum laborers in the construction industry are unskilled. This leads to improper waste handling, thus it is important to create awareness and skills amongst unskilled laborers.
- ***Lack of market competition:*** Contractors are not willing to take up waste minimization and management since the risk is associated with the contractor to bear the cost implications. If the contractors are given incentives for taking the project initiative of optimizing waste, this would set benchmarks and hence develop healthy competition.

- ***Lack of waste reduction approach by architects:*** Architects and designers don't prioritize waste minimization approaches at the design and planning stage. Other economic benefits overpower the design stage. Whereas designing as per the standard minimum size of the products can eliminate wastage up to a great extent from the site.
- ***Lack of Government Interventions:*** Policies that are more stringent towards limiting the waste produced on-site might enforce the industry to develop a better approach towards material waste management in the construction industry.
- ***Material &Methodology:*** Waste generated out of the construction activities that are no longer useful is ultimately dumped into landfills. One of the factors states improper storage of materials being the cause for material waste on-site. Under data collection storage of material as per Indian standards was noted as the research is based on the Indian Construction Industry.

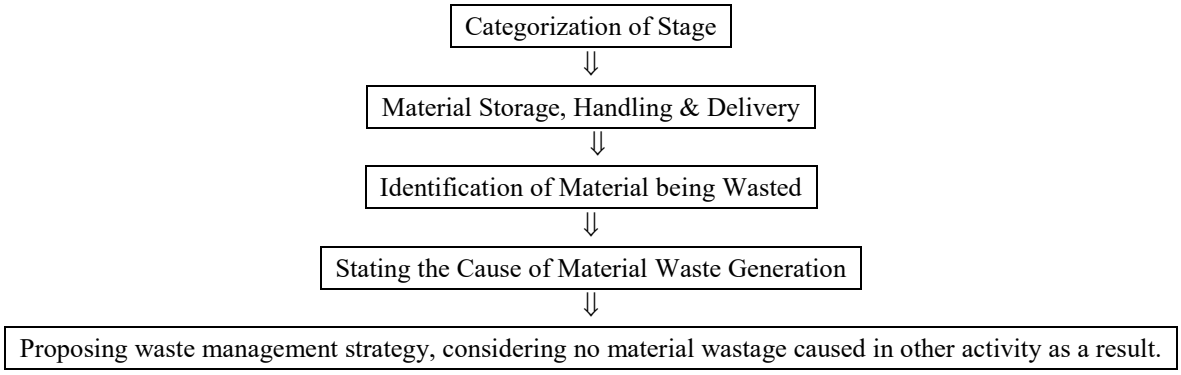

Figure 1: Flow Chart to Analyze Material Wastage on Site

The literature review highlights the types and causes which contribute in the generation of construction material waste. Also the waste minimization strategies used on site to manage waste. But a gap is seen on site in following these strategies efficiently. To get a deeper understanding of the gap on practical grounds, three case studies were carried out followed by an interview with the personnel on site. Through a flow chart (Figure 4) the data collected was further analysed. Observations and analysis done through case studies were framed in a questionnaire survey that isolates the key strategies used by personnel in managing material waste on site. The survey was carried out to achieve the objective to propose waste management strategies under material procurement, material handling and material storage. The Web link to the questionnaire survey was then sent to the respondents on various professional platforms(LinkedIn, WhatsApp group pages etc.). A total of 41 entries submission were recorded, out of which 36.6% - Architects, 29.3% - Site/Structural Engineers, 19.5% - Project Managers and 14.6% - Contractors.

The questionnaire consists of three sections. The first section asks for the role (Architect/Project Manager/Site Engineer/Contractor) of the respondent in the project and their years of experience in the construction industry, the second section assesses the level of awareness in material management, whereas the third category comprises of ranking the key strategies in managing material wastes from a scale of 1–4 (1-Not Important, 2-Least Important, 3-Important, and 4-Most Important). The ranking was further analyzed using the Relative Importance Index (RII).

RII was calculated using the formula, $RII = \Sigma W \div A \times N$,

Where W = weight assigned to each strategy by the respondents, A = Highest weight (which is 4 in this case), N = the total number of respondents (41 in this survey).

3. RESULTS & DISCUSSION

A rank ordering of these variables was then assigned based on the calculated RII.

Table 1: Ranking of Strategy Based on RII

Sr. No.	*Strategies that can minimize material waste on construction sites.*	*RII*	*Rank*
A	Effective communication and coordination between contractor's, agencies and supervisor's activities.	0.030	1
B	Adequate knowledge of construction methods and sequencing by agency on site.	0.029	2

Sr. No.	*Strategies that can minimize material waste on construction sites.*	*RII*	*Rank*
C	Provision of proper material storage on site.	0.029	2
D	Preventing double handling through effective logistic management.	0.028	3
E	Use of Just in Time delivery	0.027	4
F	Maximization of reuse of materials on-site.	0.026	5
G	Waste minimization Clause to be added incontracts.	0.026	5
H	Provision of waste skips for specific materials (segregation).	0.026	5
I	Vocational training on waste management and material handling for operatives on site	0.026	5
J	Provision for unused material to be taken back by the vendor.	0.023	6

3.1 Preference of Strategy

Based in RII, the strategies were sequenced on the basis of ranks. Those strategies were further categorized under material handling, material storage and material delivery.

Preference 01: Material Handling

- Effective communication and coordination between on-site labor, contractor's and supervisor's activities.
- Adequate knowledge of construction methods and sequencing by agency on site.
- Preventing double handling through effective logistic management.
- Vocational training on waste management and material handling for operatives on site.
- Provision of waste skips for specific materials (segregation).
- Maximization of reuse of materials on-site.
- Waste minimization Clause to be added in contracts.

Preference 02: Material Storage

Provision of proper material storage as per standards.

Preference 03: Material Delivery

- Use of Just in Time Procurement System
- Provision for unused material to be taken back by the vendor.

4. CONCLUSION

The research explored various issues involved in managing material waste on-site under material handling, storage and material procurement. Strategies under material handling resulted to be the top preference where minimization of material waste could be mitigated, followed by strategies under material storage and material delivery.

Effective communication and coordination between contractors, agencies, and supervisor's activities ranked as the most effective strategy to avoid rework and unnecessary wastage of materials on site. Whereas provision for unused materials to be taken back by the vendor ranked last since it added to the transportation cost and wasn't considered economical for the project. Instead, measures taken to avoid materials to be sent back was preferred.

Causes that can be mitigated for managing waste have been identified and strategies have been formulated to deal with it at its root cause. The strategies stated are applicable for small-scale construction sites where there is no proper standardization.

ACKNOWLEDGMENT

I would like to express my gratitude to my guides Ar. Umesh Mallya, Ar. Kalyani and Ar. Sunanda Satwafor their valuable input. Special thanks to the experts in the industry for being generous in sharing their opinions and being patient during the survey. Lastly, my Institute, CTES College of Architecture for supporting and encouraging me throughout the research paper.

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Effect of Kinetic Architecture on Energy Efficiency in Residential Building in Composite Climate

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ABSTRACT: In this 21st century, we witness that new industry standards are being set every other day in the field of science and technology. Building industry is no exception to that. Interventions of Kinetic mechanisms in various building designs are proving to be more climate responsive and efficient than traditional methods. This paper studies the impacts of Kinetic architecture on energy efficiency of small-scale residential building situated in composite climate zone of India. It includes the study of Rotational motion mechanism in buildings and whether this motion improves the energy performance of building by achieving the expected solar insolation throughout the year. This study was carried out with the help of IES VE simulation software on a bungalow design having two simulation options; the conventional static design and second being kinetic having rotational motion. After studying both simulation results, we came to conclusion that to cater the extreme conditions of composite climate and to achieve energy efficiency; inclusion of Kinetic mechanism in building design can be effective.

Keywords: *Kinetic Architecture, Rotational Motion, Energy Efficiency, Composite Climate.*

1. INTRODUCTION

In today's industrialized world, where we are totally dependent upon energy, the gap between energy demand and supply has become the key problem to solve. Depletion in natural energy sources and higher costs involved in generating energy from renewable energy sources leaves us with only sustainable option i.e., efficient use of available energy.

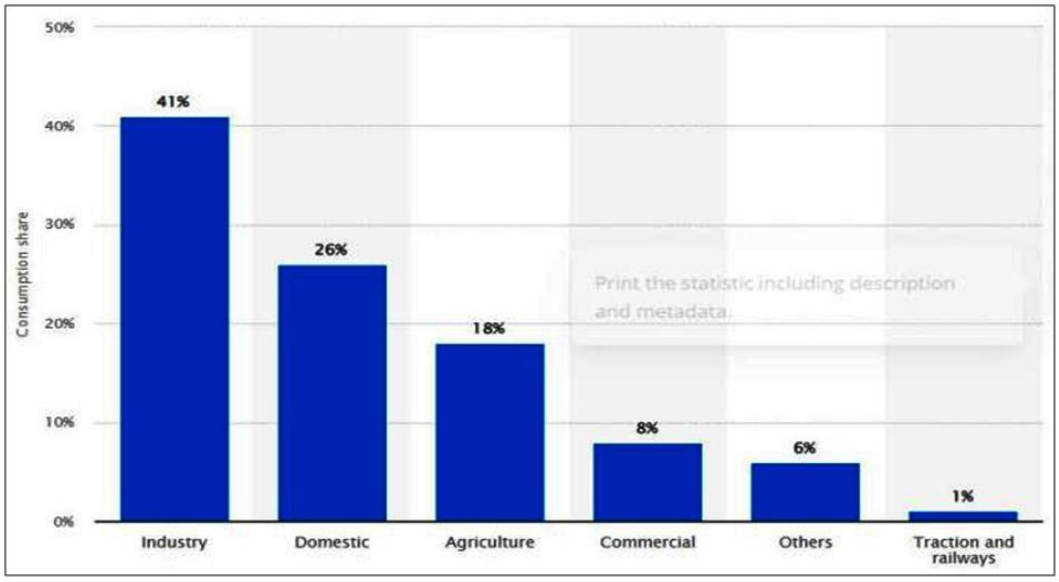


Figure 1: Energy Consumption of Various Sector in India

Building industry in India consumes major part of energy generated. (Statista, 2022) The new budget has also considered its importance and has promoted the efficient use of energy in all sectors.

The maximum energy utilization happens to achieve occupant's comfort conditions which are challenged by diverse and ever-changing climatic conditions. If we consider the climatic zones in India (Energy Conservation Building Code, 2017)

Composite climate is usually the most challenging as all seasons in this climate are having extreme conditions. Nagpur city from Maharashtra state of India which is categorized under Composite climate has such extreme conditions as temperatures in summer reach up to 47°C and during winters decrease to freezing 4°C, while monsoons having humidity levels up to 80 % (Urja Mitra).

During summers it is required to avoid excessive solar gain while in winters sun penetration deep inside the building is highly recommended. With conventional static building design principles, this solution is unachievable, but it can be made possible with inducing simple rotary motion in the architectural design.

This research revolves around whether this inclusion of Kinetic architecture improves buildings overall energy efficiency.

2. RESEARCH QUESTION

Considering the need of energy efficient building designs and technological advancements in building industry:

Will the inclusion of Kinetic architecture improve the energy efficiency in building?

Whether the extra energy required for Kinetic mechanism will be balanced by the effective energy saved due to the same.

2.1 Aim

To compare the heating/cooling loads of Kinetic building with conventional static building in order to check the feasibility of Kinetic architecture.

2.1 Objectives

- To study the mechanism of Kinetic Architecture involving Rotational motion.
- To calculate the energy requirements of selected Kinetic system.
- To compare the energy consumption with respect to heating/cooling loads of Static and Kinetic building design options.

2.3 Scope

This study will be applicable for buildings in Composite climate.

The study considers only solar gain as a parameter to compare energy efficiency for two orientation options.

2.4 Limitations

The Kinetic mechanism studied and used for further research is involving rotational motion of 180° only.

The Cost factor of implementing Kinetic mechanism and payback period is not part of this study.

The study is applicable for small scale residential buildings only.

3. LITERATURE REVIEW

3.1 Case Study: Sharifi-Ha House, Tehran

- *Architectural design:* Next Office - Alireza Taghaboni
- *Owner:* Mojgan Zare Nayeri, Farshad
- Sharifi Nikabadi (private)
- *Year of completion:* 2013
- *Built area:* 1400 m²
- *Cost:* 3.15 million euros
-

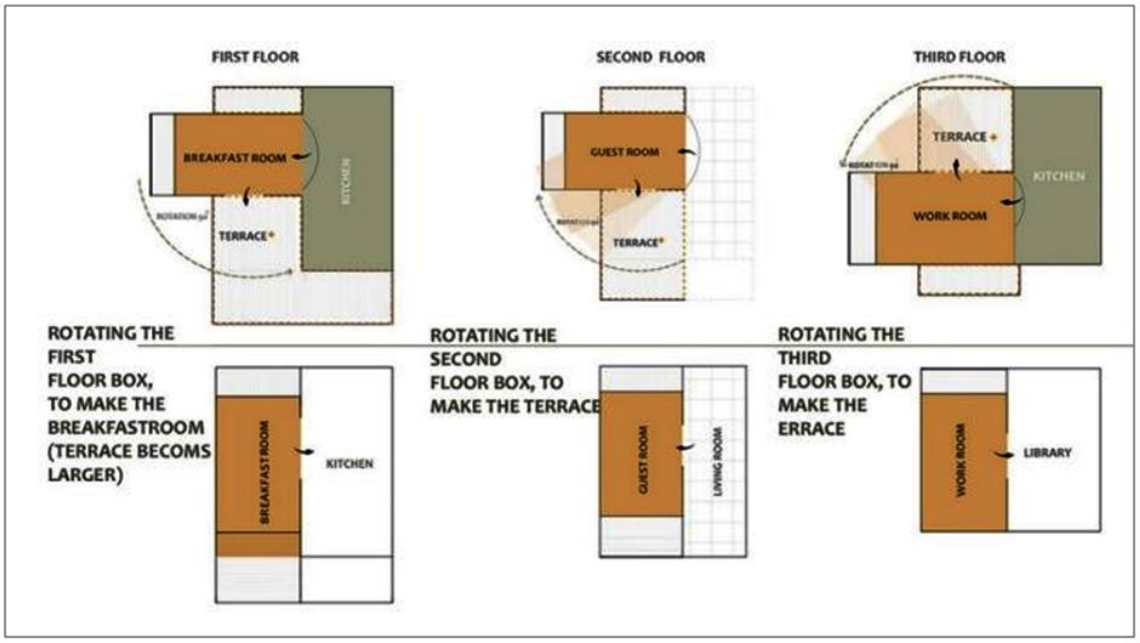


Figure 2: Sharifi-Ha House, Tehran

Completed in 2013, the Sharifi-ha house occupies 14,000 square meters arranged over 5 levels and 2 underground floors. The Sharifi-ha house embodies the ideal model of flexibility for the contemporary residence inspired from the traditional Iranian home which is provided with a summer living area and a winter one to better adapt to the torrid summers and harsh winters in Teheran

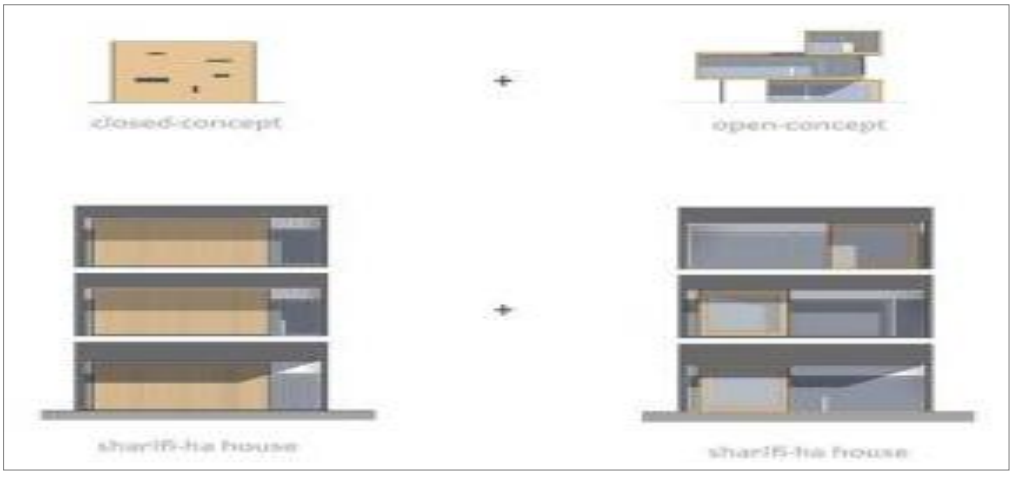


Figure 3: Sharifi-ha House Concept

Figure 4: Traditional Iranian House

Figure 5: Rotation Process in Sharifi-ha House

The house plan is divided into four sections marked by the structural grid made of steel beams and columns: two blocks separated by a triple height central void, one located on the elevation with windows and the other in the deepest part of the plot. Only one block is mobile, composed of rotating volumes. (Sharifi - Ha House)

The rotation of the boxes transforms the building from being introverted (winter scenario) to extroverted (summer scenario), the facade is transformed from bidimensional to three-dimensional and it creates different lighting scenarios as well as sensational spatial effects. The rotation system, manufactured in Germany, derives from the mechanisms for the movements of theatre sets and of the rotation of car show rooms floors and they consist of three motorised discs.

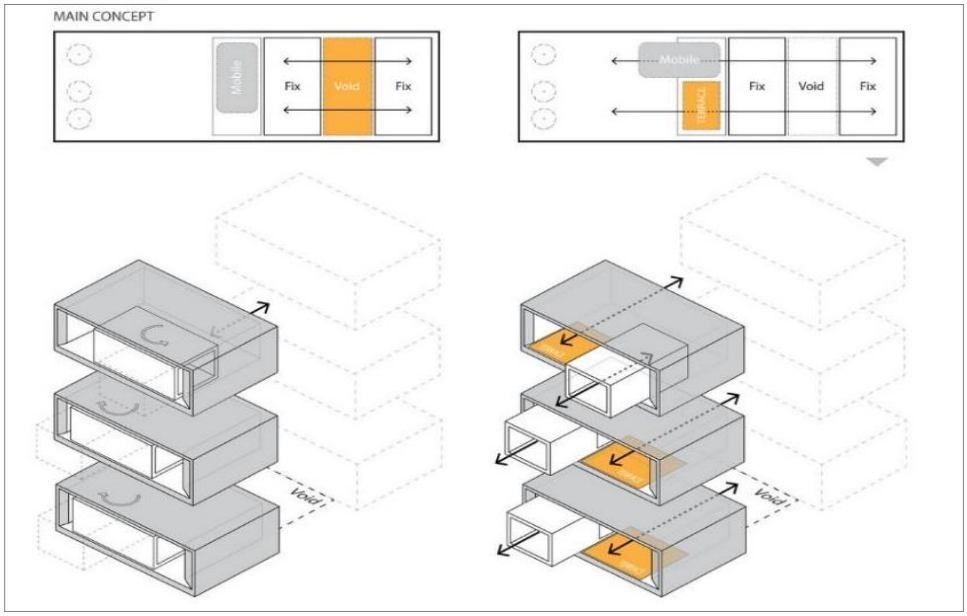


Figure 6: Sharifi-ha House Main Concept

Figure 7: Sharifi-ha Exterior Timelapse Photos

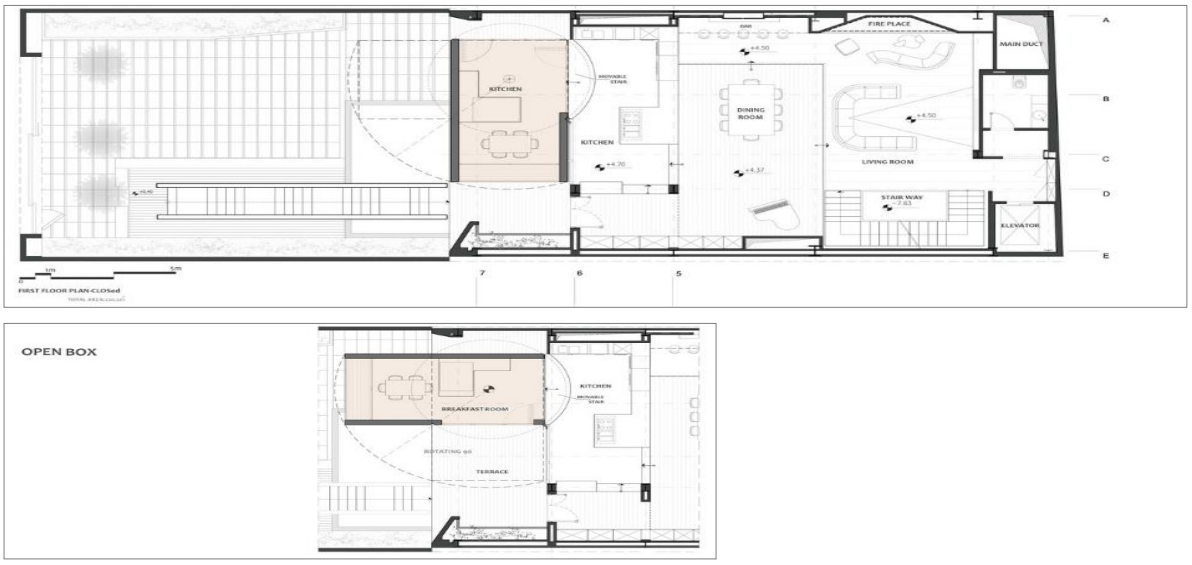


Figure 1 First Floor (open and close) Plan of Sharifi-ha House

Rotation Mechanism: The motorised system which allows the rotation of the rooms has been manufactured in Germany, by the German company Bumat which operates in the field of systems for the movement of large industrial machines and that utilises a similar mechanism to that used in theatres to move/rotate sets. The rotating box have a surface of about 18 m and they are formed by a closed part and by an open loggia. The structure of the box, 3.4 × 6.8 × 4.15 m, is composed of a frame made of HEM 160 steel completed with an external finish of wooden planks. (BUMAT turntables, n.d.)

Figure 9: Rotation Process Details

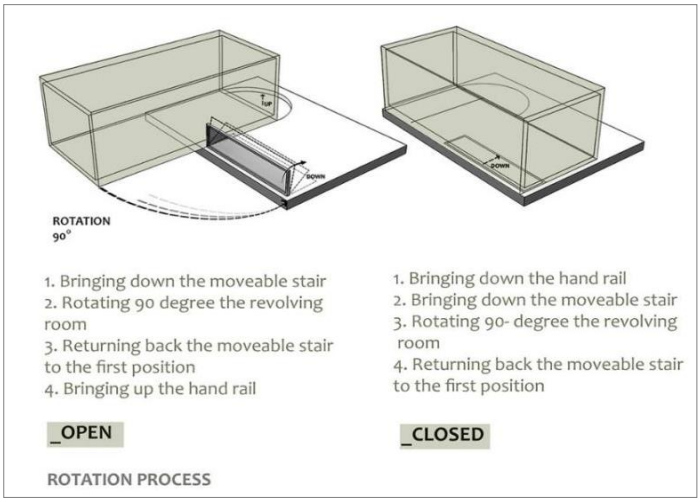
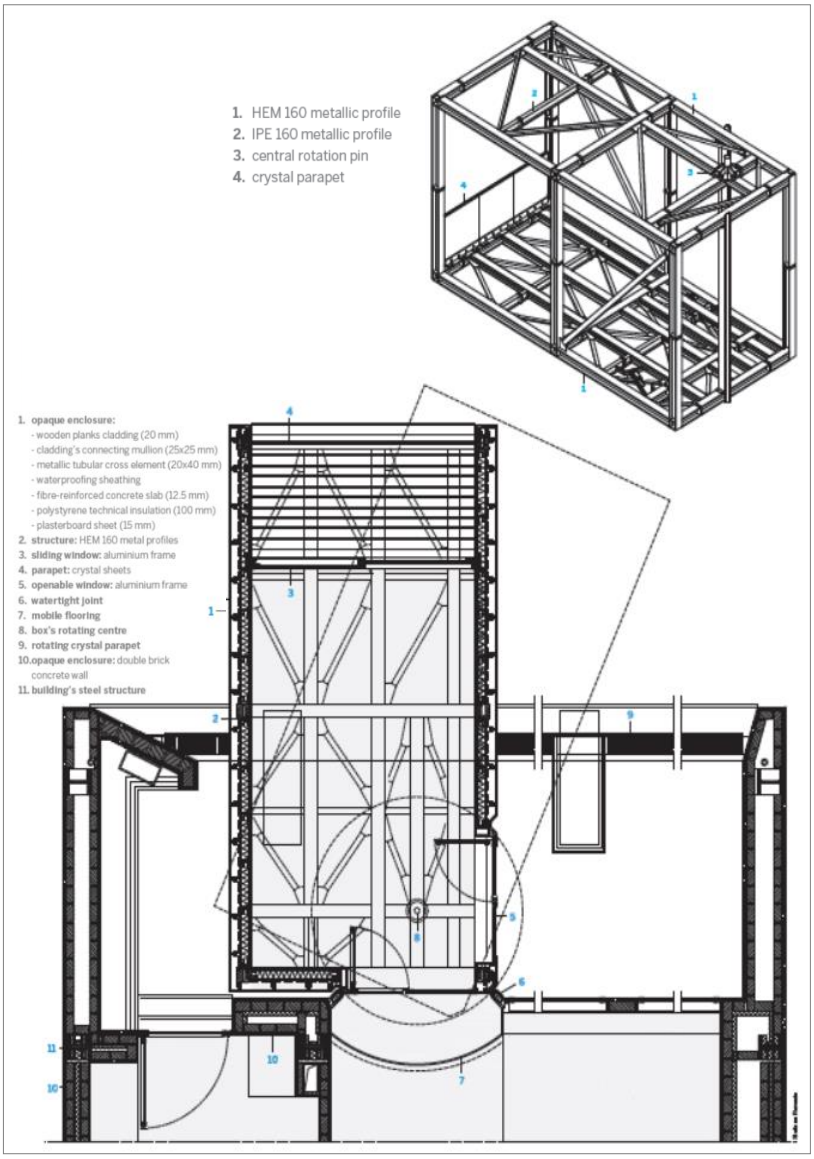


Figure 10: Sharifi-ha House Section



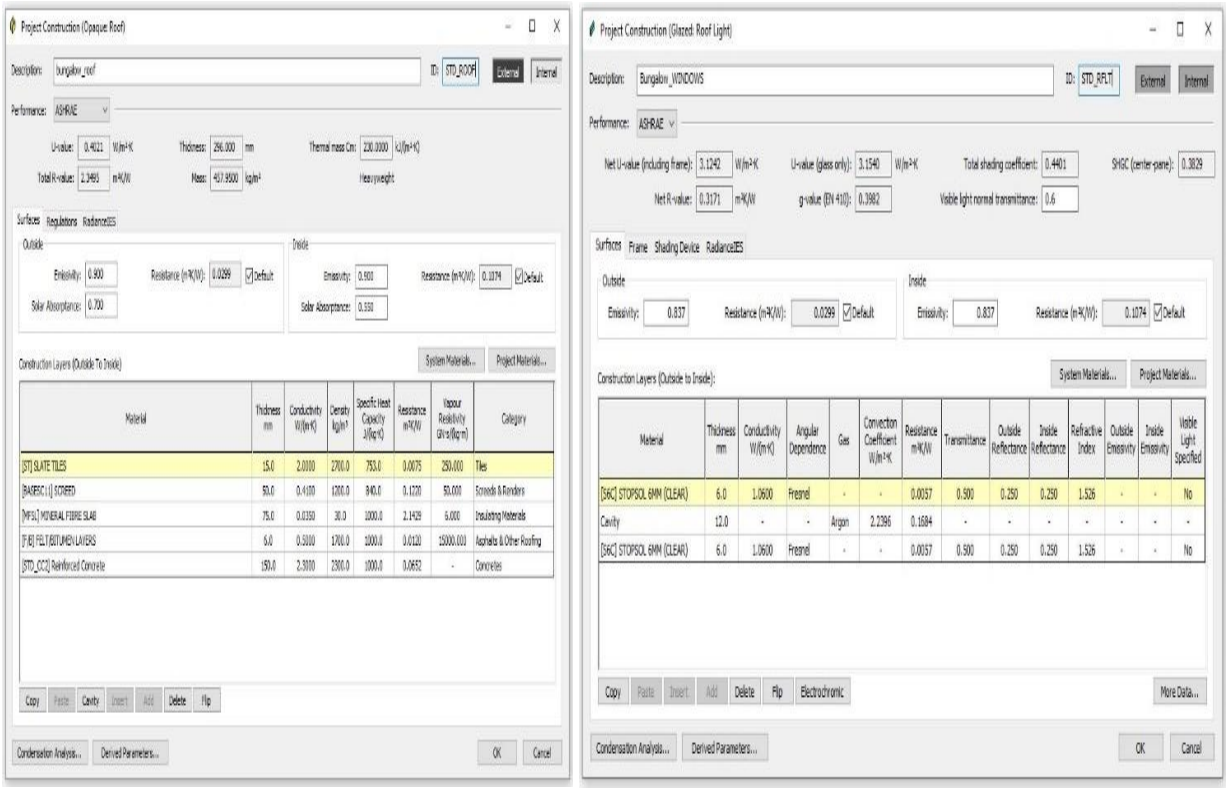
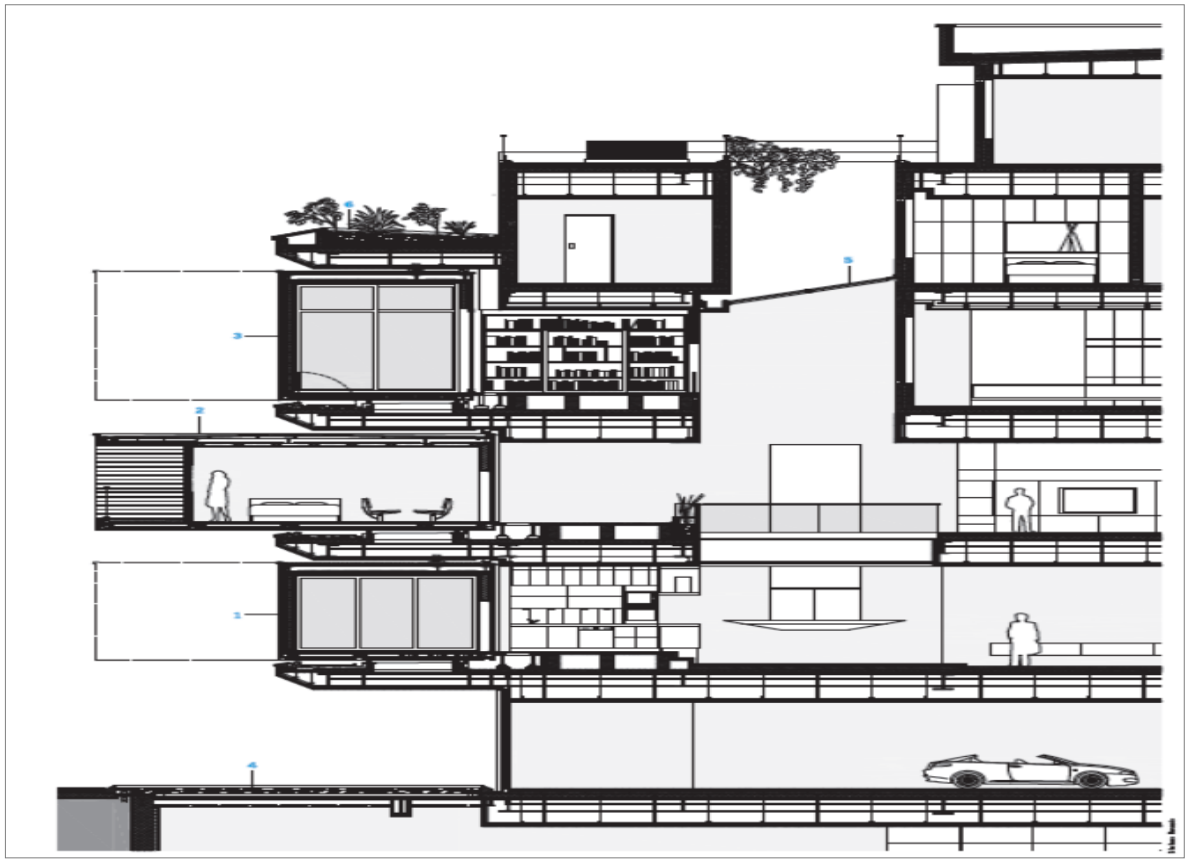


Figure 11: Axonometric View of the Structure and Horizontal Section



4. METHODOLOGY

4.1 Bungalow Design

To study the effectiveness of building orientation on building's heating and cooling load requirements, a small-scale bungalow having carpet area of 258.80 sqm. was designed considering hypothetical site in Nagpur city. The bungalow design was based on a few passive design principles which are recommended for Composite climate to make the respective building design energy efficient. The key principles considered in design are:

- East-West elongated floor plan to maximize North and South facades to improve daylighting.
- Migration to rooms on upper level during night time
- Limiting solar access from East and West side by keeping minimum openings to avoid glare.
- Inclusion of courtyard to improve daylight and ventilation.

Figure 12: Vertical Section

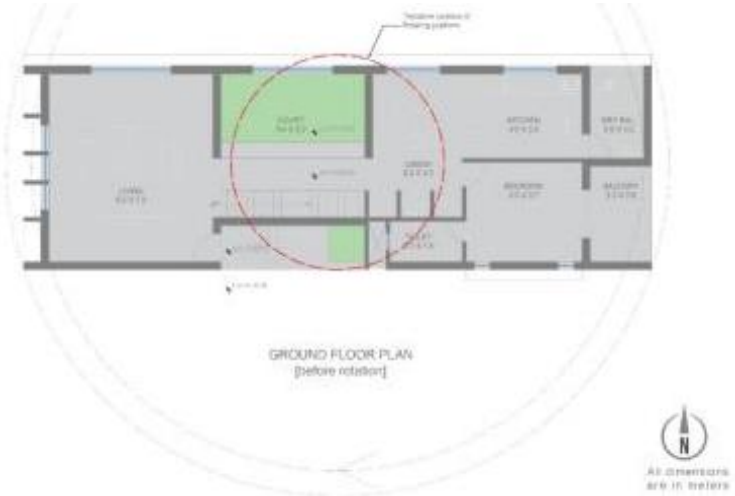


Figure 13: Ground and First Floor Plans

4.2 IES VE Building Simulation Parameters

IES VE 2019 software was used for performing simulations of Solar gain which will signify the cooling and heating loads i.e., energy requirements in summers and winters respectively.

4.2.1 *Building Envelope*

Building envelope was designed to increase the thermal lag which is recommended for structures in composite climate.

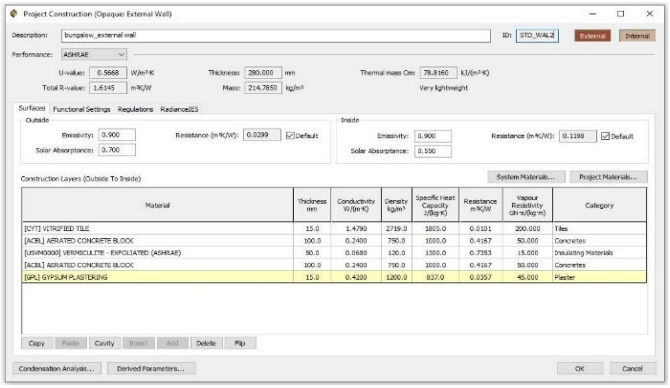


Figure 14: Wall Assembly Details from IES Software

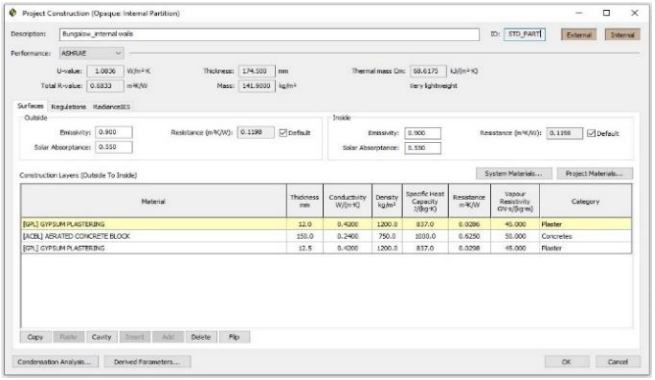


Figure 15: Floor Slab Assembly Details

External wall made of Aerated concrete blocks having two leaves of 100 mm each with 50 mm thick exfoliated vermiculite insulation in between was considered. Roof was designed with conventional reinforced concrete slab with mineral fibre slab insulation. Windows and skylights were designed as double-glazed unit made up of 6mm thick clear glass panes with 12 mm cavity with Argon gas filling.

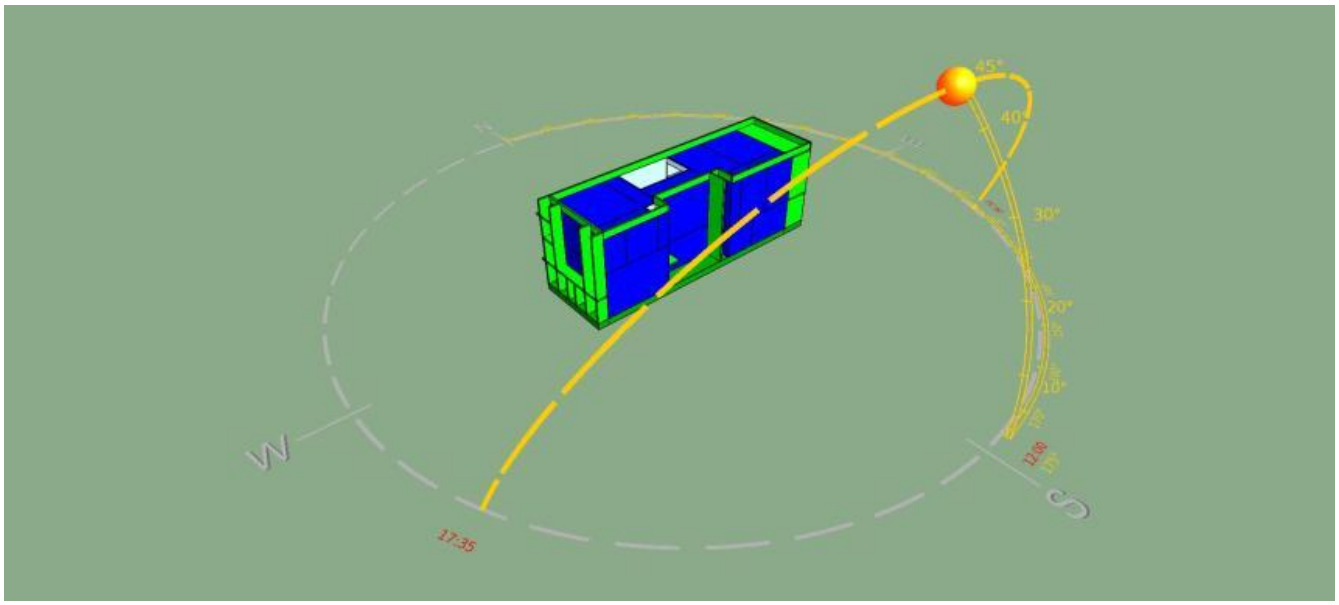


Figure 2: Roof Assembly Details from IES Software

4.2.2 *Building Orientation*

Two building orientations were considered for study. First orientation was kept for first half of the year i.e., summer. Then for the second orientation the building was rotated by 180° causing the building facades to get cardinally opposite facing for winter.

1. ***Summer orientation:*** Living room, Dining and Kitchen facing North side.
2. ***Winter orientation:*** Living room, Dining and Kitchen facing South side.

4.2.3 *Thermal Profiles*

Thermal profiles such as occupied hours, internal gains due to occupants and equipments were kept default as the same bungalow design was used for both simulations. Hence it wouldn't have affected the results.

Using these parameters two separate simulations were performed for two orientations.

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4.3 IES VE Model

The bungalow model was prepared in IES VE software. The required weather file of Nagpur city was assigned. Two separate files were created with different orientations before running the simulations.

4.4 ES VE Tools

Two simulation tools were used to obtain results:

1. **SunCast** to perform Solar exposure analysis on building envelope.
2. **Apache** to obtain Solar gains in each space.

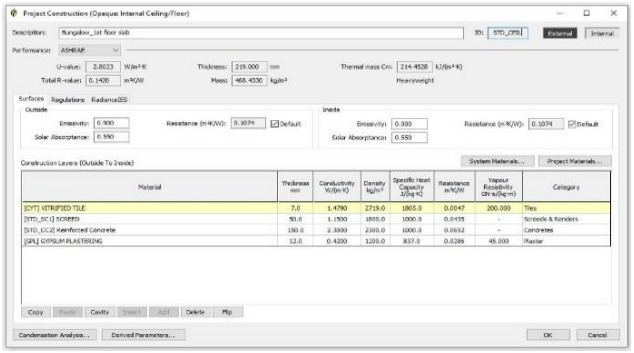

Figure 17: Summer Orientation (Orientation 1)

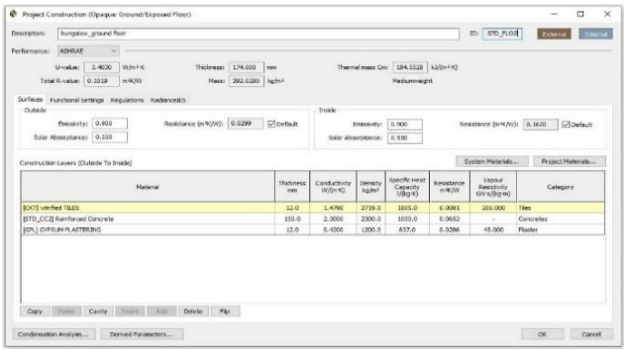

Figure 18: Winter Orientation (Orientation 2)

Two critical months, May and December which represent extremities of summers and winters respectively were considered for study. Solar gains for the month of May signify the efficiency of building envelope whereas solar gains of December will be used for comparison of two orientations.

4.4 Energy Requirements of Rotating Mechanism

Rotating mechanism for this study is referred from the case study of Sharifi-Ha house in Iran. The same type of technology i.e., turntable type was considered for rotation of bungalow. Energy required for the rotation can be quantified using building load and the turntable type applicable to concerned load will be selected from the respective providers data.

4.4.1 *Building Load*

The bungalow's total building load was calculated by considering Indian standard code of practice published by Bureau of Indian standards. (code)

IS : 875 (Part 2) - 1987

TABLE 1 IMPOSED FLOOR LOADS FOR DIFFERENT OCCUPANCIES

(Clauses 3.1, 3.1.1 and4.1.1)

SL No.	Occupancy Classification	Uniformly Distributed Load (UDL)	Concentrated Load
(1)	(2)	(3) kN/m²	(4) kN
i)	RESIDENTIAL BUILDINS		
	a) Dwelling houses:		
	1) All rooms and kitchens	2·0	1·8
	2) Toilet and bath rooms	2·0	---
	3) Corridors, passages, staircases including tire escapes and store rooms	3·0	4.5
	4) Balconies	3.0	1·5 per metre run concentrated at the outer edge

Following tabular data was referred for calculation:

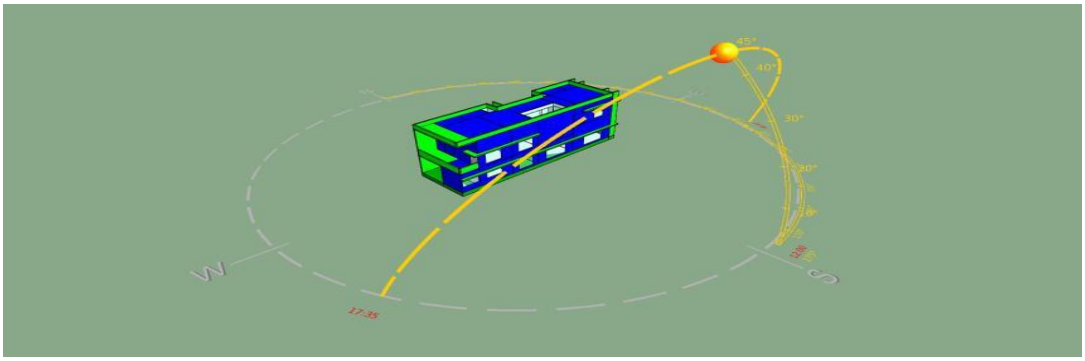

Figure 19: IS:875 for Live Load Calculations

Load calculations:

Live Load:
All rooms (217.34 sqm) - 434 kN
Toilet - 50.34 kN
Passage (43.3) - 129.9 kN
Balconies (35.02) - 105.06 kN
Total live load (UDL + ConcentratedLoad) = 725.6kN + (1.5 * 24.42) = 36.36 + 725.6
Total live load = 760.23 kN
Built-up area: 310.80 sqm
Dead load - 257kN (weyerhaeuser.com, n.d.)
Total Building load = 760.23 + 257 = 1017.23 kN

1 kilonewton is equal to 101.97 kilograms, which is the conversion factor from kilonewtons to kilograms.

Therefore, **Total building load came to be 103726 kg**.

4.4.2 *Selection of Rotating Model Type and Its Energy Requirements*

The bungalow's total building load came to be approximately 100000 kg. The corresponding turntable type was selected from the Innco product overview from website.

The High load stainless steel cover (DT)/High load dual stainless-steelcover (DDT) satisfies the required load capacity of 100000 kg. (INNCO TURNTABLES BROCHURE)

Specifications of INNCO High load stainless steel cover (DT):

TECHNICAL DATA		
TYPE	DT5000-5T	DT8000-15T
Diameter	5000 mm	8000 mm
Permissible load	5000 kg	15000 kg
Height	min. 600 mm	min. 1000 mm
Material of carrier plate	stainless steel 5 mm	
Rotating speed	1.8…7.6 °/s	1.2…6.0 °/s
(without acceleration ramp)	0.3 rpm…1.3 rpm	0.2 rpm…1.0 rpm
Positioning accuracy	±0.2 °	±0.3 °
Rotating angle	-200…+400 °	
Squarish environment	5500 x 5500 mm	8500 x 8500 mm
Ground plane connecting every	50 mm	
Control cable	fiber optic (polymer type)	
Turntable drive	gear motor	
Motor	asynchron motor, frequency inverted	
Control cabinet for drive	shielded and radio interference suppressed under EN 55022 class B	
Drive motor	2.2 kW	2 x 4.0 kW (approx.)
Connector panel	fixed in the centre	
Operating voltage	230 V 50 / 60 Hz (optional 400 V)	
Current consumption	16 A	32 A
Temperature range	+8 °C…+40 °C	

Figure 20: Turntable Type Selection

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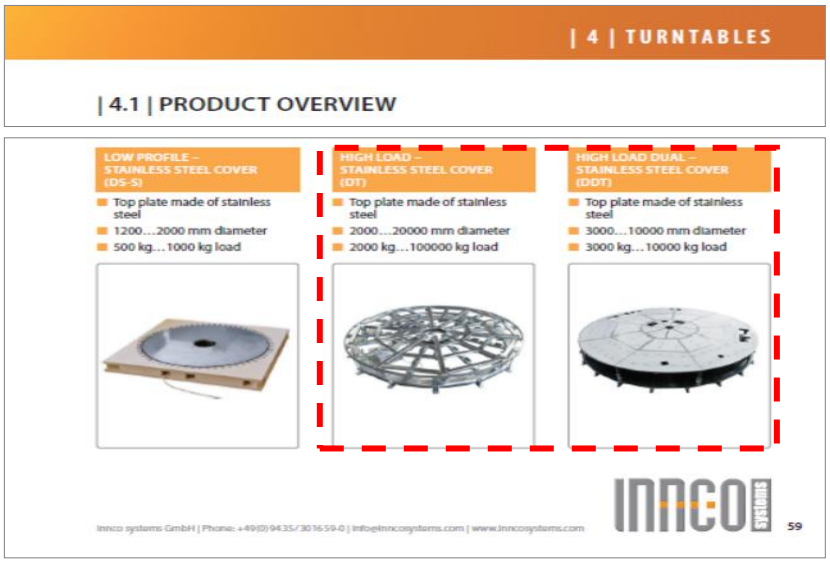

Figure 21: Technical Details of Turntable

Based on the specifications, the power requirement for rotation for 15,000 kg is 2 × 4.0 kW Similarly, power consumption for 100000 kg load is 54 kW.

Considering the time required for rotating the whole building by 180 degrees as 5 min, total energy consumption by the said technology came to be(Innco system turntables.

54 × 0.083 = 4.48 kWh …….. (5 minutes = 0.083 hours)

The system will be used twice annually.

Therefore, the total energy consumption for rotating mechanism is approx. 10 kW

5. RESULTS

After running the SunCast and Apache simulations, following results were obtained.

SunCast results

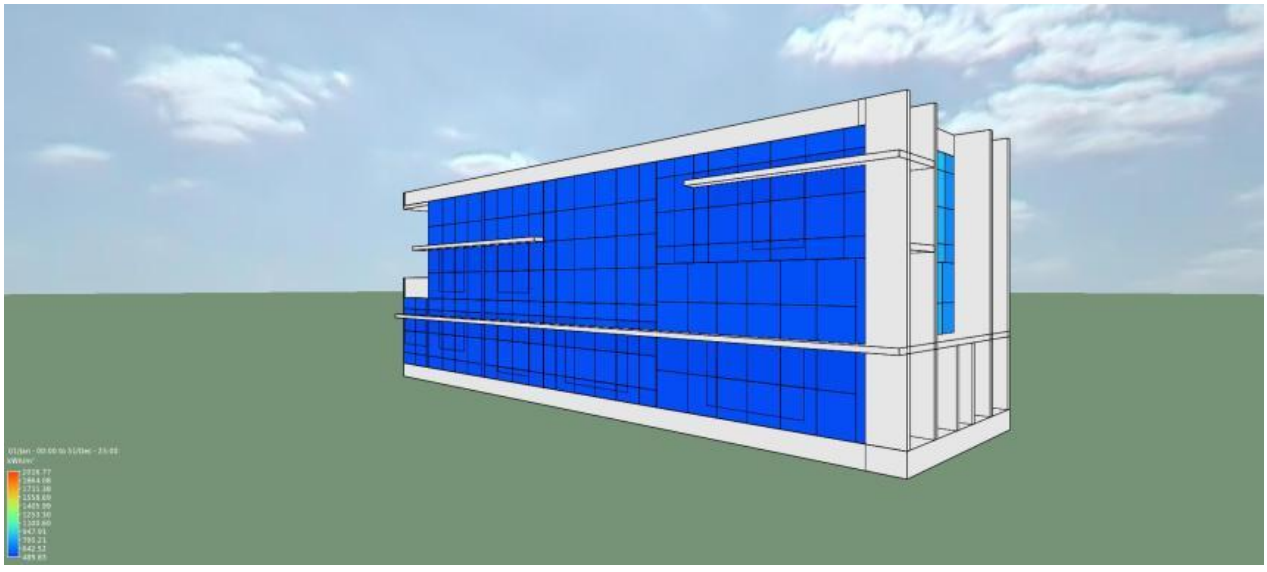

Figure 22: SunCast Result Orientation 1-NW

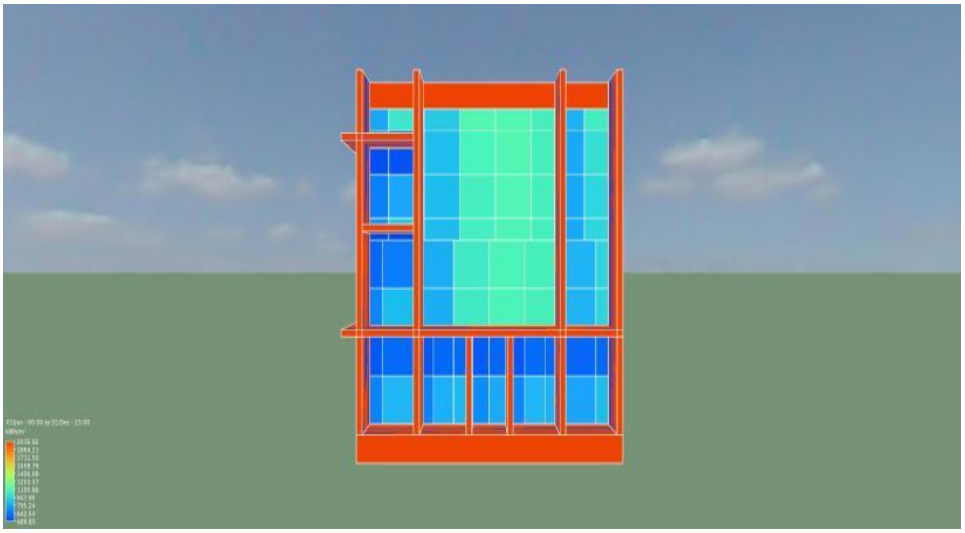

Figure 3: SunCast Result Orientation 1-Plan

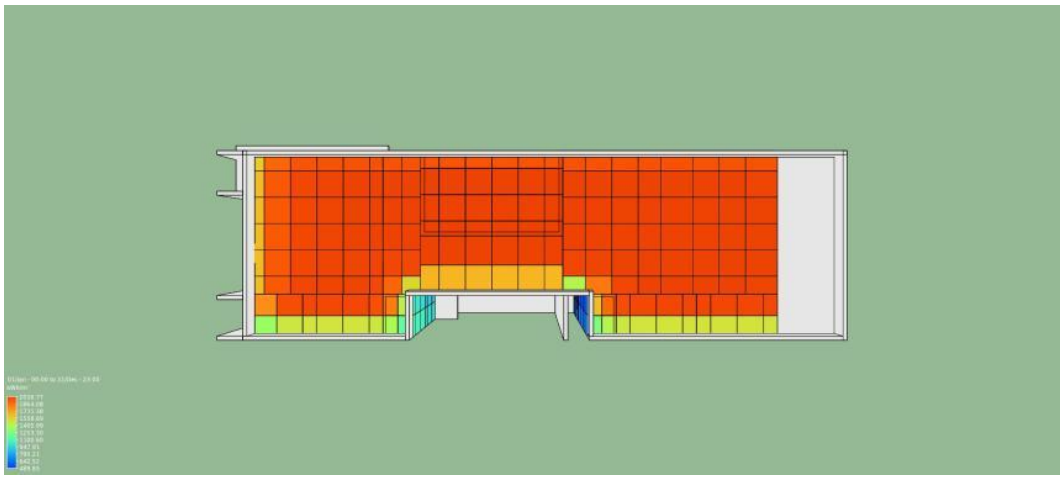

Figure 24: SunCast result Orientation 2-South

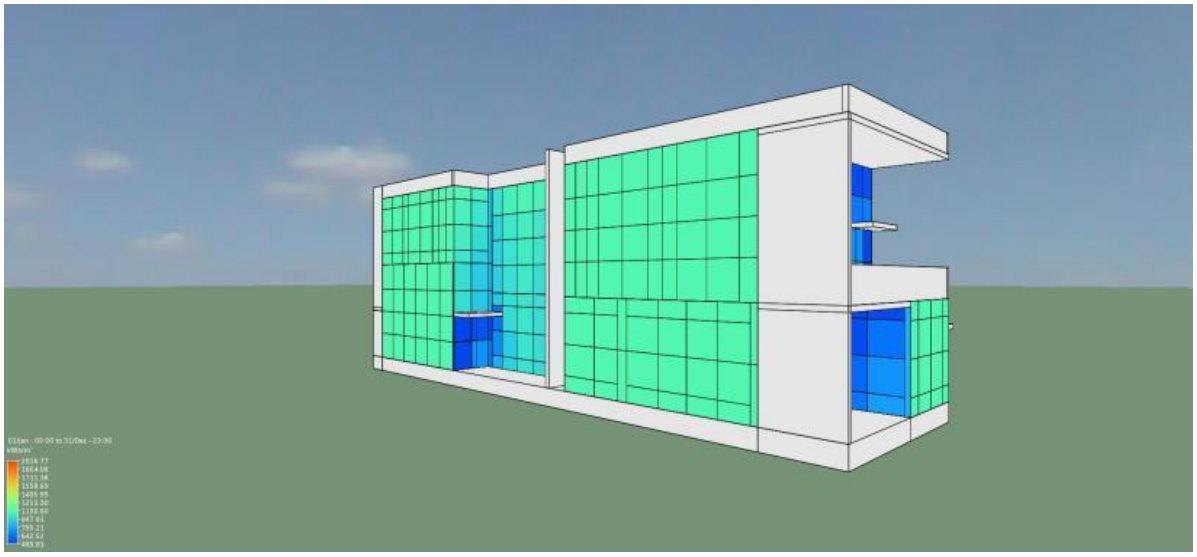

Figure 25: SunCast Result Orientation 2-East

Solar gain (Apache tool) results: Following are the solar gain results for all the spaces in MWh.

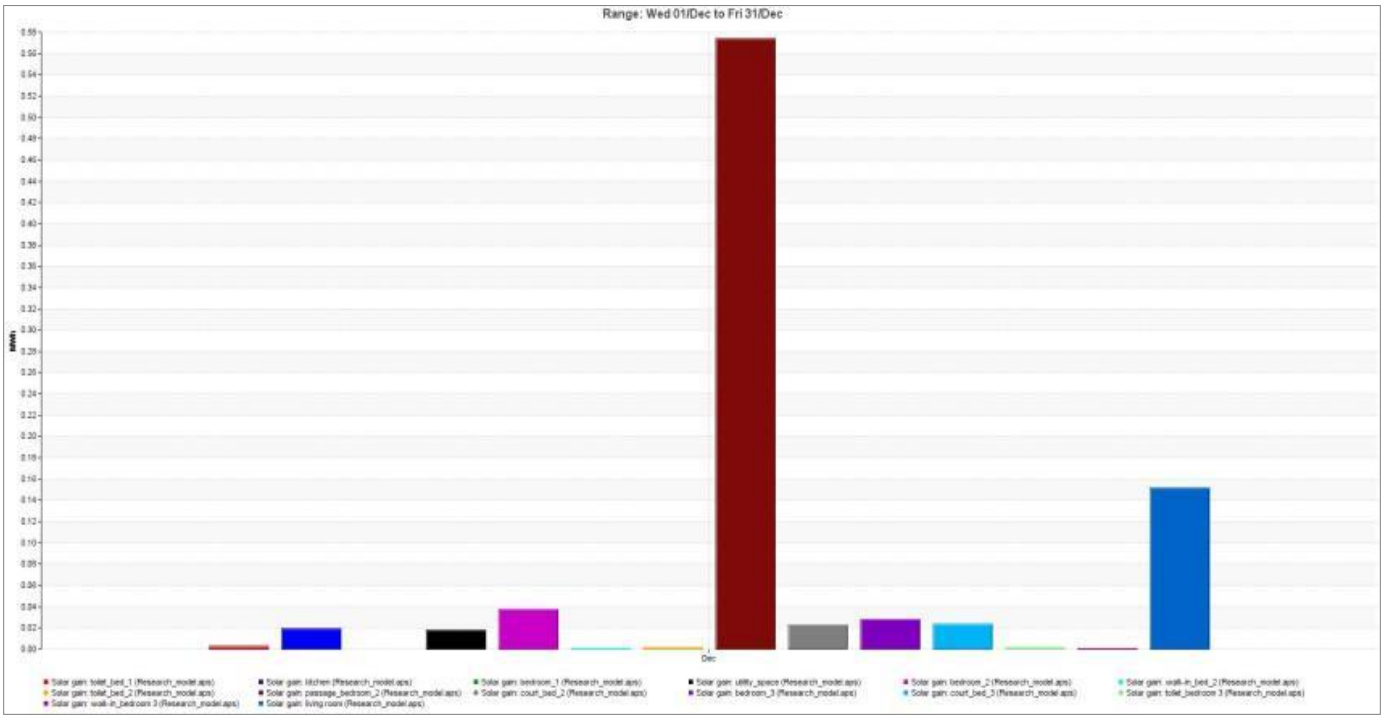

Figure 26: SunCast Result Orientation 1- SE

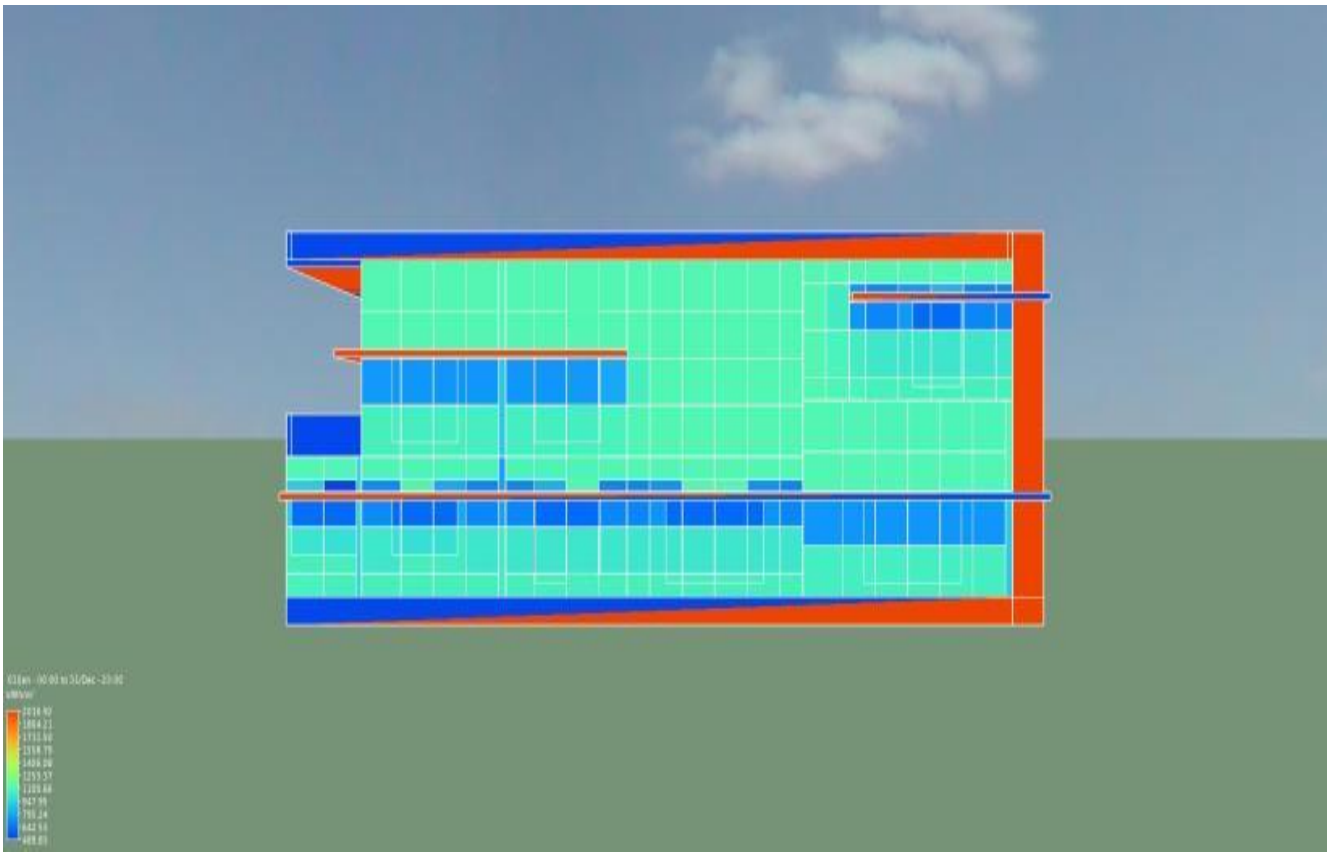

Figure 27: Solar Gain Results - Orientation 1

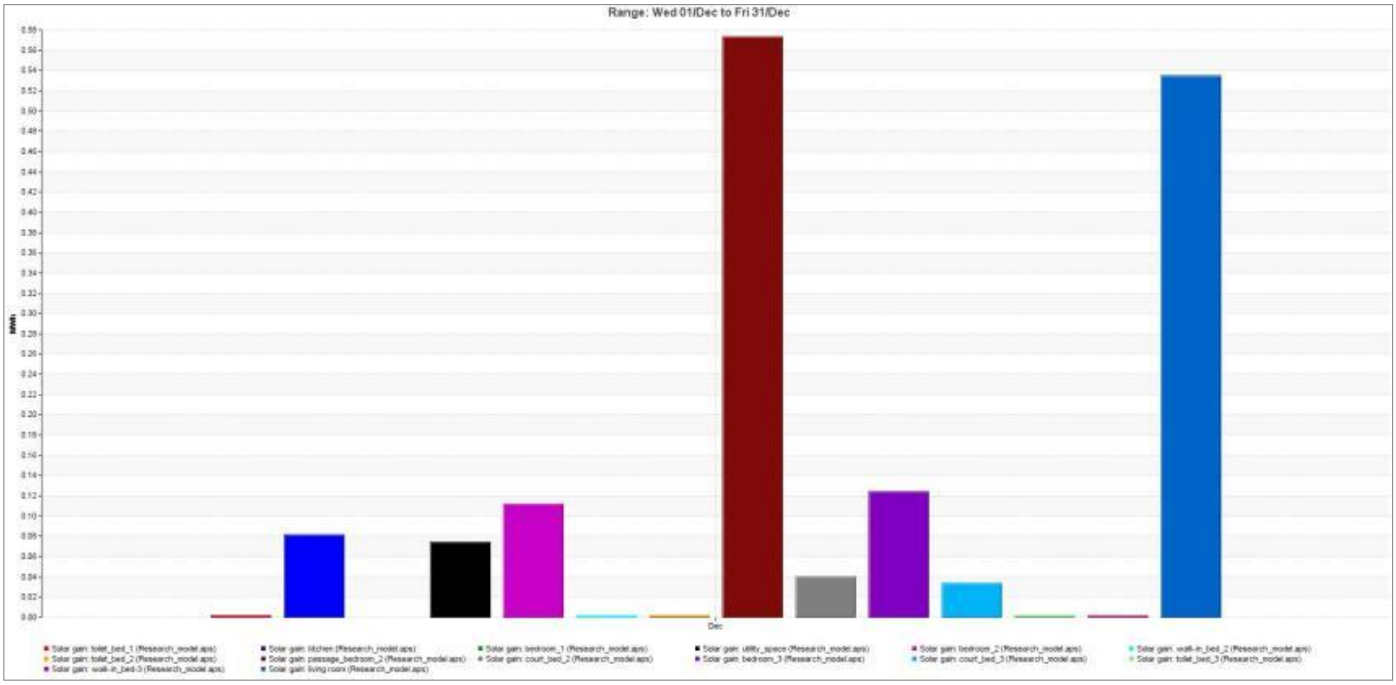

Figure 28: Solar Gain Results - Orientation 2

For the ease of understanding, above solar gain results were converted to kWh and comparative study was done for the frequently occupied spaces.

The graph below shows the comparison between Solar gains of Summer (orientation 1) and Winter (orientation 2) orientations.

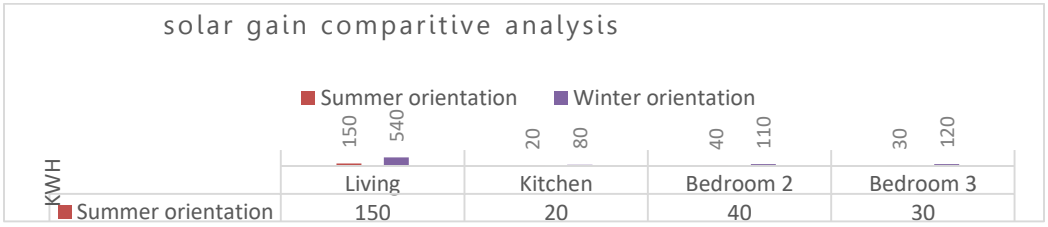

Figure 29: Comparison between Solar Gains of Summer (orientation 1) and Winter (orientation 2) Orientations

6. DISCUSSION

The effectiveness of Kinetic Architecture can be further evaluated for Cold climates as the heating load will be significantly more. In addition to that, payback period calculations should be carried out to understand the practical implementation of above Kinetic mechanism.

7. CONCLUSION

After studying the comparative results, it was observed that the average increase in solar gain during winters was 4 times the conventional orientation (Orientation 1). In other words, the heating load during winters will be reduced by 4 times.

As calculated above, the energy requirement for Kinetic mechanism is 10 kWh and the average increase in solar gains during winters came to be 75 kWh approximately.

This proves that energy required for Kinetic mechanism is far less than the energy required to meet the necessary heating loads during winters.

ACKNOWLEDGEMENT

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Finally, I wish to thank my parents, friends and colleagues for their constant support and encouragement throughout my study.

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Analysis of Flat Plate Bioreactor for Biomass Production and Carbon Reduction in India

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ABSTRACT: An urgent need for an evolution of renewable energy resources has evolved as a result of rising global energy consumption, resource depletion, and an increasing emphasis on reducing climate change and greenhouse gas emissions. On the architectural scene, we've grown accustomed to seeing buildings outfitted with photovoltaic's and wind turbines. Despite biomass's significant contribution as a source of clean energy, its incorporation into architecture is still in its early stages. Microalgae, as a plant-based biomass, have the potential to outperform other renewable resources in terms of CO_2 absorption, wastewater recycling, and O_2 release. Algae facades provide good daylight transmission and shade, work well as a load-bearing facade system, and may replace existing glass systems while preserving acceptable thermal and structural performance.

The research aims to identify suitable locations where an algae facade system can be adopted in India based on sunlight and local climatic conditions for algal biomass. One city from all five climatic zones has been taken to calculate algal biomass and the quantum of CO_2 reduction from the building. This research will help to know where the algae facade system is feasible and where not in different climatic zones of India.

Keywords: *Biomass, Microalgae, Flat-panel Photobioreactor, Algae Façade, CO_2 Absorption.*

1. BACKGROUND OF THE STUDY

With rising global energy consumption and the imminent depletion of fossil fuels, we must ensure that energy security is ensured when conventional energy sources are depleted. Nowadays, we get our energy from fossil fuels, and the production of energy emits the greenhouse gas CO2, and energy is transported over long distances.

India is the world's third-largest emitter of greenhouse gases. In the absence of pre-emptive mitigation efforts, India's buildings industry accounts for roughly one-fifth of the countries total annual carbon emissions and is expected to release seven times more CO_2 by 2050 than it did in 2005. The buildings industry is projected to offer the most significant opportunities for lowering energy use and GHG emissions.

One strategy to reduce GHG emissions is to improve energy efficiency and another is to employ renewable energy that will tend to dominate in energy production in the twenty-first century. Windmills and solar panels (photovoltaic panels) are currently prominent sustainable energy harvesters. These systems can sustainably generate electricity, but they cannot absorb CO_2. Microalgae can both reduce CO2 emissions and provide energy.

In 2009, NASA announced the OMEGA photobioreactor (offshore membrane enclosures for growing algae) project, which aims to grow algae in urban wastewater and produce biofuel (NASA, 2009).

Algae are very adaptable and an incredibly versatile plant that can be utilized in a wide range of commercial and industrial purposes, from energy to oil to cosmetics, and it has a promising carbon capture potential. For a long time, algae have been employed in small-scale versions of these applications, but photobioreactors have released algae's full potential in all of these domains.

1.1 Purpose of the Study

The purpose of this research is to explore algae as a new and renewable energy source for buildings that ecologically promote energy efficiency.

1.2 Research Questions

1. How does nature and architecture can work together to absorb and reduce CO_2?
2. What is Bio-reactor design and solar algae?
3. Why opt for micro-algae and not for multi-cellular plants?
4. How much CO_2 is absorbed in a day?
5. Will this technology be effective for Indian Climatic zones?

2. AIM, OBJECTIVES, METHODOLOGY, HYPOTHESES AND SCOPE & LIMITATIONS

2.1 Aim

The research aims to study and analyze the features of algae as building component that reduces external energy demand of the building and reducing in CO_2 in the atmosphere.

2.2 Objectives

- To overview algae technology.
- To study function and chemical composition of micro-algae.
- To study about the algae technology in architecture and its benefits with respect to energy efficiency of the building and CO_2 reduction.
- To calculate biomass production and carbon absorption by algae façade.
- To analyze issues in adoption of algae in building.
    1. Methodology Understanding Algae Technology Applications of Micro-algae in Building Analysis of BIQ building model in different climates of India
    2. Analysis of flat plate photobioreactor for Indian Cities
    3. Calculation of Biomass productivity, CO_2 fixation and O_2 production
    4. Observations Conclusions Hypothesis
        (a) Algae facades have excellent daylight transmission and shading potential, perform well as a load bearing façade system, and can replace the existing glazing systems with ample thermal and structural performance.
        (b) Algae bioreactors can improve indoor air quality by producing O_2 and absorbing CO_2 as a result of photosynthesis in algae.
        (c) Algae grown in bioreactors have the potential to convert into renewable fuel stocks like biomass or biofuel.

2.3 Scope & Limitations

- Study and analysis will be done considering current algae technologies.
- Research will only focus on Algae Façade System
- Detail study & analysis will be done only of Flat Plate Bio-reactors
- Same BIQ model will be considered for analysis in different climatic zones of India.
- Theoretical method for calculations for biomass production and carbon absorption and conversion will be adopted.

3. INTRODUCTION

Algae in General Algae are a varied collection of aquatic creatures that range in size from single microscopic cells to large-scale ocean-growing ecologies with a leafy look. They can live in colonies or large-scale ocean-growing ecologies. Growing algae necessitates the use of sunlight, water, and nutrients. Algae use sunlight more efficiently than terrestrial plants, absorb toxic contaminants, have low resource requirements, and do not compete for scarce resources with food or agriculture.

3.1 Microalgae

Photosynthesis produces carbohydrates, proteins, and lipids in microalgae, which are prokaryotic or eukaryotic photosynthetic microorganisms. Because of their unicellular or basic multicellular structure, they may develop quickly and

survive in adverse environments. Microalgae, unlike plants, can manufacture oxygen through photosynthesis (in terms of lacking roots, stems, leaves, and vascular systems for nutrient circulation). They have a higher surface-to-volume ratio than agricultural plants, allowing them to absorb nutrients and carbon dioxide considerably faster. Microalgae are responsible for 1/3th of the world's carbon fixation while also producing around 70% of the oxygen in the atmosphere.

The photosynthesis reaction that represents the conversion of CO_2 into biomass can be represented in a simplified way,

$$6CO_2 + 6H_2O \xrightarrow{\text{SUNLIGHT}} C_6H_{12}O_6 + 6O_2$$

Algae create green bioenergy and healthy protein during the process of absorbing carbon and releasing oxygen. Algae do not require freshwater to develop; they may flourish in any type of water, including freshwater, saltwater, and wastewater. Microalgae get their nutrients from wastewater (sewage), hence they're important in the wastewater treatment process. Municipal wastewater, animal wastewater, industrial wastewater, and anaerobic digestion effluent are examples of nutrition sources for microalgae. However, using wastewater as a source of nutrients in buildings necessitates careful monitoring of the potentially dangerous substances contained in the wastewater, such as solvents, paints, and medications, as well as filth and mold.

3.2 Algae as a Biofuel

Process engineering is required to transform algae from cells growing in water to a finished product. To access the substances of interest, such as omega-3 oils or proteins, the cultivated cells must first be filtered, flocculated, or centrifuged (de-watering). Once the cells are more concentrated, they must generally be burst. The product must be chemically removed from the cell debris and purified to the specified level. Additional chemical processing, such as hydrothermal liquefaction, is required to transform the oils (lipids) into a biofuel (high temperature and high-pressure conversion of oil to hydrocarbon).

3.3 Photosynthesis

The process of transforming light energy into useable chemical energy, such as ATP and NADP, is known as photosynthesis. Light absorption, energy transmission, and primary charge separation are the three essential processes involved in photosynthesis.

3.3.1 *Sources of Light*

During night time artificial lights such as tungsten lamps, fluorescent light, light-emitting diodes (LED), and others are used as light sources in photobioreactors. White light or color-specific lights such as red, green, and blue are produced by LEDs. The spectral quality of light has a varied effect on microalgae. Microalgae are usually sensitive to red and blue light.

Lee and Palsson (1994) reported that the use of LED light will minimize photon loss, eliminate the heat generated by the light source, and filter the harmful wavelengths.

3.4 Algae Façade System

Environmental concerns and resource depletion are issues that we currently face. Building energy consumption reduction is a design necessity and an innovative design method for addressing future climate change and non-renewable energy depletion. To that end, we use an integrated research strategy to address sustainability concerns with building facade systems, in which we collaboratively affect system design, materials, manufacturing, energy usage, and end-of-product-life issues.

An algae facade system, which incorporates an algae bioreactor within a glazing facade system, was designed as a sustainable alternative to glass facades. This novel algae facade is designed to replace existing glass systems while still offering acceptable thermal and structural performance, good daylight transmission, and shade. As a result of algae photosynthesis, the algae facade system is also meant to enhance interior air quality by producing O_2 and absorbing CO_2. The algae growing in the algae facade may also be transformed into renewable fuel supplies like biomass or biodiesel.

Algae integrated building envelopes are not a new concept in the architecture field. Several architects and designers have used algae in their conceptual buildings or in art installations.

1. The HOK's/**Vanderweil's retrofit** first place winning scheme for the 2011 IDEAS competition showed an algae photo-bioreactor tube attached to the top surface of the opaque building envelopes of the GSA federal building in Los Angeles.
2. In addition to this project, their recent concept design of the net energy zero Battery Park project in San Francisco incorporated algae photo-bioreactor panels to grow algae and reduce CO_2.
3. Furthermore, the Bio Intelligent Quotient (BIQ) house in Hamburg, Germany belongs to the world's first algae façade integrated building, and it is also enclosed with algae panels as the shading device.

4. CASE STUDY - HAMBURG'S BIO INTELLIGENT QUOTIENT (BIQ)

4.1 Climatic Data of Hamburg, Germany

The climate is typically moderate, warm, and temperate. Hamburg receives a large amount of rainfall, even during the driest month. Köppen and Geiger have classed this place as Cfb (Cfb suggests an oceanic climate with mild summers, as indicated by the ending. The average yearly temperature in Hamburg is 9.8°C | 49.7°F. The annual rainfall is roughly 804 mm | 31.7 inches.

4.2 Bio Intelligent Quotient

Hamburg's Bio Intelligent Quotient (BIQ) four-story residential building is green in every sense. Its innovative Solar Leaf facade made up of 129 photobioreactors (in the form of glass panels filled with water and algae), guarantees that the building outside appears unmistakably green in color.

This high-tech facade doubles as an algae farm on a vertical scale. By capturing fast-growing algae, the algal facade offers sustainable energy for the structure in the form of biofuel, heat, and sunshade.

4.3 Creating the Façade

Light to heat conversion is a well-developed technology that is commonly employed in solar thermal design. The conversion of light to biomass is a less well-known process that involves microscopically small algae called microalgae and a biochemical mechanism.

The design incorporates the concept of flat-plate PBRs, which were placed for the first time in the BIQ home to create heat and biofuel (biogas), to create a self-sustaining structure with the algae culture covering the building's energy needs. The PBR facade, which Arup and Colt have dubbed the "SolarLeaf" bioreactor facade, is the world's first facade system to produce microalgae to create heat and biomass as renewable energy sources. The SolarLeaf facade is based on the concept of designing energy-efficient buildings utilizing the biological process of photosynthesis. Glass flat panels are filled with a microalgae combination that captures solar thermal heat and light and feeds it with CO_2 and nutrients to produce biomass for energy and biofuel generation. The microalgae PBR facades are located on the southeast and southwest sides of the structure. The PBRs of the building is supported by a comprehensive building concept.

That infrastructure concept includes:

1. the CO_2 supply;
2. the nutrients supply;
3. biomass filtering and harvesting;
4. monitoring and controlling the temperature and circulation of the culture liquid;
5. heat harvesting, storing, and distribution; and
6. algae biomass transportation to the biogas plant to be converted to methane to be subsequently processed into electricity.

Maintenance cost are reduced as system can be run automatically (including the nutrient supply).

Figure 1: Hamburg's Bio Intelligent Quotient (BIQ) Four-Storey Residential Building

Source: Colt 2013.

Figure 2: Cluster of Panels with Algae Solution within It

Source: Colt 2013.

Microalgae are harvested from the adjacent Elbe River and grown in the bio-skin of the 15-unit building's glass components. This is used to generate heat and biomass, as well as to regulate light, give shade, and absorb CO_2. The sun-facing sides of the structure have a second outer shell built into the facade, in which the microalgae proliferate. Algae may photosynthesize and grow with the help of sunlight.

Flat-panel photobioreactors are clusters of three to five clear glass containers, each 2.5 m tall and 0.7 m wide (PBRs). It can hold 24 litres of liquid for microalgae cultivation. For safety and thermal insulation, the PBR is coated on both sides with laminated safety glass. The bio-adaptive facade is fully connected with the building services system, harvesting, distributing, storing, and using solar thermal heat and algal biomass on the site. The PBR uses two processes: the first is a solar thermal process that converts light into heat, and the second is a biochemical process that converts light into biomass (photosynthetic process). The PBR is supplied by two different pipe systems: compressed air and water. The injection of compressed air from the panel's bottom causes rising air bubbles that provide medium circulation to retain the microalgae in suspension, wash the inner surfaces to prevent algal deposition, and increase carbon and light absorption.

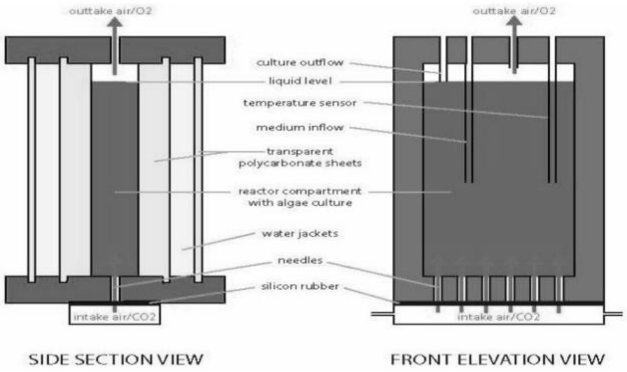

Figure 3: Schematic Diagram of Flat Plate Photobioreactor Components

Source: Colt 2013.

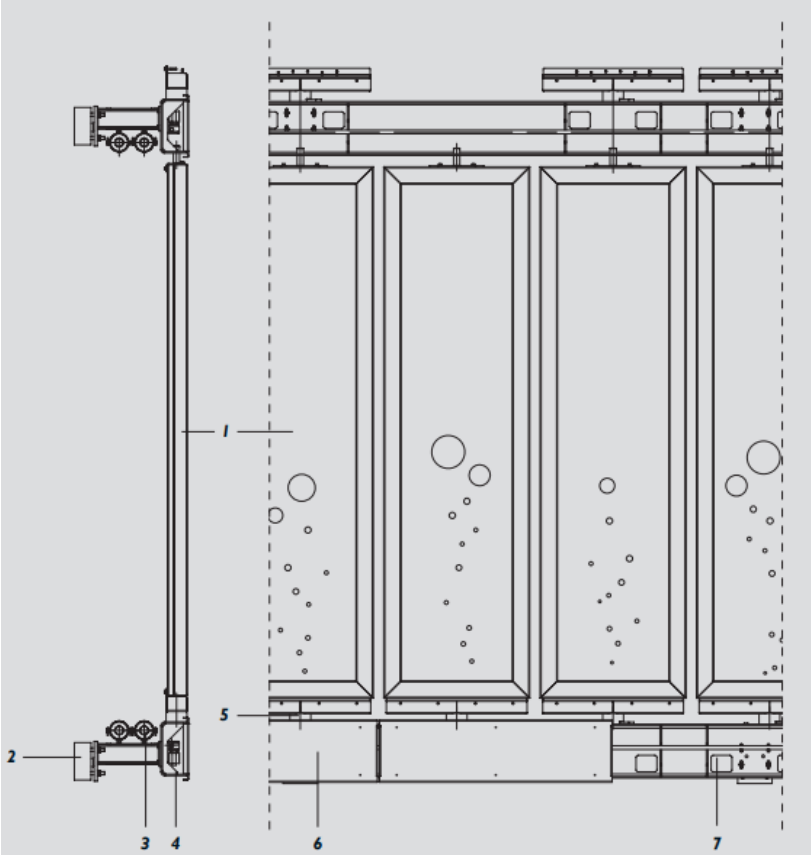

Figure 4: Section of Bioreactor Façade of BIQ

Source: Colt 2013.

1. SolarLeaf external louvers
2. Brackets with thermal breaks for the transfer of loads to the primary structure
3. Pipework for the medium to enter and leave
4. Sub-frame and rolled steel U section
5. Pivot fixing allowing rotation
6. Metal cladding
7. Supply of pressurised air controlled by magnetic valves.

Water is used as a culture medium and is loaded with nutrients such as nitrogen, phosphorus, and trace elements. The PBR's two-pipe systems are built into the perimeter frame, which is connected to the plant room through a closed-loop (building services system). CO_2 is produced from the flue gas of a biogas-fueled micro-CHP on-site (combined heat and power unit). The water circuit is supplied with an enhanced CO_2 stream using membrane technology and a saturation device. The concentrated CO_2, together with nutrients and water, is then dissolved and circulated to the microalgae within the culture.

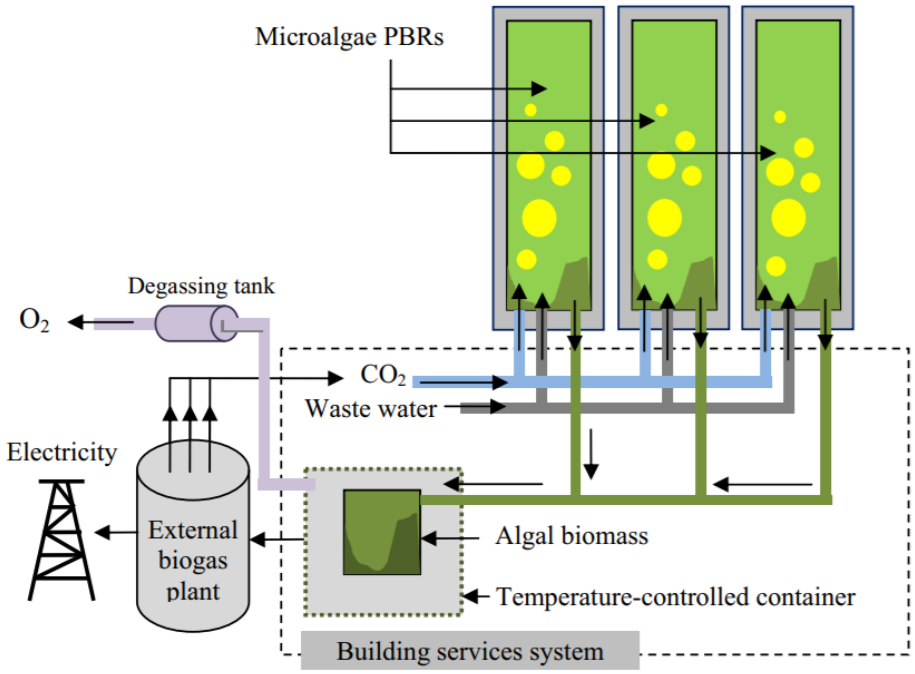

Figure 5: Schematic Flow Chart of Bioreactor System

Source: Colt 2013.

The water is heated by the portion of the solar spectrum that is not absorbed by the algae—between 400 and 700 nm, or visible light. This solar thermal heat is extracted—the temperature is kept below 40°C for a consistent production rate—and either utilized in the building or stored for later use. The algae will continue to grow and proliferate in a predictable pattern until they can be collected. The microalgae are harvested in batch or continuous mode via a bypass with a flotation system, where the algae are automatically skimmed off using a vertical cylinder. The algae produced are employed in a variety of research initiatives to build a strong value chain for the pharmaceutical and food sectors.

The quantity of light that goes through the PBRs and into the structure is controlled by harvesting the algae. This implies the algae may be left to proliferate and limit solar gain during the day's hottest hours. More light will be allowed in by harvesting the algae during the colder portion of the day. The photobioreactor is harvested regularly and stored in tanks within the structure. A local energy business will purchase and transport algal biomass to a neighboring heat and power plant, where it will be fermented, for extraction and energy generation. Methane gas will be utilized to create power in this procedure (Wallis, 2013). For architecture, the rising air bubbles and colors of the microalgae provide a fascinating new facade that is always in motion.

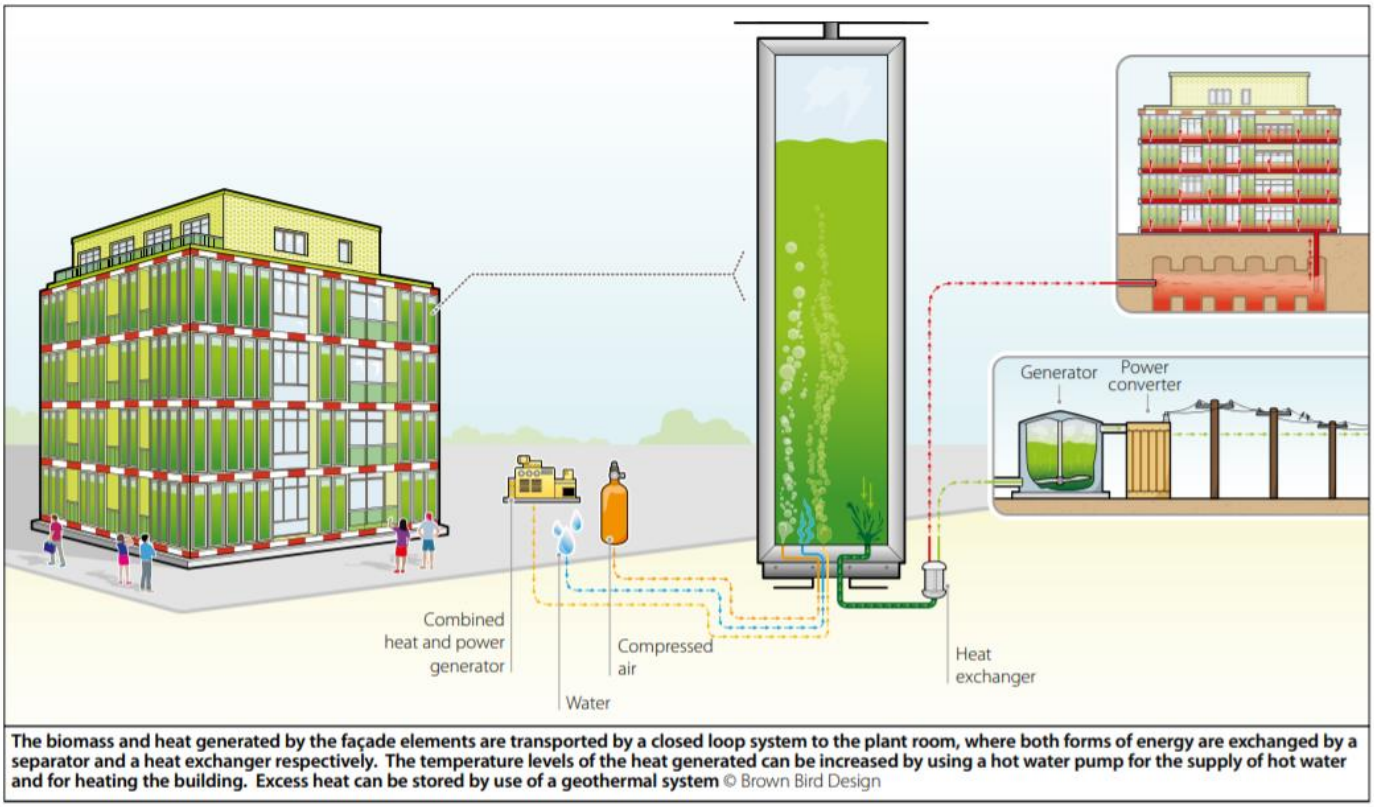

Figure 6: Biomass and Heat Generation

Source: Colt 2013.

Figure 7: BIQ Plant Room

Source: Colt 2013.

4.4 Building Services System, Room Plant, or Energy Center

The Rockwell SPS central building energy management system (BMS) automatically monitors the loop system's inputs and outputs. It regulates the availability of nutrients, the density of algae cells, and the harvesting of algal biomass. When the microalgae are ready to be harvested, the algal biomass is filtered out by a flotation system, collected in a temperature-controlled container in the building services system, transferred, and converted into biogas (methane) in an external biogas plant before being used to provide energy to the city. Once a week, this procedure takes place.

The building's energy management system also regulates the temperature to keep it below 40°C in the summer and above 5°C in the winter, which is ideal for microalgae production. The microalgae PBR panels provide heat that is utilized to warm the building since they are solar thermal collectors and shading devices. A heat exchanger in the building service system's energy center extracts heat. The thermal energy produced is used to heat the building and to pre-heat hot water. Heat pumps are used to extract excess heat, which is then stored in geothermal drilling wells beneath the building's subsoil.

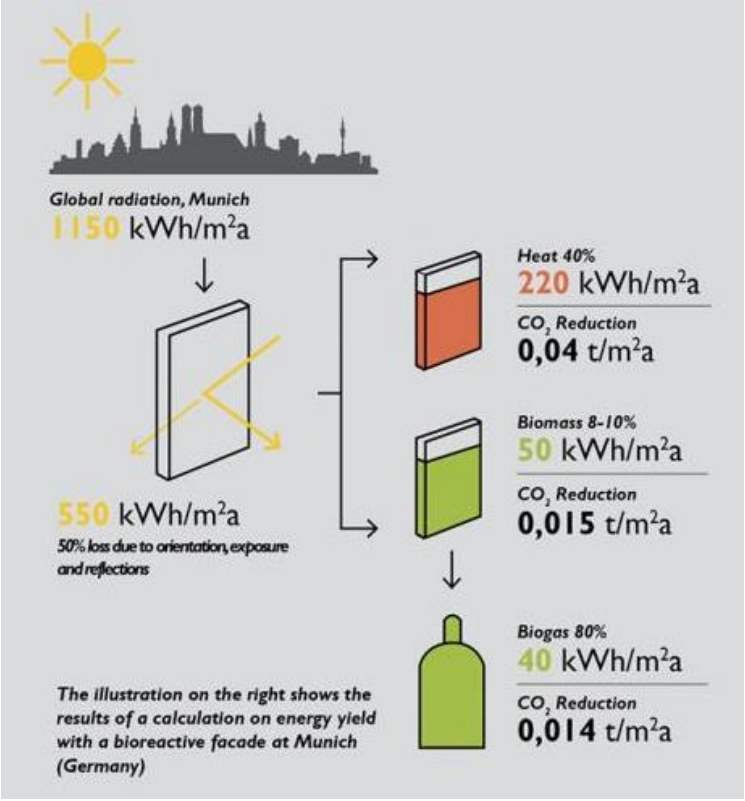

Figure 8: Estimated Calculated Energy Yield of Bioreactor Sited in Munich

Source: Colt, 2013.

Table 1: Efficiency of Conversion of Incident Sunlight to Biomass and Heat

Production	***Energy Conversion Efficiency (ECS) Ratio***
High value biomass	8–10%
Solar thermal heat	38–40%

Source: Colt, 2013.

Figure 8 shows that the global radiation energy in Munich measures 1150 kWh/m^2 p.a., half of that energy (550 kWh/m^2 p.a.) is lost due to reflection, exposure, and algae panel orientation. 220 kWh/m^2 p.a. of energy (40%) is generated as heat energy and distributed for use in buildings via hydronic heating systems. The biomass component is 50 kWh/m^2 p.a. (10%) and can be converted to biogas, which produces 40 kWh/m^2 p.a. energy. Each component, heat, biomass, and biogas, reduces CO_2 by 0.04 t/m^2 p.a., 0.015 t/m^2 p.a., and 0.014 t/m^2 p.a., respectively.

4.5 Results and Inferences

The SolarLeaf façade makes a structure and its components more energy efficient by utilizing the biological process of photosynthesis. The system has three main benefits:

(a) it generates high-quality biomass for energy purposes,
(b) it produces solar heat energy, and
(c) it can be used as dynamic shading and natural daylighting.

Microalgae growing in photo-bioreactor panels does not necessitate any extra land usage and is generally unaffected by weather conditions.

To achieve a short carbon cycle and avoid carbon emissions, the carbon needed to feed the algae is acquired from a combustion process near the facade system.

Chlorella sp. cultivation on a flat panel PBR with a volumetric productivity of 1, 9 g/L/day and 40% lipids in the biomass.

$$\text{Energy Production per Sq. M} = 49.92 \frac{\text{kWh}}{\text{Sq. M}} / \text{Year}$$

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Energy Production by Flat Plate Photobioreactor of BIQ Building

Naval Research in Washington DC, conducted a study to see how much O_2 is produced by 6.2 litres of algae solution. The research showed it produced 4.5 litres of O_2 per hour.

Based on above data,

1 Panel with volume = 0.0315 m^3

It has a capacity of 24 litres of liquid for microalgae culture.

Hence, by 1 panel = (24 x× 4.5)/6.2 = 17.42 litres of O_2 per hour will be produced.

The 200 Sq.M of integrated photobioreactors algae façade comes with a net annual energy supply of about 4,500 kW/h of electricity more than an average household consumes in a year (3,500 kW/h per year). As the BIQ house has 15 apartments, only one of them could in theory be completely supplied with electricity from the bioreactor panels. However, a much larger proportion of apartments can be provided with heat. Hence, the bioreactor façades are used for heat generation (6,000 kW/h per year), not for producing electricity.

This corresponds with the ability to supply four apartments with heat, from the bioreactors alone. In addition, thanks to the algae ability to function as a carbon capturing system, the building is able to eliminate 6 tons of CO_2 per year.

Table 1: Energy Production in a Year

Photo-bioreactors Panels Energy Indicators	
Indicators for 200 Sq.M Bioreactor Area with 300 days of Production/Year	
Biomethane Production	612 m^3 methane/year
Energy in Methane	6,487 kWh/year
Net Energy as Methane	approx. 4,541 kWh/year
Net Energy from Heat	approx. 6,000 kWh/year
Carbon Dioxide Emissions Reduction	6 tons per year
Biomass Production	900 kg/year
Energy Production in Biomass	345 kJ/Sq.M /day
Biogas Production from Biomass	10.20 L methane/Sq.M /day

5. ANALYSIS OF BIQ MODEL FOR DIFFERENT CLIMATE IN INDIA

ECBC defines five climate zones (hot-dry; warm-humid; composite; temperate; cold), which are distinctly unique in their weather profiles.

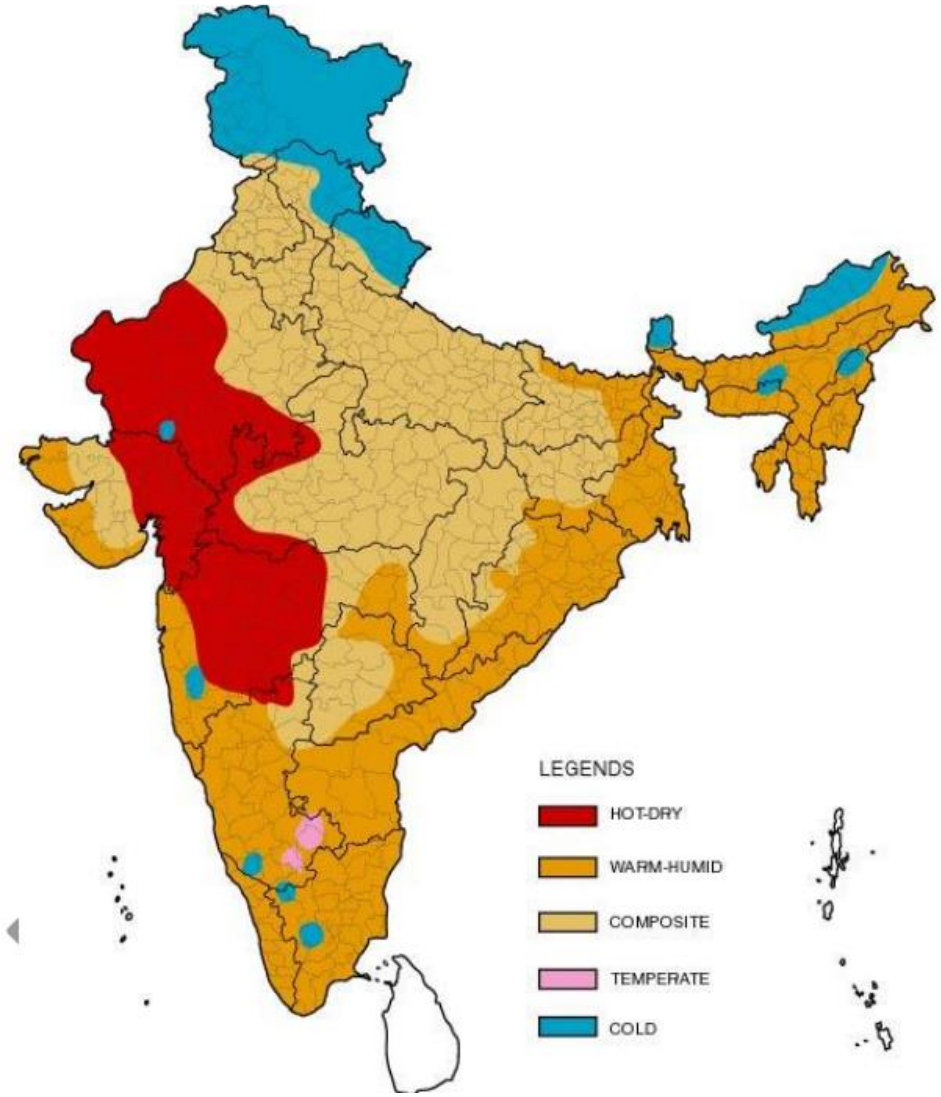

Figure 9: Climate Zone Map of India

Source: ECBC 2017.

5.1 Climate Zone for Major Indian Cities

Table 3: Climatic Zones of Indian Cities

S. No.	*City*	*Climate Type*
1.	Ahemdabad	Hot & Dry
2.	Mumbai	Warm & Humid
3.	Nagpur	Composite
4.	Bangalore	Temperate
5.	Leh	Cold

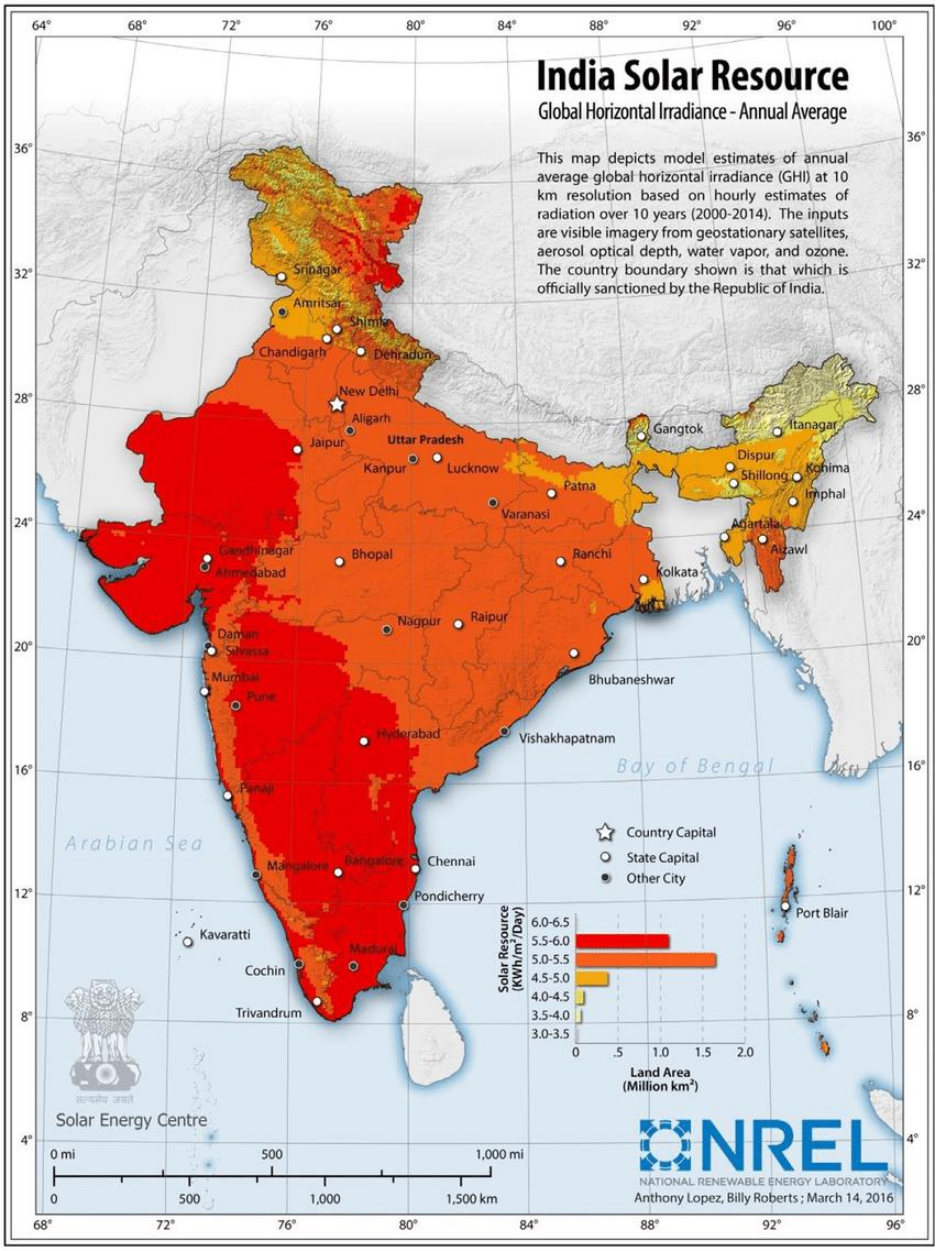

Figure 10: Global Horizontal Irradiation of India

Source: NREL.

Table 4: Global Horizontal Irradiation of Indian Cities

S. No.	*City*	*Global Irradiation ($kWh/m^2/a$)*	*Global Irradiation ($kWh/m^2/a$) (50% Loss)*	*Global Irradiation ($kWh/m^2/day$)*
1.	Ahemdabad	2098.75	1049.375	2.875
2.	Mumbai	1916.25	958.125	2.625
3.	Nagpur	1916.25	958.125	2.625
4.	Bangalore	2098.75	1049.375	2.875
5.	Leh	1733.75	866.875	2.375

(50% loss due to orientation, exposure and reflections)

Comparative Climate Data of Different Cities in India

Table 5: Climatic Data of Indian Cities

S. No.	*Cities*	*Temperature*		*Global Irradiation (kWh/m²/day)*	*Sunshine*	
		Average Max. (°C)	*Average Min. (°C)*		*Average of Sunshine Hours per day*	*Average Annual Sunshine (h/year)*
1.	Ahemdabad	41.5	14.2	2.875	9 hours 28 minutes	3453.81
2.	Mumbai	32.8	19.3	2.625	7 hours 20 minutes	2680
3.	Nagpur	42.6	14.3	2.625	9 hours 47 minutes	3573.46
4.	Bangalore	32.9	14.1	2.875	6 hours 44 minutes	2461
5.	Leh	24.6	-13.3	2.375	8 hours 46 minutes	3200.13

5.2 Photosynthetic Efficiency of Microalgae

Photosynthesis is the process by which green plants and algae convert carbon dioxide and water into carbohydrates through the action of sunlight on chlorophyll. These organisms can use the energy in sunlight to make oxygen and carbohydrates, as well as other molecules, which may be used for energy and the production of other compounds, through a sequence of oxidation-reduction processes.

$$6CO_2 + 12H_2O + \text{photons} \rightarrow C_6H_{12}O_6 + 6O_2 + 6H_2O$$

The solar energy accessible for photosynthesis is known as Photosynthetically Active Radiation (PAR), which spans the whole solar spectrum from 400 to 700 nm. The energy for photosynthetic conversion of carbon dioxide to carbohydrates is supplied by PAR, which varies with latitude, seasonality, and geographical conditions. Photosynthesis may not require all solar energy.

The maximum efficiency for converting solar energy into stored chemical energy is 33% because PAR photons have an average energy of about 217 kJ, with PAR accounting for 45.8% of incoming sunlight on the earth's surface and since 10–20% of solar energy is wasted due to surface reflection, only 12.8–14.4 percent of solar energy may potentially be transformed into algal biomass. The percent of PAR was supposed to remain constant, whereas it varies somewhat depending on the direct to diffuse solar irradiation ratio. Photosynthetic efficiency has a quantum limit of around 11.6 %. The value of $PAR_{component}$ mostly lies between 0.43-0.46. This value doesn't make any difference, as it vary a very small amount depending on the ratio of direct to diffusion solar irradiance.

8 photons are used by photosynthetic organisms to capture or fix one molecule of CO_2 into carbohydrate (CH_2O_n).

$$\text{Heating value of one mole of } CH_2O = 468\ \text{kJ}$$
$$\text{Mean energy of a mole of PAR photons} = 217.4\ \text{kJ}$$
$$\text{Maximum ideal theoretical conversion efficiency of PAR energy into carbohydrates} = \frac{468\text{kJ}}{8 \times 217.4\ \text{kJ}}$$
$$\text{Maximum ideal theoretical conversion efficiency of PAR energy into carbohydrates} = 27\%$$

5.3 Energy Stored in Biomass

Lipids, Carbohydrates, and Proteins are the three primary components of microalgae. The oil content of microalgae ranges from 20% to 80% by weight of dry biomass. The higher heating value or heat of combustion is the amount of microalgal biomass produced per unit of capture energy. The amount of energy stored in biomass can be calculated based on the percentage composition of these fractions. The heating value of microalgae was calculated using the assumed chemical composition of 40% lipid, 40% carbohydrate, and 20% protein. Microalgal biomass has a higher heating value of 23.62 MJ/kg.

$$E_{microalgae} = (f_L \times E_L) + (f_P \times E_P) + (f_C \times E_C)$$

where,

$E_{microalgae}$ = energy stored in the biomass (MJ/kg) (L = lipids; P = proteins; C = carbohydrates),

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f_L = microalgae lipid fraction usable for biodiesel,
f_P = microalgae protein content fraction, and
f_C = microalgae carbohydrate content fraction.

Microalgae biomass Production (g/m^2 /d)

$$MB_{production\ (daily)} = \frac{\eta_{transmission} \times \eta_{capture} \times S1}{E_{microalgae}}$$

where,

$MB_{production\ (daily)}$ = microalgae productivity in g/m^2 /day,
$\eta_{transmission}$ = efficiency of light transmission to microalgae,
$\eta_{capture}$ = efficiency of conversion of incident sunlight to biomass in microalgae,
S_1 = solar Irradiance falling on a horizontal surface (kWh/m^2 /day), and
$E_{microalgae}$ = Energy stored in the biomass (MJ/kg).

Microalgae Lipid Production (ml/m^2 /d)

$$ML_{production\ (daily)} = \frac{f_L \times MB_{production}}{\rho_L}$$

where,

$ML_{production\ (daily)}$ = lipid productivity from microalgae (ml/m^2 /day),
f_L = microalgae Lipid fraction usable for biodiesel,
$MB_{production}$ = microalgae productivity in g/m^2/day, and
ρL = density of lipids usable for conversion to biodiesel (kg/L).

5.4 Photon Transmission Efficiency of Sunlight to Microalgae

Photon transmission efficiency takes into consideration light distribution losses, absorption properties, land usage, and solar PAR. The availability of the growing system for cultivation throughout the year determines the efficiency of land utilization. An optimum design will reduce the number of incoming photons reaching the cells by minimizing light reflection or absorption by surfaces and materials, but any design will reduce the number of incident photons reaching the cells by some amount. The growing system was expected to maintain the entire photon flux density in the theoretical scenario, i.e., no fall in photon transmission efficiency below 100%.

$$\eta_{transmission} = \eta_{light\ distribtion} \times \eta_{land\ use} \times \alpha \times PAR_{component}$$

where,

$\eta_{transmission}$ = efficiency of light transmission to microalgae,
$\eta_{light\text{-}distribution}$ = optical light distribution efficiency,
$\eta_{land\text{-}use}$ = land-use efficiency, and
α = light absorption co-efficient
$PAR_{component}$ = photo synthetically active radiation

5.5 Solar Energy Capture Efficiency

The capture efficiency of the algae growth system depends on the efficiency of photosynthesis, absorption, respiration and photo inhibition characteristics of the microalgal culture. The energy required to fix CO_2 and produce chemical energy via photosynthesis is estimated to be 27 % as per the Z-Scheme or light-dependent reactions. While some researches might argue that higher values may be more realistic, because of our methodology of conservatism to produce an absolute maximum, eight was used because there is not yet consensus on a higher theoretical quantum requirement. Some portion of the captured energy is wasted due to respiration in microalgae during the night. The capture efficiency depends on the algae's ability to utilize the sunlight efficiently without photoinhibition.

$$\eta_{capture} = \eta_{photosynthesis} \times \eta_{photoutilization} \times (1 - r)$$

where,

$\eta_{capture}$ = efficiency of conversion of incident sunlight to biomass in microalgae,

$\eta_{photosynthetis}$ = photosynthetic efficiency,

$\eta_{photoutilization}$ = fraction of captured photons utilized by microalgae and

r = fraction of energy consumed by respiration in microalgae.

5.6 Photon utilization Efficiency – Bush Equation

The term photon utilization efficiency accounts for reductions in perfect photon absorption due to suboptimal conditions of the algal culture. A cell under optimal conditions will absorb and use nearly all incident photons. However, under suboptimal conditions such as highlight levels or non-optimal temperatures under which photoinhibition occurs, some absorbed photons will be reemitted as heat or cause damage to the cells. Reduction in photon utilization due to high-light levels can be significant for outdoor production, and the magnitude of this effect varies with species, light, and other ambient conditions such as temperature. Light utilization efficiency could range from 50–90% under low-light conditions to 10–30% under highlight conditions.

$$\eta_{photoutilization} = \frac{I_s}{I_t} \left[\ln\left(\frac{I_t}{I_s}\right) + 1 \right]$$

where,

I_s = saturation light photosynthetic photon flux density on microalgae (μmole/m^2/s) quantum of energy at which microalgal photosynthesis attains saturation,

I_t = incident light photosynthetic photon flux density incident on microalgae (μmole/m^2/s) quantum of energy available in natural sunlight.

In general, out of the total solar spectrum only 47% is available for photosynthetic applications. Furthermore, fixation of one CO2 molecule during photosynthesis necessitates a quantum requirement of eight, which results in a maximum utilization of only 27% of the PAR absorbed by the photosynthetic system. An additional 10% loss is identified as photo transmission losses. On the basis of these limitations, the theoretical maximum efficiency of solar energy conversion into biomass is approximately 11.42%. However, the magnitude of photosynthetic efficiency observed in the field, is further decreased by factors such as poor absorption, transmission, reflection, respiration and photoinhibition. Thus, it is shown that algae should obey the law of thermodynamics.

5.7 Annual Biomass and Lipid Productivity

Annual Biomass Productivity ($MB_{production\ (annual)}$)

$$MB_{production\ (annual)} = MB_{production(daily)} \times n \times 10^{-2}$$

Annual lipid productivity ($ML_{production\ (annual)}$)

$$ML_{production\ (annual)} = \frac{f_L \times MB_{production(annual)} \times 1000}{\rho L \left(\frac{kg}{L}\right)}$$

where,

$ML_{production\ (annual)}$) = annual average lipid productivity (L/ha/yr),

f_L = lipid fraction of algae biomass,

$MB_{production\ (annual)}$ = annual average biomass productivity (T/ha/yr) and

n = number of operating days

5.8 Carbon Mitigation Potential

Carbon dioxide can be efficiently fixed by microalgae. Photosynthesis converts carbon dioxide into carbohydrates, lipids, proteins, and nucleic acids. Carbon content varies according to microalgae strain, media, and cultivation conditions. The CO_2 fixation rate can be calculated by applying the law of conservation of mass.

Biomass molecular formula: $CO_{0.48}H_{1.83}N_{0.11}P_{0.01}$.

$M_{biomass}$ = 23.2 gram/mol: MCO_2 = 44 gram/mol

$4CO_2$ + nutrients + H_2O + hv → $4CO_{0.48}$ $H_{1.83}N_{0.11}P_{0.01}$ + $3.5O_2$

Rate constant K = MCO_2 /$M_{biomass}$ = 44/23.2 = 1.89.

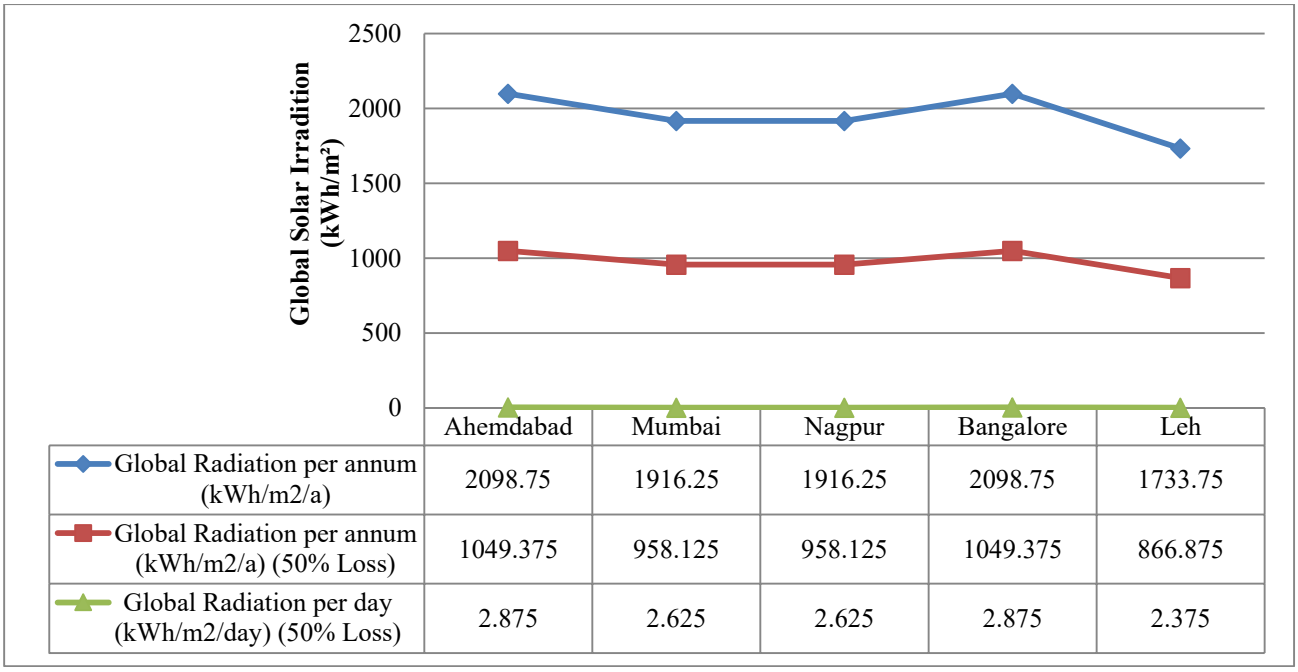
Total CO_2 fixation = K × biomass productivity × fixation efficiency

6. Results

6.1 Variation of Solar Radiation

Solar radiation is different for different latitudes because of the factors like geographic location, time of day, Season, local landscape and local weather. In a closed photobioreactor system i.e., for plat plate photobioreactor, 50% of the radiation are lost due to orientation, exposure and reflections.

Leh receives an average of 2.375 kWh/m^2/day of solar global radiation. Nagpur and Mumbai an average of 2.625 kWh/m^2/day & of solar global radiation respectively and Ahmedabad and Bangalore receives the maximum solar global radiation of 2.875 kWh/m^2/day & respectively.



	Ahemdabad	Mumbai	Nagpur	Bangalore	Leh
Global Radiation per annum (kWh/m2/a)	2098.75	1916.25	1916.25	2098.75	1733.75
Global Radiation per annum (kWh/m2/a) (50% Loss)	1049.375	958.125	958.125	1049.375	866.875
Global Radiation per day (kWh/m2/day) (50% Loss)	2.875	2.625	2.625	2.875	2.375

Figure 11: Variation in Solar Radiation in Selected Indian Cities

Source: Author.

5.10 Variation of Air Temperature

Temperatures between 20° and 40°C are ideal for algae growth. The maximum and minimum air temperatures in Ahmedabad were 41.5°C and 14.2°C respectively. The maximum and minimum air temperatures in Mumbai were 32.8°C and 19.3°C respectively. The maximum and minimum air temperatures in Nagpur were 42.6°C and 14.3°C respectively. The maximum and minimum air temperatures in Bangalore were 32.9°C and 14.1°C respectively and the maximum and minimum air temperatures in Leh were 24.6°C and -13.3°C respectively.

Summer heat makes algal cultivation difficult. Cities like Ahmedabad and Nagpur have air temperature for summers which is not suitable for growth of microalgae. Hence, for the growth external conditions need to be provided to maintain the required level of air temperature. Bangalore and Leh have low winter temperature and hence, artificial heating may be required during the winter months if the temperature rises below optimum levels.

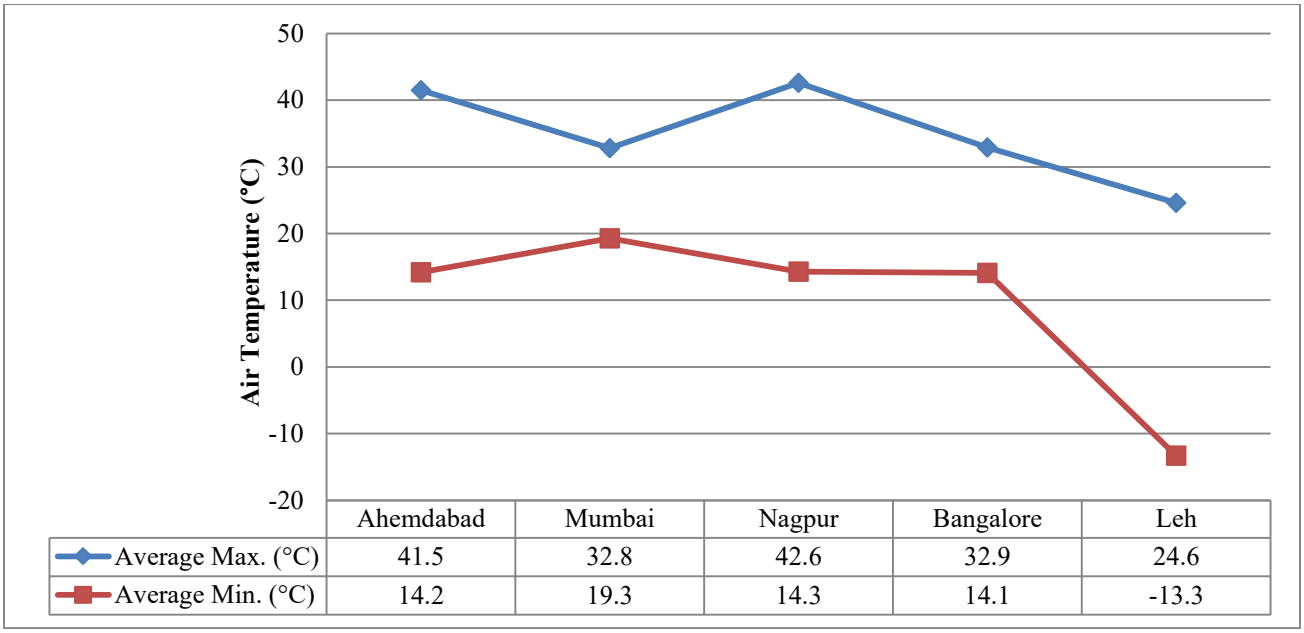


Figure 12: Variation in Air Temperature in Selected Indian Cities

Source: Author.

5.11 Biomass Production

Table 6: Values Calculated Per Day

Name	***Term***	***Unit***	***Value***
Energy Stored in the Biomass	$E_{microalgae}$	*MJ/kg*	*17.3165*
Efficiency of Light Transmission to Microalgae	$\eta_{transmission}$	–	0.419
efficiency of conversion of incident sunlight to biomass in microalgae	$\eta_{capture}$	–	0.189
Photon Utilization Efficiency	$\eta_{photoutilisation}$	—	1
Microalgae biomass production (g/m²/d)			
Cities	$MB_{production\ (daily)}$		
Ahemdabad	47.293		
Mumbai	43.181		
Nagpur	43.181		
Bangalore	47.293		
Leh	39.068		
Microalgae lipid production (ml/m²/d)			
Cities	$ML_{production\ (daily)}$		
Ahemdabad	9.2530		
Mumbai	8.4484		
Nagpur	8.4484		
Bangalore	9.2530		
Leh	7.6438		

Table 7: Annual Values Calculation

Annual Biomass Productivity ($MB_{production(annual)}$) (T/ha/yr)	
Ahemdabad	**172.620**
Mumbai	**157.610**
Nagpur	**157.610**
Bangalore	**172.620**
Leh	**142.599**
Annual Lipid Productivity ($ML_{production(annual)}$) (L/ha/yr)	
Ahemdabad	**33773.564**
Mumbai	**30836.732**
Nagpur	**30836.732**
Bangalore	**33773.564**
Leh	**27899.901**

APPENDIX 2

Theoretical Calculation of Microalgae Potential

Table 6 summarises the daily mass productivity for the selected cities, which is between the range of 35–50 g/m^2/d and daily lipid productivity or oil production is between 7–10 ml/m^2/day.

Table 7 summarises the annual mass productivity for the selected cities, which is between the range of 140-180 T/ha/yr and annual lipid productivity or oil production is between 27,000–34,000 L/ha/yr.

7. CARBON FIXATION POTENTIAL

Figure 13 summarises the annual average carbon fixation potential for the selected cities. Leh has the lowest carbon fixation capacity of almost 27 T CO_2/ha/yr. Mumbai and Nagpur have carbon fixation capacity of almost 30 T CO_2/ha/yr while Ahmedabad and Bangalore have carbon fixation capacity of almost 33 T CO_2/ha/yr. This estimate is far greater than terrestrial plants' carbon fixation capacity. Regardless of methodological differences, all estimates confirm algae's productive potential as a sustainable source of carbon sequestration and energy production.

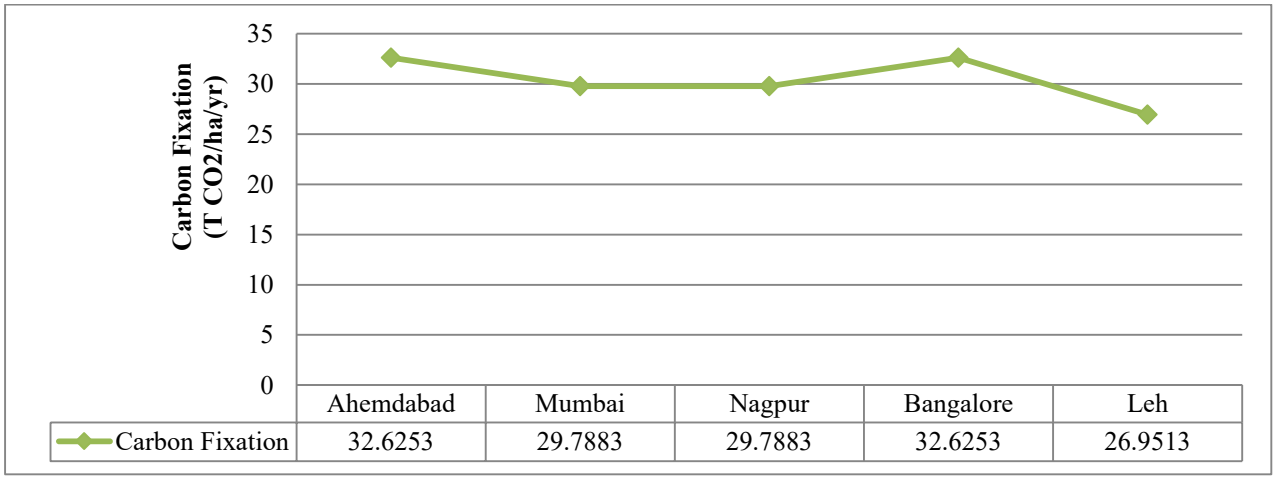


Figure 13: Variation in Carbon Fixation in Selected Indian Cities

Source: Author.

8. Oxygen Production

The weight ratio of O_2 absorbed and released by plants during photosynthesis is 1:0.938, and the ratio of O_2 released and CO_2 fixed is 1:0.727, according to the basic principle of carbon fixation and oxygen release in plants.

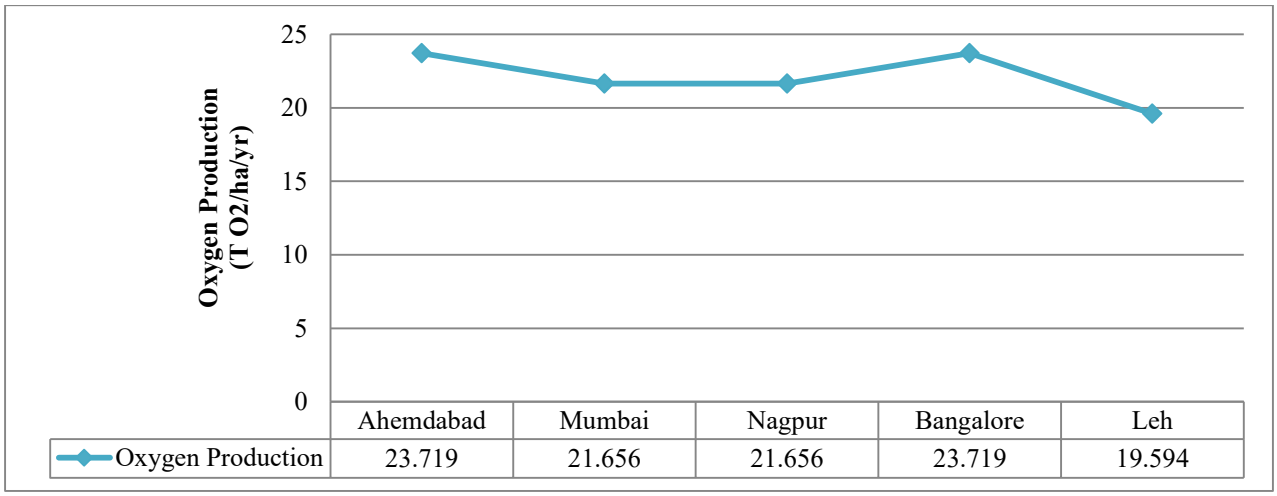


Figure 14: Variation in Oxygen Production in Selected Indian Cities

Source: Author.

9. DISCUSSION

The current study is being conducted in order to disseminate a methodology for estimating the algal biomass potential in any region given the climatic conditions. Temperate climates and Warm and Humid Climates would be ideal for providing algae façade without artificial technology to maintain temperature inside the algae medium. The study was based on the assumption that algae production would take place in flat plate photobioreactor of the same model of BIQ building using natural light in different cities of India. The biomass and lipid estimates for the potential sites were evaluated.

Algal facade can help with issues like global warming and CO_2 sequestration while providing shading to the building.

10. CONCLUSION

Based on photosynthetic light efficiency, the analytical method presented here can yield rough estimates of the algae biomass potential in India under ambient conditions. In the Indian condition, the biomass and biofuel yield were found to be 140–180 T/ha/yr and 27,000-34,000 L/ha/yr l/ha/year, respectively. The average annual carbon fixation potential is between 25–35 T CO_2/ha/yr for the selected cities.

According to the sensitivity analysis, solar radiation has a significant impact on microalgae growth. The efficiency of carbon fixation will help to aid mitigation of CO_2 emissions from the building and produce Oxygen. As a result a micro algae façade system for the Indian Climate can be designed efficiently.

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NOMENCLATURE

ATP : Adenosine Triphosphate
BIQ : Bio Intelligent Quotient
BMS : Building Energy Management System
CHP : Combined Heat and Power Unit
LED : Light Emitting Diode
LHC : Light Harvesting Chlorophyll
NADP : Nicotinamide Adenine Dinucleotide Phosphate

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APPENDIX

Appendix 1: Energy Production by Flat Plate Photobioreactor of BIQ Building 464

Daily production of lipids is 0.76 g/L/day.

$$\text{Conversion to tonnes} = 0.76 \times 0.000001$$
$$= 0.00000076 \frac{\text{t}}{\text{L}}/\text{day}$$

$$\text{Production per Year} = 365 \times 0.00000076$$
$$= 0.0002774 \frac{\text{t}}{\text{L}}/\text{year}$$

$$1\ \text{t biodiesel} = 0.86\ \text{toe}$$
$$\text{Production per Year} = 0.86 \times 0.0002774$$
$$= 0.00023856 \frac{\text{toe}}{\text{L}}/\ \text{year}$$

$$1\ \text{toe} = 11626\ \text{kWh}$$
$$\text{Production per Year} = 11626 \times 0.00023856$$
$$= 2{,}774 \frac{\text{kWh}}{\text{L}}/\text{year}$$

The flat panel PBR has dimensions of: width = 0.7 m, height = 2.5 m, depth = 0.018 m

The panel volume is: 0.7 x 2.5 x 0.018 = 0.0315 m^3

$$\text{Energy Production per Panel} = 0.0315 \times 2{,}774$$
$$\text{Energy Production per Panel} = 87.38 \frac{\text{kWh}}{\text{Panel}}/\text{Year}$$
$$\text{Energy Production per Sq. M} = \frac{2.5 \times 0.7}{87.38}$$

Appendix 5-1: Theoretical Calculation of Microalgae Potential

Optimum values of parameters used in the Calculation

Name	*Term*	*Unit*	*Range*
Optical light Distribution efficiency	$\eta_{\text{light-distribution}}$	%	0.96-0.98
Land-use Efficiency	$\eta_{\text{land-use}}$	%	0.98
Light absorption coefficient of microalgae	α	-	1
Photosynthetically active radiation of Sun	$\text{PAR}_{\text{component}}$	%	0.43-0.46
Incident light photosynthetic photon flux density (PPFD) incident on microalgae	I_s	µmole/m^2/s	150-200
Saturation light photosynthetic photon flux density (PPFD) on microalgae	I_t	µmole/m^2/s	200
Fraction of energy consumed by respiration in microalgae	r	-	0.10 - 0.50
Photosynthesis efficiency	$\eta_{\text{photosynthetis}}$	%	0.27
Density of lipids usable for conversion to biodiesel	ρ_L	kg/l	0.92

Chemical composition of Algae expressed on a Dry Matter Basis (%)

Strain	*Protein (f_P)*	*Carbohydrate (f_C)*	*Lipids (f_L)*	*Nucleic Acid*
Chlorella Vulgaris	51-58	12-17	14-22	4-5

Biomass fraction of Microalgae

Fraction	*Net Calorific Value (MJ/kg)*
Protein *(E_P)*	15.5
Carbohydrate *(E_C)*	13
Lipid *(E_L)*	38.8

Energy Stored in Biomass

$$E_{microalgae} = (f_L \times E_L) + (f_P \times E_P) + (f_C \times E_C)$$

Energy Store in Biomass (MJ/kg)						
f_P	E_P	f_C	E_C	f_L	E_L	$E_{microalgae}$
54.50%	15.5	14.50%	13	18.00%	38.8	**17.3165**

Efficiency of light transmission to Microalgae

$$\eta_{transmission} = \eta_{light\ distribtion} \times \eta_{land\ use} \times \alpha \times PAR_{component}$$

$\eta_{light\text{-}distribution}$	$\eta_{land\text{-}use}$	α	$PAR_{component}$	$\eta_{transmission}$
0.96	0.98	1	0.445	**0.419**

Photon Utilization Efficiency (Bush Equation)

$$\eta_{photoutilization} = \frac{I_s}{I_t}\left[\ln\left(\frac{I_t}{I_s}\right) + 1\right]$$

$$= \frac{200}{200}\left[\ln\left(\frac{200}{200}\right) + 1\right]$$

$$\eta_{photoutilization} = 1$$

Solar energy capture efficiency

$$\eta_{capture} = \eta_{photosynthesis} \times \eta_{photoutilization} \times (1\text{-}r)$$

$\eta_{photosynthetis}$	$\eta_{photoutilization}$	r	$(1\text{-}r)$	$\eta_{capture}$
0.27	1	0.3	0.7	**0.189**

Microalgae biomass production ($g/m^2/d$)

$$MB_{production\ (daily)} = \frac{\eta_{transmission} \times \eta_{capture} \times S1}{E_{microalgae}}$$

Microalgae biomass Production ($g/m^2/d$)					
Cities	$\eta_{transmission}$	$\eta_{capture}$	S_1	$E_{microalgae}$	$MB_{production\ (daily)}$
Ahemdabad	0.419	0.189	2.875	17.3165	**47.293**
Mumbai	0.419	0.189	2.625	17.3165	**43.181**
Nagpur	0.419	0.189	2.625	17.3165	**43.181**
Bangalore	0.419	0.189	2.875	17.3165	**47.293**
Leh	0.419	0.189	2.375	17.3165	**39.068**

Microalgae lipid production (ml/m² /d)

$$MB_{production\ (daily)} = \frac{\eta_{transmission} \times \eta_{capture} \times S1}{E_{microalgae}}$$

Microalgae Lipid Production (ml/m²/d)				
Cities	***Fl***	***MB production (daily)***	***ρL***	***ML production (daily)***
Ahemdabad	18%	47.293	0.92	**9.2530**
Mumbai	18%	43.181	0.92	**8.4484**
Nagpur	18%	43.181	0.92	**8.4484**
Bangalore	18%	47.293	0.92	**9.2530**
Leh	18%	39.068	0.92	**7.6438**

Annual Biomass Production (T/m²/year)

$$MB_{production\ (annual)} = MB_{production(daily)} \times n \times 10^{-2}$$

Annual Biomass Productivity (MB production (annual)) (T/ha/yr)				
Cities	***MB production (daily)***	***n***	***1/100***	***MB production (annual)***
Ahemdabad	47.293	365	0.01	**172.6204**
Mumbai	43.181	365	0.01	**157.6100**
Nagpur	43.181	365	0.01	**157.6100**
Bangalore	47.293	365	0.01	**172.6204**
Leh	39.068	365	0.01	**142.5995**

Annual Lipid Production (L/m²/year)

$$ML_{production\ (annual)} = \frac{f_L \times MB_{production(annual)} \times 1000}{\rho L\ (\frac{kg}{L})} \textit{sda}$$

Annual Lipid Productivity (ML production (annual)) (L/ha/yr)					
Cities	***fL***	***MB production (annual)***	***1000***	***ρL***	***ML production (annual)***
Ahemdabad	18.00%	172.6204	1000	0.9200	**33773.56448**
Mumbai	18.00%	157.6100	1000	0.9200	**30836.73278**
Nagpur	18.00%	157.6100	1000	0.9200	**30836.73278**
Bangalore	18.00%	172.6204	1000	0.9200	**33773.56448**
Leh	18.00%	142.5995	1000	0.9200	**27899.90109**

Carbon Fixation (T CO_2/ha/yr)

Total CO_2 fixation = K × biomass productivity × fixation efficiency

Total Carbon Fixation (T CO_2/ha/yr)				
Cities	***k***	***MB production (annual)***	***Fixation Efficiency***	***Total CO_2 fixation***
Ahemdabad	1.89	172.6204	10%	**32.6253**
Mumbai	1.89	157.6100	10%	**29.7883**
Nagpur	1.89	157.6100	10%	**29.7883**
Bangalore	1.89	172.6204	10%	**32.6253**
Leh	1.89	142.5995	10%	**26.9513**

Oxygen Production (T O_2/ha/yr)

Total O_2 Production = CO_2 Fixation x 0.727

Total Oxygen Production (T O_2/ha/yr)			
Cities	***Carbon Fixation***	***1 : 0.727***	***Oxygen Production***
Ahemdabad	32.6253	0.727	**23.719**
Mumbai	29.7883	0.727	**21.656**
Nagpur	29.7883	0.727	**21.656**
Bangalore	32.6253	0.727	**23.719**
Leh	26.9513	0.727	**19.594**

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Understanding the Sense of Space through the Perception of Blind

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ABSTRACT: The built environment around us is predominantly designed with a visual appreciation or function in mind. However, we communicate with the built environment with our entire body as well as our senses, with sight being the most dominant. In such a scenario, what about the people with visual impairment? How do they interact with the surrounding built and unbuilt environment? The study's aim is to gain a comprehensive understanding of the world of the visually impaired, as well as to investigate the role of architecture in facilitating their everyday lives and enhancing their senses. The methodology adopted is qualitative in nature. Wherein interviews were conducted with blind students and professionals working with them, deriving certain parameters to evaluate the selected built structure. Through the derived parameters emerging common themes deriving the relation of senses and spaces for the blind is studied. Through the study the relation of senses and architecture is derived leading towards a multi-sensory approach to architecture.

Keywords*: Non-visual Architecture, Evaluation of Built, Multi-Sensory Architecture, Perception of Space, Senses.*

1. INTRODUCTION AND BACKGROUND OF STUDY

The built environment around us is primarily constructed with a focus on visual or aesthetical properties. However, we communicate with the built environment with our entire body as well as our senses, but most notably with our eyes, which play a critical role in understanding and interpreting any area. In such a scenario, what about the people with visual impairment? How do they interact with the surrounding built and unbuilt environment? The study's aim is to gain a comprehensive understanding of the world of the visually impaired, as well as to investigate the role of architecture in facilitating their daily lives and enhancing their senses. According to WHO, there are 9 million visually impaired in India from which 80% are from rural areas. (Organisation (WHO), 1980) How do these 9 million people interpret the world designed for the sighted? They are somewhere dependent on others to guide them to understand certain spaces. This dependence can be eradicated through architecture if the architecture around them becomes communicative. The built environment existing around us is predominantly visual in nature which hampers the accessibility of the people with visual impairment creating barriers in their movement. In order to study the spatial barriers, a typology purely used by the visually-impaired should be analyzed so that one can study their behaviour, understand how they perceive space and extract their requirements. Thus, school for the visually impaired as a typology is studied critically from which the relation of spaces with them is analyzed. One such school of blind which is an ashram shala located in Dang district, Gujarat is considered as site to further explore and analyse the built character.

Further to conduct the research, methodology adopted is qualitative in nature. Wherein interviews are conducted with blind students and professionals working with them further deriving certain parameters to evaluate the selected built structure. Moreover, certain interesting exercises like making the students draw mind maps in order to understand their perception of space and form in a better way were conducted. Through the derived parameters emerging common themes deriving the relation of senses and spaces for the blind is being studied. Through the study the relation of senses and architecture will be derived leading towards a multi-sensory approach to architecture.

2. LITERATURE REVIEW

The research mainly aims to understand the world through a non-visual perception which analyses the inclusiveness of architecture. The author Juhani Pallasmaa in his book 'Eyes of the Skin' built an argument where architecture should not be objectified as mere aesthetic dominating the eye but should involve the body and all its senses to experience it. The author firstly explained the ongoing issue of Modern art and architecture where he blamed technological advancement resulting from dominance of vision. He termed it as 'Ocularcentrism' which suppresses other senses, detaching and isolating the

holistic experience of a space. The ocular-centric architecture that tries creating a striking and memorable visual image of a building does not allow us to experience our being in the world, and instead makes us mere spectators of an image projected into the eye. (Pallasmaa, 1996) He believes that architecture is the means to connect space and time, but the visual bias in architecture somewhere aims at acquiring ageless perfection but in the process becomes timeless. Also, he adds that due to this dominance of vision the ego-consciousness of the modern era has increased isolating self with the world.

'Vision separates us from the world whereas the other senses unite us with it.' (Pallasmaa, 1996)

– Juhani Pallasmaa

The above quote explains the power of other senses in experiencing the surrounding environment in a more holistic and connected way. Visually-impaired possess this power to experience the world in a holistic way, which connects them to their surroundings through other senses. Thus, in order to study the same, articles aiming to understand how blind functions and perceives a space deriving the relation of senses and architecture are studied. Moreover, articles and case studies exploring methods of evaluating the architectural elements in structures according to the comfort of visually-impaired are also taken into onsideration.

The article 'Understanding the Experience of the Visually Impaired towards a Multi-Sensorial Architectural Design' by Sarah M. Oteifa tries to analyze the world of visually impaired by understanding their spatial experiences in the environment having dominance of vision and designed for the sighted. The aim of this essay is to gain a detailed understanding of the world of the visually impaired and to derive the quality of space that meets their needs, highlighting the importance of multi-sensory architecture. Also, this article tries to examine spaces completely with the perspective of blind individuals which actually brings out their idea of space. The author tries to understand this community through an interactive and participatory method explained below:

Qualitative Inter-subjective approach:

1. Written interview of a blind architect Chris Downey
2. Written statements from the book written by blind professor Hull
3. Semi-structured interview with a formerly blind person
4. Participant observation.

Considering the above factors as the base of the study further the common parameters were extracted. By analyzing the common parameters the emerging themes of senses playing a major role for the visually impaired in experiencing the spaces were extracted and represented in the form of an idea diagram.

The paper not only aims to understand the experience of visually impaired but also derives the parameters required to be incorporated in the spaces for visually impaired. The representation of the author in order to understand the world of blind is completely according to the description and perspective of the blinds. As the methodology is derived from interactive basis with the blinds of different types, the article captures and makes the reader understand the true experience of being blind and derives the concept of using senses to help blind navigate and understand spaces.

1.1 Hazelwood School, Glasgow—Case Study

The Hazelwood School in Glasgow was one of the first developed schools for the visually impaired, relying on extensive research. The idea of the architect was to generate a real sense of independence for the pupil and to design a place of safety and ambition that would support the child. The design principles revolve around the requirements of the visually impaired where form, access, circulation and movement trial is exclusively designed keeping blind in mind. The basic parameters considered in the process of designing majorly focused on controlling the intensity of the light, Safety, Ease in navigation, Movement pattern and Sensory Indications.

2.2 Methodology (Mathematical Models used if any should be discussed here)

Through the Literature review the spatial perception of blind, senses and its relation with spaces is understood. The pilot study of Hazelwood School helped in deriving certain parameters to evaluate the building according to the blind perception of space. An intersubjective approach was adopted in order to holistically understand the world of the visually impaired. It aims at finding common parameters leading to emerging themes from several sources. As the research is more user specific methodology applied was more qualitative in nature where in interviews of blind students and professionals working with

them are considered to be the primary source of data followed by photo ethnography and personal observations. A semi-structured interview of 3 blind students (2-girls 1-boy) was conducted to understand their perception and association of spaces. The interview was a walk with interview wherein all the blind candidates had to individually lead and reach a particular destination within the school building while talking with the researcher. Thus, the movement of all three candidates of that particular path taken to reach the destination is documented and further compared to evaluate the build.

A focused group discussion with 3 professionals (teachers) in the school aims to understand the spatial barriers faced by the blind students. The interview question tries to understand their daily life and existing issues they deal with the built environment. Moreover, an exercise of photo-ethnography was conducted wherein the participants had to document certain spatial barriers in form of photos.

Common parameters regarding the built environment are drawn from the interviews and the cognitive plan exercise which is further represented in the form of comparative charts, cognitive maps and photographs. Further common themes of senses are derived where the relation of senses and spaces is discussed.

Through the study the relation of senses and architecture is derived leading towards a multi-sensory approach to architecture.

Table 1: Comparative Analysis of the Movement of Candidates

	1	***2***	***3***
Ground Floor			
First Floor			
Finding	First candidate PS is a 16 year old completely blind student. Her movement was majorly based on strong memory wherein she only had to take help of the anchor points like columns and doors at the turnings without getting disoriented in the corridors and staircase spaces.	Second candidate RP is a 16 year old completely blind student. Her movement was guided by the built around wherein she constantly needed the support of anchor points, doors and windows to reach her destination. Her movement shows disorientation in the central atrium space which shows lack of anchor points and guiding planes.	Third candidate SP is an 18 year old partially blind student. His movement seems clear on the ground floor level due to the presence of a guiding plane but a bit hazy on the first floor where he had to be dependent on anchor points due to the absence of a guiding plane. Thus his movement was dependent more upon the guiding planes followed by other factors.

3. RESULTS & DISCUSSION

In order to understand the perspective of blind, an exercise was conducted wherein the blind candidates had to individually lead and reach a particular destination within the school building while talking with the researcher. This exercise was performed by 3 blind students having different cognitive levels and different kinds of blindness but in the same built structure. Through the cognitive maps the movement and orientation of all the candidates is analysed (represented in table no. 1) all the three, parameters related to the built structure are evaluated.

3.1 Spatial Arrangement

Spatial arrangement is the organisation of space which brings together different forms and shapes and provides a cohesive structure to a design. The mere organisation of spaces sets up relationships between space and humans through multiple means. The school building has a centralised organisation where an atrium space lies in the center of the structure followed by corridors space connecting the rooms at the periphery. The atrium space due to its huge volume is an overlooking

gathering area with stage at one side. Due to the volume blind students tend to get disoriented as the sound echoes, the direction cannot be recognised.

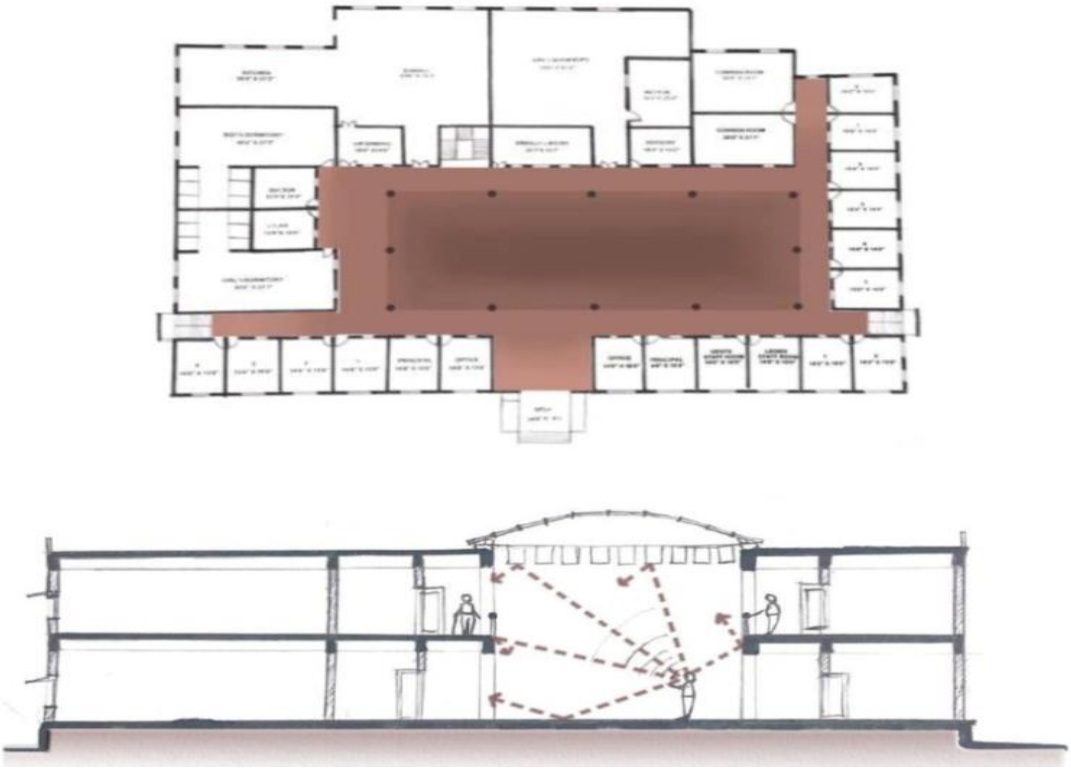

Figure 1: Plan and Section Highlighting the Placement and Adverse Effect of Atrium Space on the Spatial Arrangement

3.2 Orientation and Mobility

Direction alludes to the capacity to know where one is and where one needs to go. Mobility alludes to the capacity to move securely, productively, and adequately starting with one spot then onto the next. Orientation and mobility is an integral part of the visually imapired education system practised to make them understand the environment around them. The built structure plays a major role in guiding and developing the sense of orientation and mobility which could be analysed by evaluating the guiding planes and the anchor points in any space.

3.2.1 *Guiding Plane*

Figure 2: School Plan Highlighting Guiding Lanes and Image Showing Their Hierarchy

Guiding planes are the medium that provides a sense of direction to a space by creating a continuous strip or band. These could be on horizontal surfaces like floors of corridors, atrium spaces, rooms, etc as well as on vertical surfaces like walls. The guiding band should be differentiated from the rest of the plane by varying properties of colour and texture to give a more communicative sense of direction. The property of colour could be partially seen by the partially visually impaired but not visible to completely blind people whereas texture could be recognised by both making it inclusive in nature. Hence, the presence of a guiding plane makes a space safer and communicative which can be understood in the ground floor movement of SP who is partially visually-imparied. Whereas the absence of a guiding plane hinders the movement of the user which is observed on the first floor level corridors.

3.2.2 Anchor Points

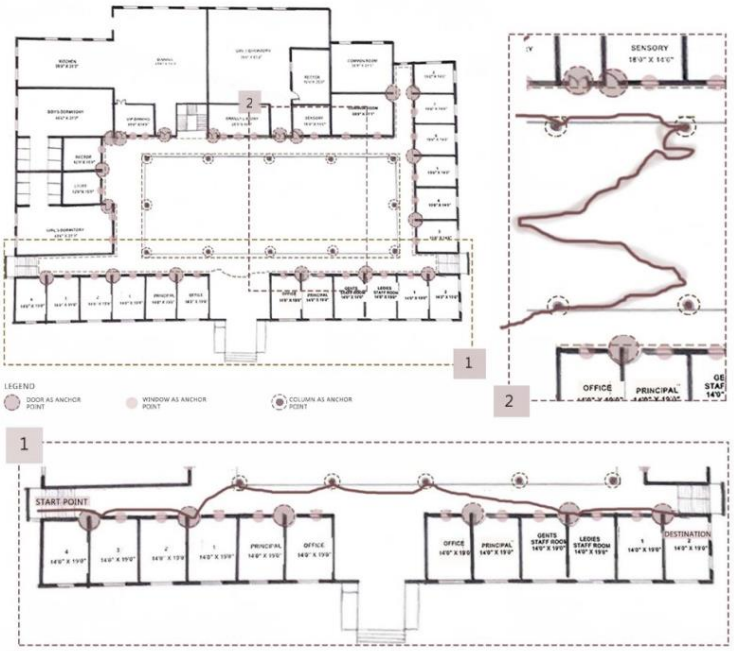

Figure 3: Plan Showing Types of Anchor Points and Corresponding Detail Movements

Anchor points are the point of contact within a surface that creates a mathematical sequence by repetition of certain attributes of space. Anchor points take care of the orientation by limiting the frame at the same time it also provides safety and a sense of direction for the movement of the user. Columns, railings, doors and windows act like a strong anchor point for the built spaces. Anchor points act like an extension of the guiding plane that provides precise location of the space. The study shows disorientation in the movement of Second candidate(RP) in the atrium space. The lack of anchor points to achieve column free space in the atrium hampers the movement on the ground floor resulting in disorientation for the blind.

3.3 Material and Textures

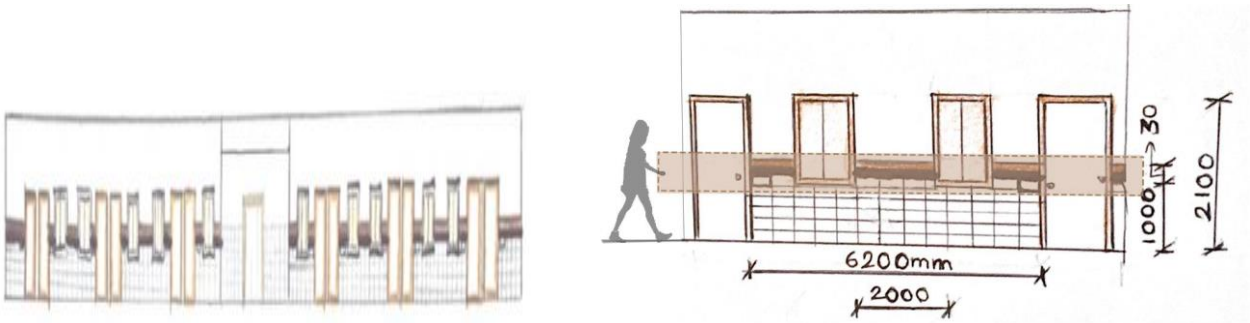

Figure 4: Internal Elevation showing the Hierarchy and Repetition of Material

Visually impaired children are trained to use their hands and feet to feel materials surrounding them. They naturally use their hands by touching the surface.

Once in a while they will in general stretch their legs to have the option to distinguish objects on the floor and to feel the various surfaces to know the specific area they are remaining on, particularly in the event that they're not close to dividers. They also learn to recognise different materials by using replicas of wood, aluminium, plastic, and cement, remembering them by their surface, temperature, and weight, and matching with related materials. “Materials are felt” as mentioned by Downey, a blind architect. They are heard and felt through touching, tapping and listening to their echoes. Visually impaired people's tactile perception increases as new materials with different textures are used giving an identity to a particular space.

3.4 Understanding Spaces

The study of movement and interview of the visually impaired candidates revealed that each individual has a unique way to recognise a space. The visually impaired students in their academic syllabus are taught to memorise spaces by forming a mathematical sequence which in a way forms a cognitive map helping them to navigate and understand spaces. Also, naturally they tend to recognise spaces by its spatial quality which for them becomes an identity. The study shows that the first candidate (PS) seems to be dependent more upon her memory of space which guided her to form a mathematical sequence of position of staircases, number and distance of anchor points guiding her to different rooms where signages help to identify the exact space. Whereas the second candidate (RP) was dependent upon the spatial quantity and identity of the space wherein she followed all the anchor points leading to a particular space and then recognised the space by its spatial quality. The spatial quality of space can also be termed as the sense of space where certain characteristics like volume, light intensity, smell and thermal atmosphere in an enclosed space plays an important part in becoming the identity. The atrium space in the school is identified by the huge volume created due to the double height space. Though an identity is created due to its volume, atrium space gives an adverse effect on the movement as well as auditory experience for the visually impaired. Due to the huge volume the sound in the atrium space as well as the corridor space tends to echo confusing the blind individual regarding the direction of sound and further misleading them.

Table 2: Table Showing Comfort Conditions of Spaces with Respect to Senses

Spaces	*Comfort Condition*	*Hap-Tic*	*Audit-Ory*	*Olfac-Tory*	*Temper-Ature*
Atrium		N	Y	N	N
Corridor		Y	N	N	N
Classrooms		Y	Y	N	N
Sensory Rooms		Y	N	Y	Y
Music Room		N	Y	N	Y
Hostel Room		Y	N	Y	Y
Mess Area		N	Y	Y	Y

Through the derived parameters analysed above common emerging themes deriving the relation of senses and spaces for the blind is further discussed below:

Haptic Sense: One of the key channels by which the visually impaired experience their surroundings is through tactile feedback or the sense of touch where the body physically interacts with the surroundings. Visually impaired people can use their sense of touch to feel the nature and environment around them, identify space, recognise materials and textures. Every material inherents different tactile properties with varying textures. A communicative space tends to have multiple layers of tactile properties having different functions. For instance, to generate a boundary for safety on the floor, a band high grained hard texture could be used for vertical or horizontal guiding plane or anchor points.

Figure 5: School Plan Showing the Comfort Level of Spaces

Auditory Sense: Hearing helps the visually impaired in perceiving and comprehending their surroundings since it offers a three-dimensional distant and close environment.

Hearing architecture is how one imagines and interprets the space, as well as the height, since hearing, unlike touching, is a sense of distance. It also assists visually disabled people in assessing their position and orientation.

Olfactory Sense: According to the interviews, the sense of smell assists visually disabled people in creating a mental image of their surroundings. One of the most interesting observations about the sense of smell is its connection to feelings and memory. The sense of smell gives a space an intangible identity.

4. CONCLUSION

This research aims to understand architecture in a non-visual way through the perception of the visually impaired community. It helps us understand blinds' way of seeing and their association with spaces along with understanding spatial barriers they face in daily life. It examines the role of architects to design barrier free and communicating spaces using all senses as medium to experience spaces. Moreover, it open ups a new thought for discussion where senses could be used as a medium of communication between human and architecture. The relation of senses and architecture i.e. multi-sensory architecture could be derived wherein architecture is not only a visual aesthetic sculpture but also helpful communicative friend for the disables and is a more active and liveable environment for everyone.

ACKNOWLEDGEMENTS

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Aarogyalaya—A Holistic Healthcare Facility for Integrated Medicine

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ABSTRACT: India has one of the oldest civilizations and still thriving in the 21st centaury we have a unique agglomeration of various contemporary and ancient wisdoms be it in any discipline. Particularly when it comes to the field of medical sciences no other country in the world has so many different forms of treatments available. The different medical disciplines in India like Ayurveda, yoga, unani, siddha, homeopathy, spiritual healing, meditation etc. are based on the doctrine of "prevention is better than cure" Inculcating these disciplines in our life and strengthening the body from within is the basic essence of leading a healthy life, because of our busy life India is experiencing rise in Non communicable diseases (NCDs). Integrative medicine is the amalgamation of contemporary and traditional medical practice towards the healing. This research is an attempt towards designing a holistic healthcare facility to promote these medical disciplines of India.

Keywords: *Holistic, Integrative Medicine, Healing, AYUSH, Medical Practice.*

1. INTRODUCTION

India is a land known for its rich knowledge and expertise in Healing and wellbeing be it with respect to spirituality or medical care the knowledge and wisdom of various scholars since time immemorial.

A synergistic approach in healthcare uses knowledge of various medical systems towards the healing of an individual, this is new to the field of healthcare in India but has got evidence to prove its benefits towards improving the health of people. An integrated medical system encompasses various medical disciplines towards the healing of patients. Combining the allopathy's strategy of "offence" and alternative medication strategy of "defense" for curing the ailing condition of patients has helped them to recover from their diseases in a holistic way where in the side effects of various allopathy treatments have been mitigated by the use of alternative ayurvedic therapies.

The effectiveness of these treatments and affordability has contributed in the rise of medical tourism in India, in turn medical tourism to India from various countries such as the ones in Sub Saharan Africa, Europe, USA, Arab countries has contributed to attract Indian masses towards these treatments.

By analyzing Alternative medical care in India, the government of India launched the AYUSH Department which aims at providing treatments in the domain of Ayurveda, Yoga, Unani, Siddha, Homeopathy and encouraging medical practioners to extend their courtesies in a holistic way.

Allopathy along with the AYUSH medication has many prospects as well as challenges which arise due to ambiguity of medical practioners who consider only their system of medication to be the ultimate solution for the treatment of patients.

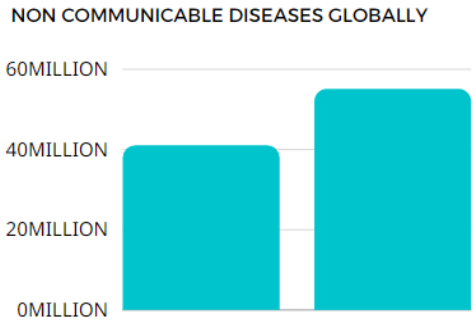
This research studies the prospects of developing a healthcare facility which focuses on the symbiotic relationship of both medical systems that offer a common ground for such an inclusive and holistic practice where patients have the prerogative to make a choice for opting the post-operative alternative medication.

2. NEED OF STUDY AND BACKGROUND-

The advent of urbanization and fast paced life has brought about the mayhem of Non communicable diseases (NCD).

NCDs are major cause of death for many people in India. NCDs are characterized by many factors such as genetic, phycological, emotional, behavioral. Apart from this NCDs have a major impact economically on the sufferers.

Globally NCDs affect 41 million people and are likely to affect 70% of the population in the world out of which 14 million alone happen within the range of (30–70). 5.8 million deaths happen only in India alone there has been an increase in these deaths from 30 % in 1990 to 55% in 2016.



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Non-communicable Diseases | National Health Portal of India (nhp.gov.in)

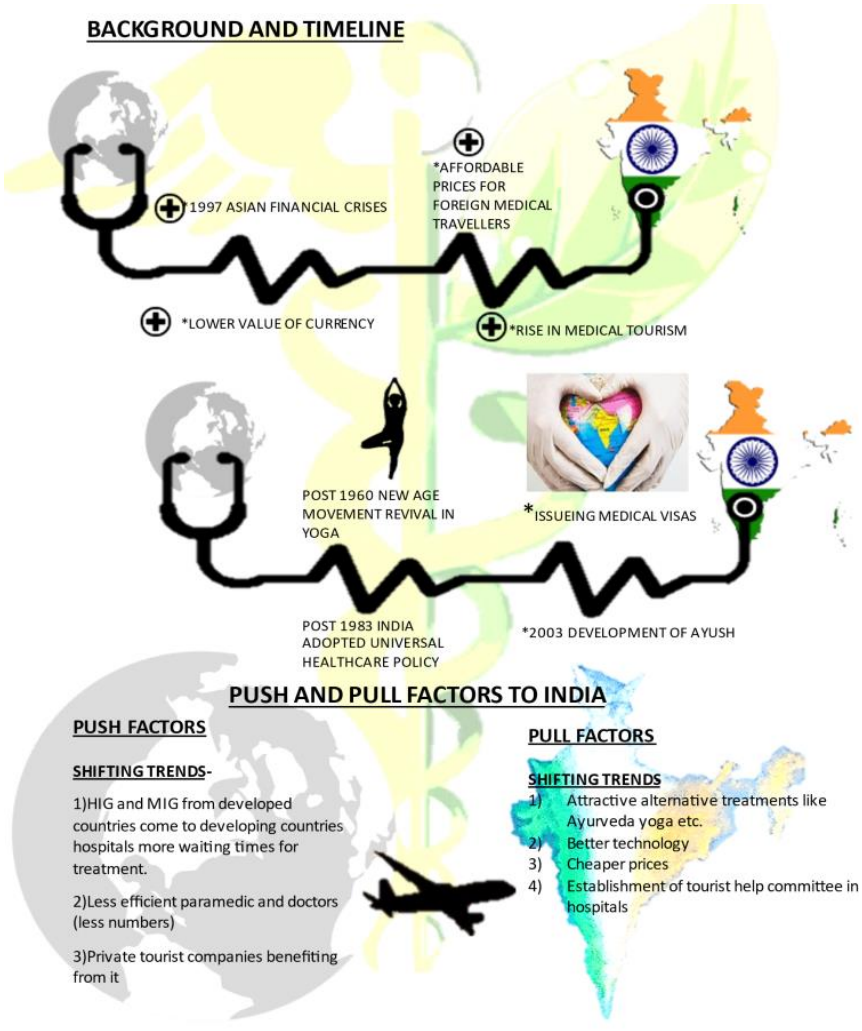

Image Courtesy: Graphic Made by Author

Patients heal in a better way in an environment which looks after their physical, mental and emotional wellbeing. A holistic healing environment for patients is a key factor contributing to their health in improving. Many NCDs such as cancers if

detected in the early stages can be cured and can be eliminated completely, cardiovascular and diabetes diseases on the other hand have an important behavioral and lifestyle aspect apart from the inheritance via genes

3. RESEARCH QUESTIONS

What are the limitations in healthcare design and technology which affects doctors' practice in India?

- How will an ideal environmentally responsive design intervention help to attract Indian masses (rural urban fringe)?
- What are the treatments which help to attract medical tourists from overseas and the various incentives in the private and public sector on the basis of which doctors provide expert treatments?
- How desirable and feasible is a healthcare facility encompassing various medical disciplines in India?

Aim: Studying the integration between architectural design of healthcare facilities and healing in order to have a holistic approach towards treatment of patients in India.

Objective: To understand the prospects of integrative medication as a solution for the betterment of India's healthcare systems.

Scope: The universal healthcare scheme and national healthcare policies and the promotion of AYUSH Department aim at improving the healthcare for Indian people the design solution can act as a holistic treatment facility encompassing various forms of treatment towards integrative medicine

The healthcare facility can form the basis to attract medical travelers as well as Indian masses to experience the benefits of both the forms of treatment.

Limitation: This study is a result of secondary data analysis and Primary data collected from people it depends on the seeking a solution via architectural capabilities only.

It lays an important focus only on developing a holistic healthcare facility for making the patients accessible to various forms of treatment ''contemporary'' and ''alternative care".

The design programme focuses on ailments like NCDS hence it does not have a scope for developing prospects of pandemic-based diseases.

4. LITERATURE REVIEW

4.1 One in 10 Indians will develop cancer during their lifetime—WHO report, Feb. 04, 2020

4.1.1 *Major Findings*

Out of 1160000 cancer cases in India 7,84,800 cases have resulted in mortality **2260000** cases in India fall under category of 5-year prevalent cases in the population of **13500000** behavioral, lifestyle, socio economic factors have a major contribution in the increase of cancer cases in India.

Source: One in 10 Indians will develop cancer during their lifetime: WHO report—The Hindu.

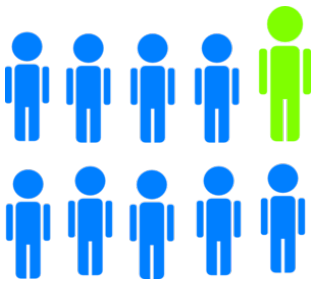

Image courtesy: 1-in-10 People SVG Clip arts download - Download Clip Art, PNG Icon Arts

Challenges faced by medical tourists in India and its growth prospects (a descriptive study).

Name: Dr. Aditi Sharma, Dr. Niranjan Prasai, Dr. Puneeta Ajmera, Sheetal Yadav, Dr. Samragi Madan February 2020.

4.1.2 *Major Findings*

If more healthcare facilities also look for measures to develop medical tourism apart from just improving the state of art technology in hospitals and extend their service beyond patients to their relatives and escorts with respect to accommodation, cuisine and train their staff to look into these various issues then this can become a forte for medical tourist industry in India.

The presence of Ayurveda and other alternative treatment options like yoga etc. which fall under the spiritual realms of treatment can also attract a huge market for medical tourism. hence it can be said that medical tourism can flourish along with vacationing and leisure activities to attract more market for medical tourists.

If ministry of tourism and ministry of healthcare both work in unison towards this industry to promote other aspects of tourism along with healthcare as the prime focus then this can act as one of the many attracting factors for medical tourists from all over the world.

Image courtesy: www.tourmyindia.com

Source: www.ijstr.org/final-print/feb2020/challenges-Faced-By-Medical-Tourists-In-India-And-Its-Growth-Prospects-a-Descriptive-Study.pdf

4.2 The Architecture of Recovery: Can Design Affect Your Health?

April 17, 2014

4.2.2 *Amber Bauer*

Major Findings

The author is trying to say that cancer cannot be eliminated by a building but with the help of evidence-based design we can achieve a desired impact on cancer patients' health emotionally as well as mentally.

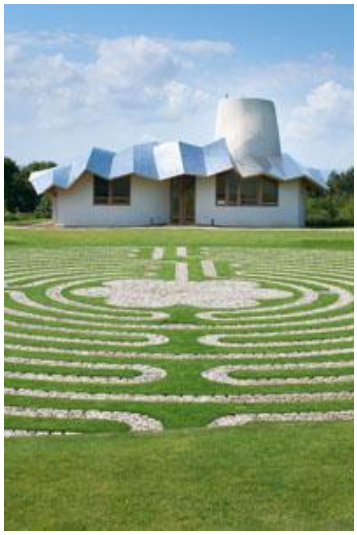

Image courtesy: The Architecture of Recovery: Can Design Affect Your Health? | Cancer.Net

Source: The Architecture of Recovery: Can Design Affect Your Health? | Cancer.Net

The author mentions the Maggie centers in Britain and Hongkong which stimulate this healing process.

The author stresses on the importance of having hospitals more of an approach like a home

Where patients can live with relatives and in an environment which connects them to nature and more outdoor environment and small kitchens etc. which helps them carry on their day-to-day activities during the course of their stay.

4.2.2 *Relevance*

From the literature reviews it has been found that there is going to be a rise in Non communicable diseases eg. cancer, etc. which are a by product of our lifestyle.

In the recent years the alternative therapies have gained prominence among Indian masses and medical travelers

Promotion of alternative therapies and the impact of design on health and wellbeing of the person can be integrated through an architectural intervention.

Seeking medication in a spatially conducive and supportive environment which has positive impact on healing is the current need for designing any healthcare facility.

The Design can have prospects for catering to the needs of patients in post-operative recuperation as alternative therapies have a beneficial impact especially in post-operative stages of healing and have a responsive design for the same.

5. MATERIAL AND METHODOLOGY

5.1 *Primary Data Ollection*

This mode of collection is based on the survey conducted at a personal level and depends solely on the personal responses of medical practioners and common masses.

The intent was to understand the opinion of people on the topic of integrative medical care and to get deeper insights of common masses regarding the desirability of developing a holistic healthcare facility.

5.2 *Studying the Economic Profile of Patients*

- Indian
- Foreign

5.3 Secondary Data Collection

This mode of collection is based on the statistical data collection and literature reviews regarding the subject.

6. RESULTS AND DISCUSSION

6.1 Inferences of Questianaire from Common Massess

6.1.1 *Intent of the Questionaire*

The questionnaire included responses from 70 people based on:

- Economic demography
- Awareness about healthcare
- Regarding accessibility of care
- Quality of healthcare

6.1.2 *Observations and Inferences*

- India remains a promised destination for seeking and providing state of at quality care because of availability of various treatments in the best possible monetary range.
- Most of the participants cannot afford 5 class treatment because of economic constraints.

- Healthcare facilities do not extend their courtesies beyond treatment in the recuperation of patients post treatment stage but participants felt that there must be such provision available in hospitals.
- Most of the participants are not aware of AAYUSH Programmes and Alternative treatments.

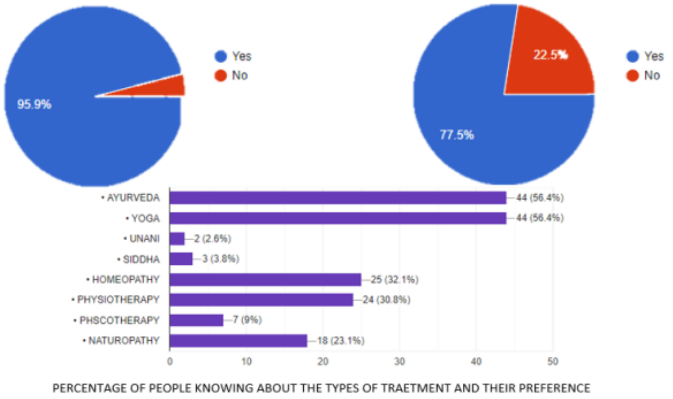

Image courtesy: Graphic Generated from Survey by Author

It has been observed that AURVEDA and YOGA are the most preferred treatments by common masses followed by homeopathy, physiotherapy and naturopathy.

However, UNANI and SIDDHA are not much preferred this can be due to the prevalence of siddha in southern parts of India subcontinent and not much prevalent in other parts of India.

Physcotherapy has also received less response because of lack of awareness regarding the subject.

32.9% of participants have faced mis treatment and discontentment at the hands of medical practioners where as 68% of participants were happy with the treatment they received.

Approximately 60% participants were given a chance to opt a treatment of their choice and 40.3% were discouraged by medical practioners for doing so.

6.2 Inferences from Secondary Data Collection

- India has diverse medical disciplines and diverse patient groups in terms of socio-economic grounds etc.
- India remains a promised destination for seeking and providing state of at quality care because of availability of various treatments in the best possible monetary range.
- NCDs have been on a constant rise in India because of neglect and lack of awareness based on socioeconomical grounds
- Healthcare facilities do not extend their courtesies beyond treatment in the recuperation of patients post treatment stage.
- AYUSH programme is acting as a felicitator of medical tourism and providing medical practioners a recognition in the society for recuperative and post treatment stages but this initiative is still in its infancy to cater to a large scale.
- Different socio-economic and ethnic user groups have the basic need of wellness and health improvements but they can have different architectural requirements and the design should be sensitive enough to cater to that.

7. CONCLUSION

Analyzing the prospects of alternative medical care and the development of healthcare facilities providing these treatments to the patients will lead to encouragement of these treatments as well as create awareness among masses regarding the same.

An architectural intervention for the integration of different forms of alternative therapies will not only encourage our different medical disciplines to revive and flourish in India but will set up a precedent in the future when it comes to healthcare design.

The healthcare facility can be a prototype to develop a holistic healthcare design for any future design of healthcare.

The prospects and advantages of having this design programme in rural-urban fringe areas the healthcare facility can most successfully work to its intent at a full potential in rural urban fringe and can explore more aspects of Indian tourism as well as act as a nodal point for rural folks.

Hence, the site selected for designing this healthcare facility is located in Karjat which lies is in the Navi Mumbai Airport Influence Notified Area (NAINA Zone).

The site is located close to the Upcoming Ulwe airport and lies close to Mumbai-Goa Highway this ensures good connectivity from major urban centers and also the close vicinity to nature adds to the USP of the design which will be developed.

The holistic healthcare facility can manifest itself as a-

Medical resort, medical retreat center (to explore alternative care) .

ACKNOWLEDGEMENT

I express deep gratitude towards My mentor Ar. Anuprita Surve mam who has always been a source of inspiration for me and she has always gone a mile extra for helping me out to properly study the topic and has been very supportive of my ideas by providing me with proper inputs for the entire project she continues to be a constant help for me every time whenever I face any difficulty of any sort while researching the topic.

This research paper chronicles the painstaking efforts of our teacher Ar. Sunanda Satwah mam who has guided us to write this paper.

I consider it to be a prerogative for me to be associated with architectural pedagogy.

I thank the entire CTES College of Architecture teachers, admin staff as well as the support staff who have been always there for me throughout my academic odyssey.

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Architecture Issues in Urban Slums of Pune: A Study of Natural Light, Ventilation and Sanitation

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ABSTRACT: Urban Migration has become a major problem of India as a disproportionate rural population is migrating to the urban areas in search of employment. This has given rise to Urban Slums wherein the population density is higher and the living conditions are poor. This paper studies the architectural issues persistent in the Urban Slums of Pune city. The issues addressed in the paper are related to Light, Ventilation and Sanitation. The study has been conducted in an urban slum of Pune, wherein the dwellings have been analyzed and mapped as per the parameters discussed before and inferences have been drawn accordingly. The paper explains the government intervention into urban slums and then studies in-situ slum rehabilitation. It also discusses the major issue as to why the living conditions in an urban slum deteriorate even after it has been declared as an "Urban Slum" by government institutions and has a lot of money being spent into planning and designing of the dwellings. This a case specific study done in the Urban slum of Nagpur Chawl in Pune, Maharashtra.

Keywords: *Urban Slums, In-situ Rehabilitation, Pune, Natural Light, Ventilation, Sanitation.*

1. INTRODUCTION

India has one of the highest rates of urban migration in the world. It is estimated that around 15.6% i.e. around 75.8 million people of the total population of the country has moved from the rural areas to the Urban Areas (Joshi, 2018). Most of this migration has been to the metropolitan cities of Delhi, Mumbai, Chennai, Pune and Bangalore. (Nijman, 2009)

Pune has one of the highest migration rates in Maharashtra after Mumbai. The Urban slum scenario of the city is such that 40% of the total population of the city lives in slums which are either declared or are encroached on government lands. The government intervention to resolve these issues are classified into three types (N.B.O., 2015):

- *Urban slums not addressed/neglected by the government:* It is evident in Pune city that some of the urban slums have been neglected by the government officials for decades after their formation. This happens due to the land disputes between the government and the corporates. Until and unless the land is cleared from legislation, the government officials do not intervene in these matters.
- *Urban slums rehabilitated at the same place:* To reform the illegal slum settlements, the government declares these settlements as legal and provides infrastructure and services such as electricity and water connections. This is the most ideal solution to cater to the existing slums as they are now registered under a government scheme and the residents do not face any threat of eviction. At the same time, their daily life is not affected due to relocation. This is often known as incremental housing wherein one half of the construction cost is paid by the government and the other half is paid by the dweller.
- *Shifting the slum dweller to apartments:* In this method of government intervention, the dwellers of a particular slum settlement are shifted (relocated) into apartments which usually comprise of towers and they might not be located in the same locality as that of the existing settlements. A pattern has been observed wherein the dwellers shift back to their original slum dwellings or in the near-by neighborhood due to proximity to their employment site. That is why, this method has proven to be less of a success compared to the method rehabilitating the slum settlements on the existing site.
- *The need to rehabilitate slums on its existing sites:* To resolve the issue of rehabilitation one needs to understand as to how an urban slum is formed in the first place. The main reason for the formation of a slum is the urban migration from rural areas of the country. This happens mainly due to the need for employment which can earn sufficient income enabling a person to take care of his own family.

The employment that most of the migrators seek leads to a meagre income which is not sufficient to provide adequate housing. This results in formation of slums which are often seen encroached onto vacant government lands or on barren hills (Joshi, 2018). A slum settlement is formed in the closest proximity to the dwellers' employment site. This is the main factor which decides whether a rehabilitation program would be successful or not.

An interview questionnaire was prepared wherein the specific questions related to the parameters of study were asked to the dwellers. A single cluster of dwellings which comprised of 21 houses was interviewed and respective analysis were made. Detailed observations have been recorded and analyzed in forms of graphs and pie charts. On this basis the conclusions have been formed. The parameters of study were Natural light, Ventilation and Sanitation. The parameters of study were selected in order to analyze the dwellings with respect to the requirements of the space and its architectural planning.

To cater to a successful rehabilitation of an urban slum, it is always advisable that the rehabilitation be done on the existing site of the slum (N.B.O., 2015). This does not hamper the daily lifestyle of the slum dweller and hence it leads to more chances of the dwellers not fleeing from their existing slum and residing into some other (Mahabir, 2016). Moreover, rehabilitation on the same site helps in conserving the existing social dynamics of the settlement and at the same time provides basic amenities to the dwellers such as electricity, water connections and drainage lines. The slums are also declared as legal slums and the dwellers do not have to face any fear of eviction.

The government rehabilitates the existing slums by reforming the slums into its schemes such as JNNURM (Jawaharlal Nehru National Urban Renewal Mission). This is a form of a public-private partnership wherein the existing slum dwellers are offered incentives by the government. In this partnership the government pays for half of the cost of construction and the dwellers pay for the other half. This monetary assistance by the government helps the dwellers in construction of their permanent houses on the same site. This not only helps the dwellers into residing into a permanent house but also gives them an identity. The slum dwellers are then eligible for other government schemes. But these government policies also have their respective gaps wherein the government does not put a cap on how much should one construct on his/her piece of land. The construction work is not regulated and there is a lot of corruption observed into implementing of such slum rehabilitation projects.

2. THE CASE STUDY: NAGPUR CHAWL, YERAWADA, PUNE

The urban slum that was studied was Nagpur Chawl in Yerawada. This urban slum was declared as a legal slum in 2008 as part of JNNURM scheme. What makes the slum unique is its location, situated at the heart of one of the most developed areas of Pune. The slum is situated in Viman Nagar and is located 5 km away from the airport and 8 km away from the Pune railway station. The slum is declared as a slum which has been rehabilitated under JNNURM scheme of the government. It has been developed by MASHAL. According to the scheme, the rehabilitation process was a public-private partnership wherein the government would rehabilitate the existing dwellings made up of tin sheets (kaccha house) into Concrete houses (pakka houses). According to the scheme the government was to construct the first 350 sq.ft of the house and later part of the house was to be constructed by the dwellers.

3. HOUSING TYPOLOGY

The master planning of the slum had been done taking into consideration the initial 350 sq.ft. constructed by the government and an additional 350 sq.ft which was provided to the dwellers as per the incremental housing scheme. At the time of handing over of the rehabilitated slum in 2008 the initial 350 sq.ft (ground floor) of the slum was constructed. As years passed and when people started building the upper floors the government didn't pay the required attention as to how these floors were built and how many extra floors were being built on top of the existing floors. The government mentioned that conforming to their building strength, only a structure 2-storey high could be built. But neglecting this fact the dwellers have constructed structures standing to a height of 5-storey (15 m high). This has put the entire settlement into direct vulnerability across various hazards such as fire, flash floods, etc.

The cluster that has been studied is known as Hanuman Chowk in the settlement. It has followed a certain typology wherein most of the owners have built their houses upto 5-storeys high. The ground floors have been converted into shops and second third and fourth floor has been rented out to non-residents. A typical observation one can make is the lack of basic safety arrangements that the dwellers have neglected. For eg: The unauthorized floors which have been rented out do not have proper staircases and staircase landings. Such constructions which have led to many accidents over the past years.

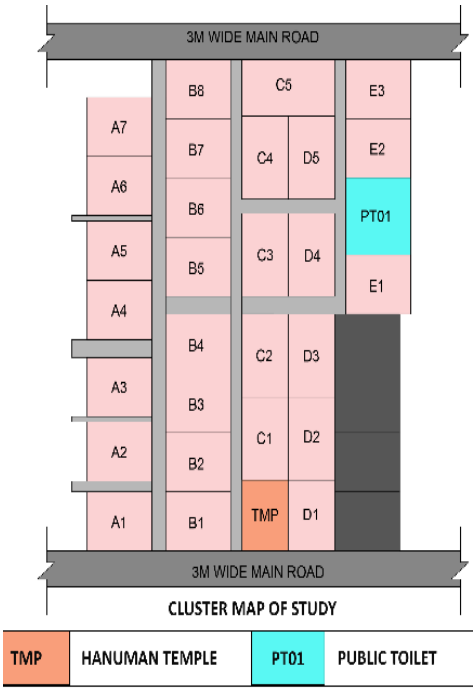


Figure 1

Source: Self.

Figure 2

Source: Self.

4. TYPOLOGY AS PER MASTERPLAN

Figure 3

Source: Self.

The masterplan provided each dwelling with a 350 sq.ft built space and an incentive of 350 sq.ft. A cluster of 21 houses was developed and various such clusters inside the settlement were formed. All these clusters were connected to each other through primary roads which were 4.5 m wide and secondary branches which were 2.5 m wide. This provided each house with adequate light and ventilation even considering the later development which consisted of the additional 350 sq.ft. The slum was assumed to reach its full potential within a period of 10 years and the population was estimated to be 1.5 times the initial population.

The Present Typology: The present typology is vastly contradicting the one which was proposed in the masterplan. There are encroachments seen all over the place and open spaces that were meant to act as light and ventilation corridors have

been turned into additional rooms. The dwelling which was safe to a take a load of 2-storey has been turned into a 5-storey apartment building. This has resulted in the slum being overpopulated. The additional houses have been rented to non-residents of the slum at an average rent of 2000 INR. The population density therefore, has increased and the actual population has risen 2-3 times of the estimated population. This has led to problems such as insufficient natural lighting, ventilation, sanitation and also lack of parking spaces as most of the male dwellers are auto-rickshaw and cab drivers. Due to a limited number of water connections there is a problem of water shortages faced by the dwellers. The sanitation facilities are often overwhelmed and this has resulted in drainage malfunctions. During the monsoon there is flash flooding observed in the areas.

5. PARAMETER OF STUDY: NATURAL LIGHT

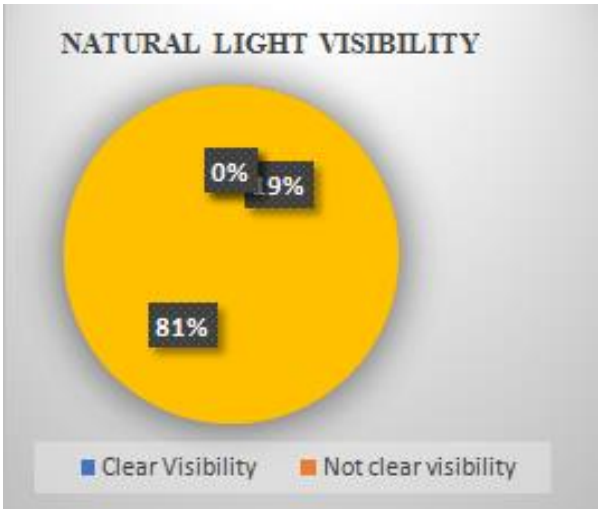
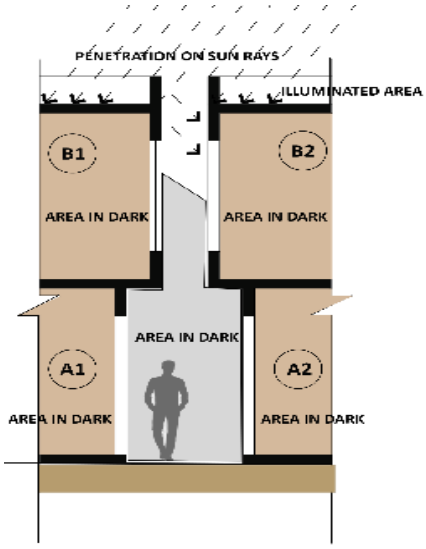


Figure 4

Source: Self.

Out of the 21 households interviewed, only 4 households (19%) had a clear visibility in day time. Rest of the 17 households (81%) were dependent on artificial means of light such as tube-lights and LED lamps even in broad daylight.

Table 1



TURAL LIGHT CONDITION IN THE SLUM

Source: Self.

The lighting conditions are so poor that the lowest lux intensity measured in these houses was 0 lux. Due to such adverse conditions the households with no clear visibility end up spending more on the electricity as they have to depend on artificial lighting throughout the day. The homemakers face difficulties carrying out the smallest of the household chores and during the periods of power cuts, irrespective of the time of the day, the household chores have to be stopped as the whole house turns dark.

The dwellers have adopted local techniques to deal with the lighting problems by occupying the street in front of the house to do menial chores. Some households have invaded the surrounding road and placed the kitchen in the newly encroached portion of the house while the ones which have houses surrounded on three sides have shifted their kitchen areas towards the pedestrian walkway. This has resulted in reorientation of the planning and the existing kitchen areas which have water taps and drainage lines are no longer used. New water and drainage lines are installed and this has created service malfunctions such as multiple leakages in the water pipes. Due to this there is water accumulation in the cluster which has become a breeding ground for mosquitoes.

Figure 5

Source: Self.

6. PARAMETER OF STUDY

There was only 1 house out of the 21 houses interviewed where cross ventilation was possible. Rest of the household had built structures on three of its side and the fourth side having only a 1.5 m walkway and again a built structure abutting it. Initially, all the 21 houses in the cluster were designed for cross ventilation but the rapid encroachment hasn't left any open space inside the cluster and natural ventilation has become a major problem.

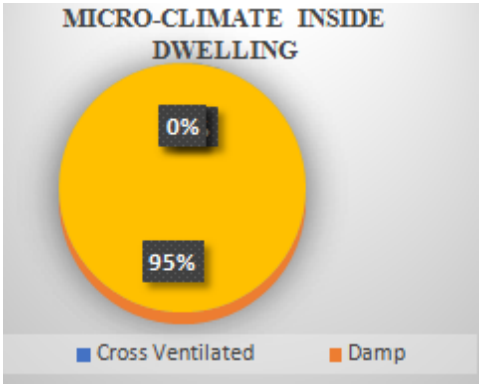


Figure 6

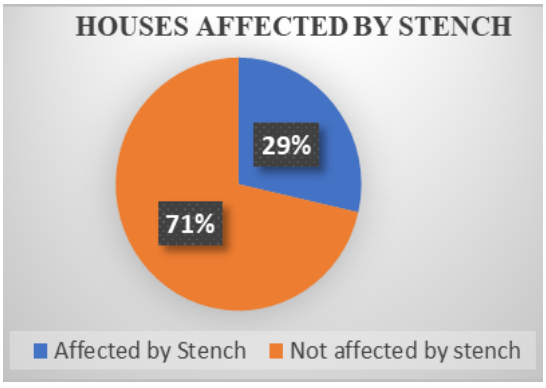
Source: Self.

The summers are believed to be the hardest time because the temperatures are on the rise and the heat waves transfer heat from the ceiling to the interior of the house. The houses are so closely inhabited that the air becomes damp as it gets trapped in between the dwellings. Due to this, any kind of stench or stink can be felt in the air for longer periods of time. During cooking hours, the whole cluster smells of curry and coughing is evident as there is nowhere to direct this air to. One cannot use exhaust fans as there is no opening left to place the exhaust fan upon. The dwellers complain about the stench from the public toilet in the vicinity. If it is not cleaned on a daily basis, it causes unbearable stench. That is why airborne viral infections have long lasting effects and they have a wide spread effect in the cluster. It is estimated that every year a minimum of 15 households have patients suffering from viral fevers and other airborne diseases. Treatment of such patients is difficult because there is no place for them to be treated and the government hospital in the vicinity has all its beds acquired due to the same situation arising in the all of the clusters.

7. PARAMETER OF STUDY: SANITATION

The sanitation facilities included a bathroom and a toilet. Both the facilities were used frequently by the dwellers and were maintained. The drainage lines were enclosed in pipes so the stench was controlled. But due to encroachment and additional unauthorized apartments being built, there were leakages seen in the pipelines and this has led to formation of puddles along the roads. As and when the water leaks it creates a puddle which then has mosquitoes breeding in it. There is a public toilet in the vicinity. It was reported that pre-covid times the public toilet was the main reason for stench but since covid there has been regular cleaning taking place in the public toilet. But it has been witnessed that every evening there is still a heavy stench felt by the dwellers whose dwellings are situated in the vicinity of the public toilet. These families have to bear with the stench until next morning when the cleaners from the municipality arrive for cleaning. Out of the 21 households interviewed, 6 households face this problem of stench coming from the public toilet. The dwellers are quite informed about sanitation and know the importance of the toilet. There are various outreach programs organized by various NGO's to create awareness about sanitation. Monsoon season results in the storm water lines being overwhelmed by storm water and many a times the lines fail and there is flooding seen in the cluster. One of the main drainage lines runs past the cluster and has a storm water line adjacent to these drainage lines. Every year, the monsoons lead to the damage of storm water line as well as the drainage line resulting in choking of both lines. This choking leads to sewage overflow which comes in contact with the residents and due to this the hygiene quality of the cluster is greatly compromised. In the past few years there is a trend where outbreak of large-scale epidemics of flu and pneumonia have been observed. The local government hospital also becomes over-whelmed during this monsoon period and due to insufficient health infrastructure, the epidemics rise two-fold. That is why, the problem of sanitation needs to be dealt with urgently as it contributes largely to the spread of epidemics and highly compromises the personal hygiene.

Table 2



Source: Self.

8. CONCLUSION

Even though rehabilitation has brought the slum out of its existing problems, it has given rise to new problems which need to be solved. Encroachment of land has remained one of the major problems and the unawareness towards hazards has further endangered the life of the dwellers. The unauthorized development is often neglected by the government officials

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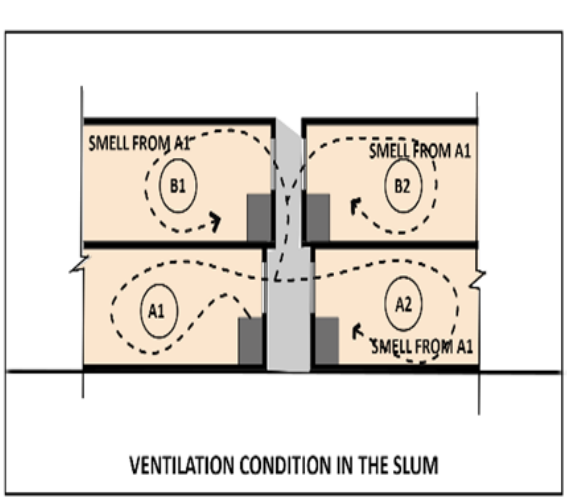
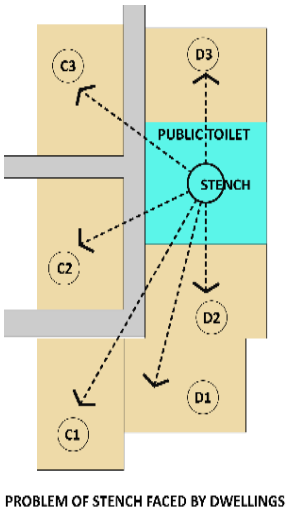
and this has become a major factor for the poor lighting and ventilation. There has been blame sharing seen when it comes to the unauthorized constructions as the authorities blame the planners and the planners blame the authorities for a lack of intervention into this new problem. This has brought the whole current concept of in-situ slum rehabilitation in Pune under question as the problem of encroachment still persists and basic services such as light, ventilation and sanitation have not been served. Even though the initial planning of the rehabilitated settlement was done aiming to make it self-sufficient, still the need arises when government interventions are necessary. The new problems that have arisen are far more complicated such as over-loading of the buildings, unavailability of wide roads to counter any fire hazard, absence of cross ventilation and natural light due to high density of dwellings.

Table 3





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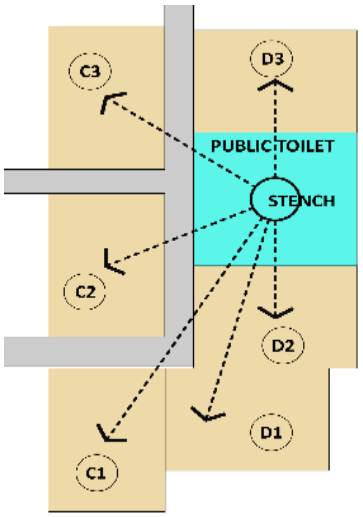

Figure 7

Source: Self.

If pouring in so much of government capital and resources into in-situ rehabilitation of urban slums is not being able to solve basic requirements of shelter such as natural light, ventilation and sanitation then one needs to assess the problem critically and major changes need to be made at policy level as well as implementation and sanctioning levels. A major alteration in the monitoring process needs to take place. Here the question arises – How can Urban Slums be rehabilitated rightfully?

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Study of Transition Spaces in Office Buildings

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ABSTRACT: Traditionally, Transition spaces have been classified as being located either indoors or outdoors. They are also called intermediate spaces. These spaces show connectivity between static spaces, two destinations, and built form and environment (Murali, Transition Spaces and how they translate).

As we know, In IT offices employees spent 8 to 9 Hrs. so we have to think about their comfort. We should create some interesting, interactive spaces for them. But it is not feasible to design different spaces. So, we should think about the spaces which are mostly used by employees in their daily routine. The spaces which are used by employees in daily routine are mostly transition spaces like staircases, corridors, courtyards, verandas, etc. we can design transition spaces impressively instead of just a buffer space. To make transition spaces more interesting we should focus on their qualitative aspects like natural lighting, material, and finishes, Covered and uncovered spaces, by using these aspects we can create a healthy environment in office buildings. If we make these transitions or connect spaces in such a way so that they invite some natural and healthy environment in the building, this may influence the working and nonworking activities of employees.

Keywords: *Transition Space, Connectivity, Office Building, Qualitative Aspects, Environment, Impacts.*

1. INTRODUCTION & BACKGROUND OF THE STUDY

Transition spaces are intermediate spaces. Passages, stairwells, courtyards are the inevitable spaces in the design of most structures (UnderstandingTransitionSpaces, 2015). Without transition spaces the architectural spaces are incomplete. Design elements provide a lot to transition space. There are colonnades, passages, courtyards, aisles, pathways, etc. Such spaces may influence human behavior.

In-office spaces, we can design transition spaces in such a way so that they allow to get some enthusiasm in employees. Very few studies have provided evidence on the relation between architectural variables and human behavior. Employees are daily working in that particular space so it should not be tedious for them. The working space and the environment plays the important role in their frame of mind. This paper addresses the relationship between transition spaces in architecture and their effects on employees. There are some easiest and most effective ways to design these spaces by providing natural material, natural light through large openings or glass ceilings, plants, running water like fountains or waterfalls, views of nature through windows. It can create a positive work environment that makes employees feel satisfied with coming to work and this motivates to sustain them throughout the day (Richardson, March 27, 2019) y.

The working environment has a significant impact on employees' behavior, performance, and productivity. The work environment includes the location, internal and external environment. If we create a positive work environment then workers feel good and they can produce extraordinary results. So, it is necessary to study such spaces which are helpful to create a positive working environment

The purpose of the research is to examine particular elements of architecture that are responsible for motivating the behavior among employees in offices. The activity mapping identifies the design aspects of transition space that are most influential for behavioral outcomes.

Transition spaces are neither consistently classified as being indoors nor outdoors, and it shares properties with both indoor and outdoor space. The scope of the study is limited to the transitional spaces including corridors, courtyards, foyers, lobbies in offices. (Transitional Spaces)Transition space is act as both buffer space and physical link. It has a unique quality as an architectural system of relying on nature without damaging nature.

2. LITERATURE REVIEW

2.1 Understanding Transition Spaces

Rashmi Singh (2015)

The paper states the transition spaces their importance and role in Indian Architecture. The paper also includes case studies of projects by famous architects to understand transition spaces better. This research paper helps to find some important aspects of transitional spaces and how did they provide a balance between private, semi-private, and public areas. To analyze the topics some case studies have been done. From these case studies, we can study the landscape, topography, built forms, and materials. On studying and researching the case studies in general, I noticed that transition spaces play a very important role in design and architecture. Also, we can study, how the transitional spaces are useful for climatic, cultural, and aesthetical benefits. One of the most important functions of transition spaces is sustainability in building design. (UnderstandingTransitionSpaces, 2015)The proper use and placement of these spaces in a building design may increase its energy efficiency.

2.2 Transition Spaces and How They Translate Informal Learning Space

Christi n Kray,Holger Fritze, Thore Fechner. September (2013) In this study, the concentration will be on the three types of transitional spaces: transition between two destinations, the transition between exterior and interior, and the transition between nature and buildings. This research paper is focused on space independent and dependent utilization activities by students based on environmental behavior. To study the transition space and environment. The research was carried out in the transitional spaces within the academic zone of Ungku Omar Polytechnic Malaysia involving diploma students. This research recommended transition space between two destinations as an ideal informal learning space in higher education.

2.3 Transitional Space: Between Indoor and Outdoor Spaces (2013)

Christia n Kray, HolgerFritze, Thore Fechner In this paper we can better understand transitional spaces, and investigate their properties and uses. In this paper, they reported on initial evidence demonstrating that two types of Transitional Spaces: Between Indoor and Outdoor Spaces are not enough: there is a third type of space – transitional space –that is neither consistently classified as being indoors nor consistently classified as being outdoors, and it shares properties with both indoor and outdoor space. (Schwering, 2017)

2.4 Transition Spaces

In this paper, we can examine more specifically the transitions between the natural and built environment. This paper will help to maintain a direct relationship with nature is of great importance because we need to be in contact with it and its proximity, as it has proven a positive influence on people, both mentally and physically. Most people have lost contact with nature and also have forgotten its importance and its positive effects on our lives. Because of this, it is important to deal with transition spaces and their investigation from this paper, we can observe that transition spaces are indispensable in design and architecture. Not just our buildings, but our public spaces and our environment would be incomplete without the existence of these spaces. (SZAUTER, 2018)

3. METHODOLOGY

In this research paper, we can study the transition spaces designed as an interactive space instead of just a buffer space. There are some case studies are done to observe and analyze the qualitative characters of the transition spaces in office buildings. The chosen methodology will impart qualitative findings concerning different aspects of transition spaces and the activities of employees affected due to it. The research will be conducted with multiple case study designs to find and compare the various space characteristics defining the transition spaces in office buildings:

- Abstract, aim, objective
- Data collection through—survey, research paper, case studies, observations
- Evaluation of the data collection
- Comparative analysis
- Conclusion

4. SELECTED ONLINE CASE STUDIES

- Eon it park, kharadi
- KPIT technologies campus, Hinjewadi
- ICC tech park, S.B. Road

The above stated its offices are in Pune. Some of the examples are well known. these are the fine examples in which the office spaces are designed by considering some aspects like – how it should feel and its effects on those who spent their time there. Also, from these case studies, we are going to find some positive standpoints as well as deficiencies.

4.1 Case Study 1

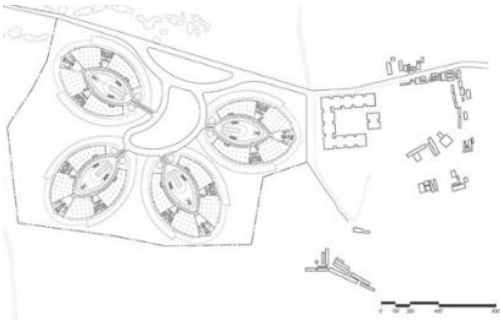
EON IT Park, Kharadi (2004)

Project – Falling Lotus Blossoms
Location – Kharadi, Pune.
Architect – FORM 4 architecture

The EON IT Park campus is designed in buildings, that occupy the whole site in the EON-free zone.

Planning

The structure of this complex is inspired by the white lotus. There are four G+7 buildings on this campus. Each building is designed as a petal arranged like a four-leaf clover with open space at the center.



https://iccpune.org/commercial-property-in-pune/icc-tech-park

The open space at the center is designed as a connecting space for all the buildings. Courtyard morph into a giant kaleidoscope by the landscape and building elements with neon lights. Here the landscape elements play a vital role. Shaded atriums serve as meeting or gathering spaces. As a result, playful, spontaneous spaces were created in these connecting spaces.

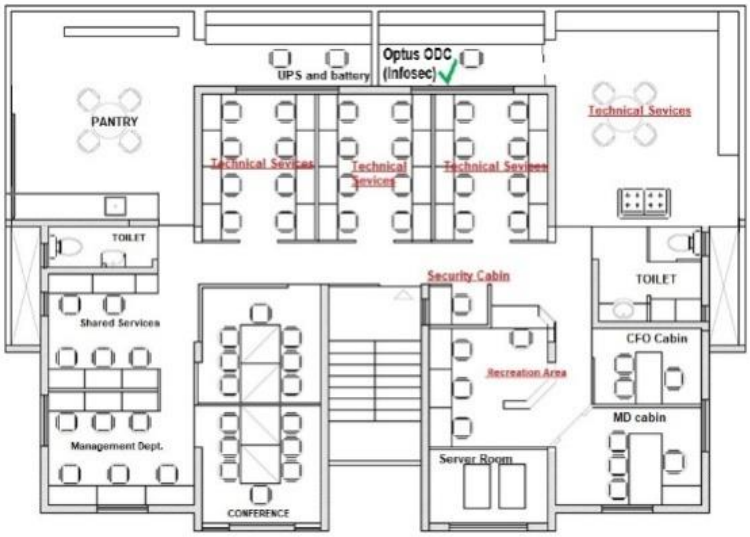
Large openings, glass walls, and transition spaces are designed in such a way that it makes complex more interactive.

4.2 Case Study 2

KPIT Technologies Campus, Pune (2017)

Location – Hinjewadi, Pune
Architect – Suresh Patara

The campus has a strong context of hellscape. Healthy and interactive spaces created with pure built form. The Breathtaking Views from the 3rd and 6th-floor ads value the entire campus. The buildings are arranged in such a way so that at the center a vacant space is created which is act as a courtyard. Orientation of buildings is arranged according to climatic conditions. Workspaces are designed by considering the external views. The flooring compositions are composed interestingly to show some segregation in areas. The ceiling is kept exposed for services. Every office space is designed with unique and vibrant colors.



4.2 Case Study 3

ICC TECH Park (2006)

Location: S.B. Road, Pune

Project Developer- Panchashil Reality

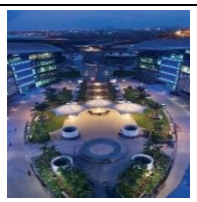
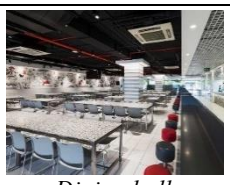
https://iccpune.org/commercial-property-in-pune/icc-tech-park

The International Convention Centre (ICC) is a mixed-use type of trade center. ICC Trade tower and ICC Tech Park are built for the workspace requirement. JW marriage and shopping malls are designed near to the campus which offers shopping and entertainment.

The flooring, ceiling, walls are interestingly decorated. Open and semi-open spaces are designed which create a healthy environment. Every space is designed in such a way so that at least some amount of light can enter. The color combination of walls, flooring, and furniture is very decent.

Parameters	***EON IT Park***	***KPIT Technologies Campus***	***ICC TECH Park***	***Effects on Employees***
Natural lights  Transition space in the office where the sense of natural light can be seen. https://hmcarchitects.com/news/the-benefits-of-natural-light-in-office-spaces-lighting-design-for-increased-employee-satisfaction-2019-03-27/	A kind of Open planning is observed. Each building is arranged in such a way so that open spaces are created at the center and between two buildings hence incorporating natural light within transition spaces.	The built form is mid-rise and narrow to allow natural light and create a sense of a healthy working environment. Every block is arranged in such a way that it will have openings at least from 3 sides.	Large openings are provided to get light. Most of the Transition spaces like ramps, lobbies, and staircases are designed at the external face of the building to get natural light ventilation.	Natural light is the main aspect and had a great effect on employees' mood, anxiety, performance. Direct or indirect natural light provides higher satisfaction among employees translates to productive work. (chin, dec 11, 2014)
Materials  Use of wood and stone in creating a natural setting https://riworkplace.com/7-modern-office-design-concepts-to-attract-the-best-employees/	In every transition space like passages, staircases grey tiles, and glass is used	Interesting flooring compositions are created with carpet and vinyl flooring. Each office space is designed with a unique and vibrant color theme, reflecting itself in the floors and ceiling.	The grey and white descent combination of paint and tiles are observed. Glass partition and glass doors are mostly used in transition spaces.	Material and finishes play major roles. It sets the employee's tone and creates a vibe of that space. Natural materials can bring a real raw aesthetic to space.
Connection with Nature  Design and the incorporation of natural elements into their immediate office setting https://www.designboom.com/design/biophilic-design-human-spaces-interface-12-11-2014/	The cluster of four buildings is arranged like a four-leaf clover with green open space in the center. This is the best example of the transition between built and environment.	This campus is located in the green area and is surrounded by hills. So, they have designed the campus in such a creative way so that employees can enjoy the view. They designed the transition spaces according to the green spine.	This building does not have any form. Two independent towers combine spaces with retail space. Transitional spaces do not have any environmental connection but they have focused on color combination, furniture, and tile composition.	Transition space having nature contact can reduce stress among the employees while they pass from one place to another Nature contact may establish healthy workplace exposure. (chin, dec 11, 2014)

5. COMPARATIVE ANALYSIS

Courtyard  https://ajrenvironmental.com/commercial-landscaping-hardscaping/courtyard-design/#	The courtyard is the heart of the complex, each courtyard morphs into a kaleidoscope by the building elements with neon lighting.	Interlocking connection of spaces linking each other and at the center of blocks green spaces are designed for better light and air ventilation.	No courtyard was provided.	Courtyards provide comfort, relaxation, and socialization within a built complex. If we provide some natural aspects in courtyards it will help to create a positive working environment. (Courtyard Design)
Transition spaces as an Interactive space  Due to the presence of natural light, a different combination of tiles and seating arrangements to get a view make that lobby more interactive http://www.bdcnetwork.com/blog/open-plan-20-tips-successful-transition-new-open-office-design	Buildings themselves contain shaded atrium spaces that serve as meeting or gathering spaces for the buildings' occupants.	Blocks also create green social spaces both indoors and outdoors inviting visitors to use the building as a more informal meeting point, creating an active crossroads of campus life.	Interactive spaces are not designed in buildings but There are a lot of spaces like cafés, restaurants, shops as it is a mix-use building.	If the Transition spaces like a courtyard, lobby are designed for interaction, or some activities like meeting, the conference then the employees can enjoy their work and it will help to create a productive atmosphere.
Images	 *Courtyard -the heart of complex*	 *Staircase*  *Conference room with a pleasant view*	 *Dining hall*	

Transition spaces that are open to sky or semi-open, having natural light, some natural connect such spaces are appropriate to design for working and nonworking activities.

6. LIVE CASE STUDY

Inteliment office, Pune (2004)

1. There are two branches of the Inteliment office. These offices are designed in a commercial complex. The floorplate area of office 1 and office 2 is 1850 sq. ft and 1600 sq. ft respectively. Around 45 to 55 people can work at a time.
2. The places are designed in such a way that the transition spaces like passages are automatically lead to the functional spaces that in order. Only external walls are provided in the entire office.

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3. To separate the spaces glass partitions are used. Glass partitions are used for better visualization also the employees should not feel like they are seated in a closed space. Workspaces are designed in such a way that from 45 people only 8 people are facing towards the wall.


Library

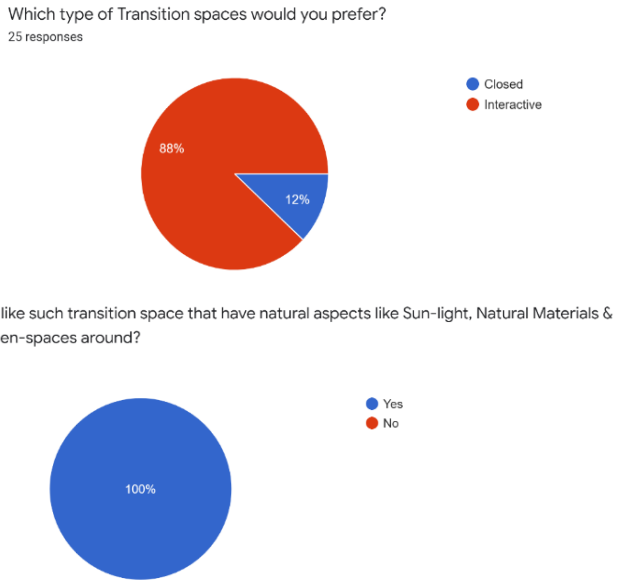

Quotes on Walls


Lobbies

4. As the office has less area there is not enough space to create different interesting areas so they focused on the transition spaces. In every passage, they have displayed some quotes or work-related information also there are small libraries in the passage and pantry so that employees can refresh their mood. It is a good example of the Utilization of transition space. One of the good things about this is that office has less area but the spaces are well organized also the transition spaces play an important role.

7. RESULTS AND DISCUSSION

The purpose of the research is to examine the qualitative aspects of transitional spaces which makes these spaces more interesting. I have collected the feedback of employees with the help of a questionnaire.



8. CONCLUSION

In this research paper, different transition spaces are studied in IT offices. From this study, we can understand the role of natural light, material, nature in transition spaces.

This research demonstrates empirical evidence for the importance of transition space in motivating certain behavior among employees. This research aims to explain the importance of space utilization concerning qualitative aspects. The finding of this research paper should contribute to designing derivatives for Offices

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Impact of Biophilic Design on Facades for the Health and Well-being of People

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ABSTRACT: With the increase in urbanization and rapid development, 68% of the world will be living in urban spaces by 2050, mentions UN world organization prospects. Due to urbanization people in the cities seem disconnected from the natural environment. Many of the occupants of buildings face the problem of Sick building syndrome (A condition in which occupants suffer from the symptom of illness and chronic disease). People spend 90% of the time in a day indoors. The spaces surrounding the occupants have a huge impact on their physical and mental well-being, mentions NHAPS (National Human Activity Pattern Survey). In today's world, most of the people living in the cities combat physical and mental health problems like chronic fatigue, loss of productivity, depression due to stress-related disorders. This paper intends to evaluate the relation of humans to the natural environment by exploring the importance of Biophilic Design on the health and well-being of people.

Keywords*: Biophilic Design, Health, and Well-being, Built Environment, Facades, Sustainable Architecture.*

1. INTRODUCTION

The idea of Biophilic Design is derived from the term 'Biophilia', the idea that humans possess a biological inclination to affiliate with natural systems. The term 'Biophilia' was coined by social psychologist Erich Fromm to describe the 'love of life or living systems. 'It expresses the ethos of maintaining and developing a life of humans in all dimensions, that is physical, psychological, moral, artistic, social. Biophilic Design reduces stress, lowers blood pressure, provides pain relief, learning, healing, stimulates creativity and critical thinking, improves physical and psychological well-being, and accelerates healing. Biophilic Design has many environmental benefits such as it fosters an appreciation for nature, providing protection for natural areas, and helps in reducing pollution and maintaining a pollution-free clean environment. Biophilic Design encourages the use of natural elements and processes in Architecture. Integrating interior plants, natural materials, outside spaces with access to nature trigger responses that allow us to perform better and feel more connected. Biophilic design can be categorized into three categories: Nature in a space, Natural analogues, and nature of the space.

(A) Nature in space deals with seven biophilic design patterns:
- Visual connection with nature,
- Non-visual connection with nature
- Non-rhythmic sensory Stimuli,
- Thermal and airflow variability,
- Presence of water
- Dynamic and diffuse light
- Connection with natural systems.

(B) Natural analogs encompass three patterns
- Biomorphic forms and patterns
- Material connection with nature
- Complexity and order.

(C) Nature of the space includes
- Prospect
- Refuge
- Mystery
- Risk/peril. (Kellert, Heerwagen, & Mador, 2013)

The paper will focus on the impact of Biophilic Design on Facades for human health and well-being.

Aim: The research aims to examine the impact of Biophilic Design on facades on human health and well-being**.**

Objectives

- To study various theories related to Biophilic design and its application in architecture.
- To study various patterns, elements, strategies, and attributes related to Biophilia.
- To explore different ways in which Biophilia can be integrated in architecture.

2. LITERATURE REVIEW

There are two dimensions of biophilic design followed by six biophilic design elements and 70 design attributes. The first basic dimension of biophilic design is an **organic/naturalistic** dimension which is defined by shapes and forms in the built environment. The second basic dimension of biophilic design is a **placed-based/vernacular dimension**, defined as buildings and landscapes that connect to the culture and ecology of the locality/geographic area. (Kellert, Heerwagen, & Mador, 2013)

Ways of integrating Biophilia into the design are as follows:

- Windows should be designed in a way to provide an outdoor view towards nature.
- Blurring the boundaries between interiors and exteriors and creating a transition by use of the courtyard, atriums, terraces, balconies, covered porches, gazebos, etc.
- In designing glazing systems, railing, and other features that interfere with the view of nature.
- Glazing should be vision glass providing view to outdoors and creating rhythmic patterns of living light, shadow, sparkle that vary throughout the day and provide high level of day lighting
- Incorporate green roof and provide physical and visual access to it.
- Bring nature into the building.
- Integrate living walls with the built form which would purify the air by removing the pollutants.
- A water feature provides visual and acoustical benefits reminding the occupants of waterfall and rains.
- Using potted plants and small gardens in interiors.
  (Kellert, Heerwagen, & Mador, 2013)

3. IDENTIFICATION OF MAJOR RESEARCH GAP

Stephen Kellert mentions Biophilia is a missing link in sustainable design.

3.1 Material and Methodology

- The methodology for research followed isa Literature review of Biophilic design and its impact on human well-being through books, research papers, documentaries, and case studies.
- The method adopted for research is data collection, reading, analysis, interpretations of the collected data.
- Curating people's experience through interviews of the building's residents and users and carrying out different experimental studies to understand the impact of biophilic design on the occupants.
- To study various theories related to biophilic design and its application in architecture.
- To study various patterns, elements, strategies, and attributes related to Biophilia.

4. RESULT AND DISCUSSION

Comparative Study of five Cases for Biophilic Design					
Project Name, Location	***Oasia Hotel Downtown, Singapore***	***Park Royal, Singapore***	***Bosco Verticale, Singapore***	***KMC Corporate Office, Hyderabad, India***	***Jewel Changi Airport, Singapore***
Images	 *Source:* Archdaily	 *Source:* Archdaily	 *Source:* Archdaily	 *Source:* Archdaily	 *Source:* Archdaily
Designed By, Year	Woha Architects, 2016	WohaArchitects , 2013	Ar. Stefano Boeri, 2009	RMA Architects, 2012	SafdieArchitects, 2019
Project Type, Climate	Commercial, Hotel, Mixed development, Tropical	Hotel, Office , Tropical	Residential towers, Mediterranean Climate	Office, Hot and dry	Mixed use Architecture , Tropical
Height, Area	190 m, 19416 sq m	89 m, 7500 Sq m	111m, 360000 Sq m	26 m,890 Sq m	37 m, 135700 Sqm
Application of Biophilic Design	Facade	Skygardens, Reflecting pools, waterfall, planter Terraces, and internal lobbies green walls	Balconies	Facade	Rain Vortex Waterfall, Butterfly Garden,
Structure	The building structure is made of reinforced concrete frame which wrapped in three-layer envelope assembly of internal curtain wall, fiberglass planter set on an integrated reinforced concrete ledge and an expanded aluminum ledge that supports the planter at the base.	The structure is made up of precast Concrete.	A water draining and root resistant system Polyethylene and geotextile fabric later in between the soil and concrete container. There are different dimensions of concrete containers depending on the type of plant.	It has a double-skin facade that allows the modulation of air and light. The outer facade comprises a custom cast aluminum trellis with hydroponic trays integrated for a growing variety of plant species.	The bagel Shaped roof spans more than 200 m which is supported on tree like 14 columns The roof is a network of 18000 steel beams and 6000 junction.The façade is made up of 9000 glass panels.
Landscaping	33 Different species of trees and shrubs are planted on sky terraces. The building consists of 21 different species of creepers with colorful flowers and greenery	The sky garden includes tropical plants. There is a diverse variety of species ranging from shaded trees, small plants, tall palms, flowering plants, leafy shrubs, and overhanging creepers	The balcony had 100 different species of plants,800 trees,4500 shrubs, 15000 plants are planted in the balconies.	The facade is dynamic where assorted species are organized in a way to create a pattern that blooms at various times of the year.	Five Story garden consists of 120 different species of trees, palms, Ferns, Shrubs. It hasButterfly Garden

Services and maintenance	An automatic irrigation cum fertilization system is installed arranged by the stations at each level with control based on the plant's water demand	 *Source:* Inhabit.com Landscape is designed to be self-sustained. Solar irrigation systems have been employed. Rainwater collected from upper floors irrigates the planters on the lower floor by gravity by using non-potable recycled water.	 *Source:* Archdaily The maintenance of vegetation is done by two cranes installed on the top of the building which are used by the gardening staff to operate the plants from outside. The plants are watered by a centralized system equipped with drippers that filter and reuse greywater from the building.	 *Source:* Archdaily The facade is maintained by 20 gardeners who access it by using catwalks on all five floors. The trellises have an integrated misting system in order to regulate the amount of water for irrigating the plants	 *Source:* Archdaily To water of the waterfall is recirculated and reused within the building for irrigation of the landscape.
Nature in the Space	**Visual Connection with nature** is enhanced by indoor living plants **Non-rhythmic sensory stimuli** **Presence of Water** in sky garden **Dynamic and diffuse light**	**Visual Connection with nature** with the use of indoor living plants. It has accessible sky gardens **Presence of Water t**hroughout the building helps to maintain the temperature. **Connection with natural systems**: Attracts fauna and encourages biodiversity within the city.	**Visual Connection with nature**is achieved using trees plantation in the balconies **Dynamic and diffused light:** Filtered and diffuse light enters the spaces **Connection with natural systems:** The facades are dynamic it changes with the changing seasons which creates an awareness of the natural systems	**Visual Connection with nature** is created by the trellises and creepers on the facade. **Dynamic and diffused light**: The changing intensity of light outside creates dynamic shadows cast by the creepers. **Thermal and airflow Variability** Modulation of air and light through the building	**Visual Connection with** nature is there in all the spaces of through use of trees and water **Presence of Water** throughout the building helps to maintain the temperature **Dynamic and diffused light** The waterfall is integrated with lighting and sound system which is dynamic

Nature of the Space	 *Source:* Archdaily **Prospect:** There are unimpeded views of the city skyline from the sky courts and terraces	 *Source:* Terrapin Brightgreen **Risk and Peril:** It is created by cantilevered bird cages and large open platforms which overlooks the city from a great height. Also, there are dramatic views from the infinity pool. **Refuge:** There are cabanas with optional privacy also there are secluded wooded spaces with small water features.		 Source: RMA Architects **Refuge:** The façade has double skin that protects from the direct solar radiation**.**	**Mystery** is created in the topiary walk and mirror and hedge maze  **Risk/Peril** is experienced by the users in the sky net walking and sky net bouncing. Also canopy bridge made of glass creates a sense of fear among the visitors
Health Benefits	Lowered blood pressure and heart rate. Positively impacted circadian system functioning. Increased visual comfort.	Lower blood pressure/heart rate; improved mental engagement/attentiveness, positively impact, attitude and overall Happiness. Positively impacted perceptual and physiological stress responses. Observed View Preference. Results in strong dopamine or pleasure responses.	Occupants living in the building experience a high level of satisfaction with comfort levels and thriving green areas.	Lowered blood pressure and heart rate. Positively impacted circadian system functioning. Increased visual comfort. Improved perception of temporal and spatial pleasure (alliesthesia). Enhanced Positive health responses and shifted perception of the environment.	Reduced Stress and anxiety. Sound of water had positive impact on the brain and created sense of mental tranquility.
Benefits to the environment	Creates a mini-ecosystem for the species of animals and birds. The openness of sky-courts improves the cross-ventilation throughout the building. It has 240% of green Plot Ratio. The ecosystem Contribution Index is 80%.	Environmental benefits like the facade filter out the harmful pollutant entering into the building and helps to cool down the city.	Filters Sunlight. Helped in reducing pollution. Increased green cover of the city Reduction of urban heat island effect. Absorption of 30,000 tonnes of CO_2 from the environment. Gives 20,000 tonnes of O_2 into the environment	The green facade naturally cools down the building and helps in reducing the energy consumption. Improves indoor air quality	The trees purify the air and improves the indoor air quality.

5. CONCLUSION

The paper discussed the impact of biophilic design on facades for human health and wellbeing. It also discusses three different categories of biophilic design that is nature in space, Natural analogues and nature of the space. The describes ways in which Biophilia can be integrated into the design. The study also understands the integration Biophilia in five different cases and its impact on the wellbeing of humans and environment. The paper also analyzes different patterns of biophilic design implemented in five different cases and its implication on human health and well-being.

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An Architectural Xpression in Sensitive Ecological Conditions

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ABSTRACT: The paper intends to study architectural practices in the cold climatic region of the Mana village, Uttarakhand state. Since last decade, the culturally rich regions of Uttarakhand are losing their architectural identity to buildings constructed in global materials rather than indigenous ones. The disregard for the locally available materials has increased in the contemporary generation after the rise of modernist philosophy that gives out two unavoidable outcomes: 1) Fast construction with the load on services. 2) In their attempt to reach faraway places, their contribution to pollution has also increased due to manufacturing and delivery.

For this research, a climatic region with severe weather and sensitive ecology conditions along with intricately woven relationships of people and place of Mana village is studied. The research intends to propose an architectural expression by designing according to site conditions and creating programs that are best suited for the village.

Keywords: *Bioclimate, Vernacular Architecture, Culture, Site Specific, Cultural Tourism.*

1. INTRODUCTION

The Indian subcontinent is a host of diverse sensitive ecological regions. Their knowledge and traditions are passed through several generations. As one takes a closer look at all these regions, cultural and architectural evolution can be observed. The newer generation brings in innovative ideas, technology, and a shift in practices of customs, all of which contributes to the increased standard of living. As the buildings made in global materials came into picture, serving as a material that can promise faster construction with an all-weather reliability, people began to accept such changes in these regions.

The idea of universal design and materials slowly replaces the existing ornamentation which reflects the region's cultural heritage. As the value and use of ornamentation decreases and rise of structures in their brutal form with the use of factory manufactured materials also contributes to the heat island effect in several urban facilities for which sustainable methods proposed by IGBC are recommended or made a necessity as per the region.

To propose an architectural expression in a sensitive ecological condition, a cold climatic region has been chosen- a site that has an intricately woven relationship with people and place. As architects, we have far advanced in providing solutions in the subsets of warm climatic regions. As to the colder regions, especially in the villages of the Himalayas the study and practice are not moving hand in hand. One such locality with a distant tribe, surviving in the cold climate is the Mana village which is in the vicinity of Badrinath Dham. This leads to asking a few questions and introspecting over it.

- Can ecological building practices be reflected in design strategies?
- How can we reimplement traditional architecture that uses local materials to build architectural spaces?
- Can evolution of form be site specific and local culture?

A House in Mana Village

Source: Google street view.

Aim: Aim of this paper is to create an alternative architectural practice in an ecologically sensitive environment of Mana village, responding to people and culture with locally available materials to boost tourism in the village.

Objective

To study the evolving architecture of the place:

- To study, record and analyze the available materials on site for an ideal design belonging to the village climatic condition.
- To intervene as per the requirement of the village i.e., Create a built-form program that will help the village itself in its seven months of functioning.
- To design and formulate construction methodologies suitable for the site that responds to the ecological conditions without any hindrance

Scope

- To create an extension of the village where villagers can handle tourists more efficiently.
- Rediscovering an efficiently reusing and existing architectural style.
- To design a self-sustaining model for the region to understand and replicate in similar terrain.

Limitations

- Availability of materials and it is optimum usage.
- Site conditions.

Research Question

- What is the position of architecture between sustainability and comfort conditions?
- What do we need to express architecture in a sensitive ecological condition?

2. LITERATURE REVIEW

Understanding multiple research papers and concluding the same from the relevance of the topic, the literature review is summed in three major points. They are as follows.

2.1 Design Evolution in Architecture and its Influence around the World

The invention of a material such as steel and concrete gave more flexibility to the designers and quickly became the favorite of the architects around the globe as the hunt for a long-term standing material without a weather restriction came to an end. Different architectural styles, composite with traditional materials started coming up. Slowly, with modernism stepping in, concrete and steel took over the world, even in places where it was not required to be.

Now, the debate was no longer about what material to use, but it was about the expression of a design. It was about the very existence of ornamentation.

'Architects are out of the habit of looking nonjudgmentally at the environment, because orthodox Modern architecture is progressive, if not revolutionary, utopian, and puristic; it is dissatisfied with existing conditions. Modern architecture has been anything but permissive: Architects have preferred to change the existing environment rather than enhance what is there.' –Robert Venturi

Around the world, even in hilly regions, the local architecture preserved for several hundred years by the existing people living there, is being replaced by modern houses. Pollution and global warming are increasing rapidly with the contribution of not only cement manufacturing, but also the transporting vehicles used to reach distant places. This creates an urban heat island effect that leads to melting of glaciers and further leads to floods in valleys near the mountains.

Importance of sustainability in construction. - How construction contributes to global warming, and the social barriers that prevent sustainability - excerpts from Ar. Ashok B. Lall.

The importance of sustainability in the construction industry is one of the prime topics in today's picture, with statistics speaking volumes about the contribution of global pollution. The fumes are generated during the manufacturing of the concrete and the majority of which is given out by petrol or diesel running trucks that are used for transporting those heavy machineries and products to the far away site from the manufacturing plant.

In the hunt for a universal solution, the evolving materials are being used under the assumption that it will be available to the corners of the earth, but the problems arise when it contributes to global pollution during traveling and transport.

From the research paper, two things became known - one, the tangible issue of the hindrance of sustainability and second, the intangible relation between nature and humans. Let us understand them…

'The rich nations see it as an added cost to their comfort conditions that they have aspired to until now, while the poor or developing nations see it as a hindrance to their comfort conditions.' (Ashok B. Lall)

The problem of pollution which happens due to transport is resolved by using local materials and hence less traveling, while the concept of sustainability is also met with reduction of urban heat island effect due to lesser embodied energy in the natural materials.

2.2 Cultural Expression in Architecture

When architecture reflects the needs, culture, geographic conditions, the past and their present function, we call it vernacular architecture. Naturally, vernacular architecture is region specific and dominates the chief weather of that exact locality.

Climate responsive architecture provides solutions using certain elements, while vernacular architecture is carried by locals since it is the knowledge that they preserve with their culture. That is why culture is slow in getting adapted to a certain change of time. Why Vernacular architecture lasts is because culture takes time to change. That is why we keep on seeing Kath Kuni houses in several separate places but they all last several decades and even centuries.

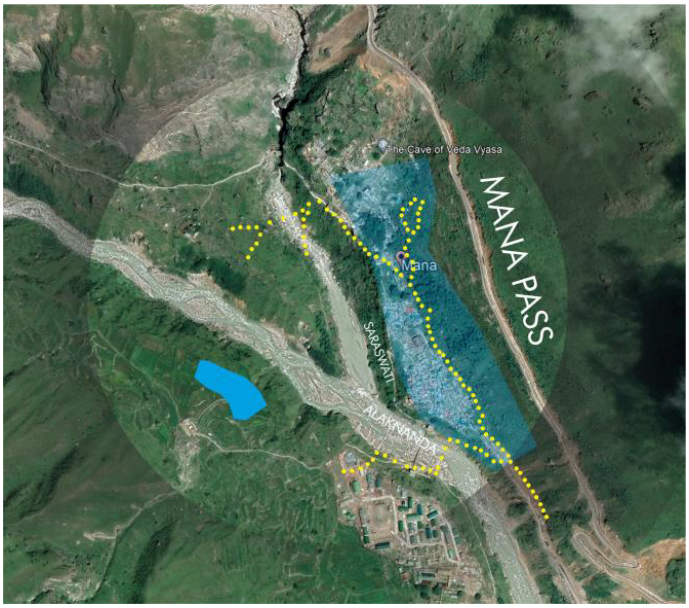
From the paper, Amos Rapoport says 'Culture is a whole way of life.' Just like how culture and vernacular architecture are dynamic, another word that relates to a tribe is traditions. Traditions too, are dynamic. People change with newer generations and traditions change with them.

Traditional Family in Mana Village

Source: Youtube channel – visa2 explore.

3. ABOUT MANA VILLAGE

Location: The village is situated 4.4 km from Badrinath Dham in Chamoli district, Uttarakhand state of India.
(Site location and village with roads and access)



Lifestyle: The major occupations are based on shops for tourists, cattle and dairy products and handicraft art on clothing and asanas unique to the people. Being the last Indian village, it has become a brand as 'the last Indian village.' The change in topography from Tibet to Mana valley brought changes in the village traditions and culture. Their occupations of trading with the Tibetan plateau changed with the arrival of more tourists. Right now, Mana village is losing its cultural identity. Few examples of their architecture reflect their culture and traditions, as they are giving in to the modernist materials and tourist bound economy.

Asana Handicraft

Source: Google street view.

Beliefs: The village worships a Jain deity by the name Ghanta Karna Devta who is the village Kshetrapal.

Apart from this, there is a factor of medicinal herbs. The village elders have known about the local herbs and their healing properties for a long time and with every new generation, the knowledge is dwindling. Around thirty or more species of special herbs are available in the region with their own medical properties.

4. OBSERVATIONS

The proposals in Mana village are brought down to 4 points:

1. The Badrinath revamp project which will have more influence on the village daily.
2. The increasing population every coming year.

3. Proposing programs to boost their existing culture and lifestyle.
4. Reflecting their culture into architecture.

It is quite admirable to observe that even after tourists coming every year, and their transhumance lifestyle of shifting every six months back and forth, the people have not forgotten their culture and religion. Even after having a rich culture, the people are shifting into brick houses or cement and concrete houses thinking they are far sturdier. Meanwhile the valley down the river suffered floods due to the heat island effect.

5. ARCHITECTURAL INTERVENTION

Considering all these factors, the design program has been introduced:

Extension of the village (Kath Kuni houses): Homestay hosting houses, cattle houses, low-income group houses, market houses.

- Herbal garden.
- Community hall.
- Anganwadi
- Stb plant
- Market
- Bridge connecting island and mountain.

The characteristics of the site are surrounding it to a few architectural styles that are indegenous to Himachal pradesh. Since the site conditions are earthquake grade V zone, heavy snow, average snowfall and mountain terrain the most suitable architectural style is Kath Kuni and Koti Banal.

Sketch by Author—A Kath Kuni Representation.

6. CONCLUSION

The new proposal of extension of village will keep the existing fabric intact and yet pave the way for a better lifestyle for the people of Mana village, administering to the government border village scheme and the esoteric lifestyle of the people of Rongpa community.

As the tribe continues to live on as a transhumance, that is changing residence every six months due to heavy snowfall, it would be ideal to have a better lifestyle whenever they return to Mana valley.

ACKNOWLEDGEMENT

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Application of Waste Product in Architecture

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ABSTRACT: The aim behind the research is use of waste products in architecture with exploring waste materials and its products. The growing rate of new constructions and waste materials has made it necessary to find innovative ways of recycling and subsequent reusing of waste materials to achieve a more sustainable environment. A large percentage of waste generated by Industrial as well as human activities can be recycled in different ways. Most of the recycled products nowadays have shown similar or better performances than new products. Descriptive research methodology helped the author to formulate the research. The primary data generated through site visits and secondary data through the study of various scholarly articles and research papers has helped the author to do the critical analysis and draw the conclusion. The main objective of this research is to highlight the various applications of waste products and promote their use in Architecture and construction.

Keywords: *Recycled Materials, Waste Products, Sustainable, Environmental Impact.*

1. INTRODUCTION

Buildings use 40% of the global resources and emit 1/3rd of CO_2 emissions. Environmental impacts can be seen at every step of the building process- extraction of raw the visual arts that is materials, processing, manufacturing, transportation, construction and disposal at the end of a building's useful life. As a step towards circular economy waste by-products can be used as resources that will reduce the utilization of finite resources for socio-economic benefits. There are various building products available in the market that are manufactured from recycled materials such as steel, bricks, aluminium, glass, tiles, Fly-ash concrete, etc. Most of the recycled products have similar or even better performances than new products such as Fly-ash bricks that have higher compressive strength than normal clay brick and have lower thermal conductivity than simple concrete block. Lack of technical knowledge and market for recycled products has slowed the progress of the recycling industry. Awareness is necessary about the various applications of using waste products and exploring their potential for innovative and sustainable architectural solutions. Environmental Impacts Can Be Seen at Every Step Of The Building Process- Extraction Of Raw Materials, Processing, Manufacturing, Transportation, Construction And Disposal At The End Of A Buildings Useful Life. The Growing Rate of New Constructions and Waste Materials Has Made It Necessary To Find Innovative Ways Of Recycling And Subsequent Reusing Of Waste Materials To Achieve A More Sustainable Environment. As A Step Towards Circular Economy Waste By-Products Can Be Used As Resources That Will Reduce The Utilization Of Finite Resources For Socio-Economic Benefits recycling of waste materials and promoting the use of waste products can help reduce energy intensity and environmental footprints of buildings and infrastructure.

2. LITERATURE REVIEW

Increase in public and political awareness has helped to promote the recycling of waste materials. due to which, there has been a rapidly accelerating trend towards the recycling of waste from industrial, agricultural as well as human activities India produced some 52 million tonnes of waste each year, which is approximately 0.144 million tonnes per day, of which roughly 23 per cent is processed-taken to landfills or disposedof using other technologies (cpcb report, 2016)the continuous expansion of population as well as migration from rural to urban areas has resulted in rapid boost in solid waste generation. indian municipalities spend almost 90% of their total budget on collection and segregation of solid waste, the collection efficiency is verypoor about 70-72% though As. (nema 2004; cpcb 2012).the government has rebuild the municipal solid wastes (management and handling) rules 2000 and published the new solid waste management rules, 2016 on April 8,construction and demolition (c & d) waste management rules, 2016 are new rules that werenotified on 29th march, 2016 by the ministry of environment, forest and climate change (moef&cc).c & d waste processing facility – 'orange' category activity consent to establish under section 21 of air (prevention & control of pollution) act 1981 andunder section 25/26 of water (prevention & control of pollution) 1974 has been treated as anorange category project by delhi pollution control

committee (dpcc). categorized in the following way: earthenware, terracotta, porcelain, China, bone China, stoneware or many others, (Ayodele Taiwo V., 2021). Most of waste, except hazardous waste, is a resource of secondary raw materials. Construction and demolition waste can be reused in building industry, since about 90% of debris is completely or partially recyclable after being sorted. For example, the statistics of STRABAG building company quotes that their amount of construction and demolition material decreased up to 10% in the last two years. Since 2014, strabag has started to separate construction waste consistently and subsequently use it in its building production. The effective construction and demolition waste recycling reduces the need for gravel sand and other minerals used for the production of building materials. Separation of the individual materials from waste can provide secondary raw materials for the further reuse in the building construction. Recycling makes it possible to obtain building materials whose production costs are lower and physical properties are comparable to non-recycled building materials. In terms of the sustainability, the treatment of construction waste is an inevitable solution, ideal if it is processed and subsequently inbuilt directly on the building site

3. MATERIALS AND METHODOLOGIES

In the procedure of data collection for this analytical type of research and in order to get references and also a better understanding of different types of waste materials use in building construction I had to visit various different places which hold few of the many places in Pune and also done various case study. Some of the places that I visited were malls, parks, hotels, etc where they have used such kind of waste materials Data was also gathered by visiting to various case studies This was all about the primary data. For the secondary data, I had to go through many other research papers and news and articles which gave me a deeper insight into the subject. The research aims at exploring the various methods of using waste products in Architecture. To do this following methodology. This was all about the primary data. For the secondary data, I had to go through many other research papers and news and archaeological articles which gave me a deeper insight into the subject.

4. RESULTS AND DISCUSSION

While studying the entire subject about waste material, I came across many facts and different ways of using waste material in various ways in architecture. We realize that there is so much to learn from our ancestors and our culture and there is so much knowledge about anything and everything that we can benefit from, even on today's date. I got to study various different methods of waste material and also gained knowledge about various different materials that could be used for making the use of waste material. Recycling and subsequent reuse of waste products from industrial and human activitiesis necessary to reduce the utilization of natural resources and divert the waste material.from landfill dumping. Rapid growth in construction sector has impacted the supply and demand for building materials. The country generates an estimated 150 million tonnes of C&D waste everyyear, according to the Building Material Promotion Council. But the official recycling capacity is just 6,500 tonnes per day which makes about one per cent, according to a report by Centre for Science and Environment Recycle content is an important feature for choice of recycled material. Recycled content is assessed into two types supported on its origin namely Post Consumer and Pre-consumer or Post-industrial Post-consumer recycle content is consumer waste that has already been used for its primary purpose. Post-consumer recycled materials can be diverted from landfills. Therecycle content was generated by industrial, commercial, or institutional end-users andcannot be further used for the reason it was manufactured. Aluminium, paper, plastic, demolished concrete, steel, Glass etc., and are the examples. Waste material output or by products from industries is Post-industrial recycled contentwhich is usually diverted to other industries or land filled. Slag, crusher dust, fly ash bricks, saw dust, tiles etc., are the examples glass-Majority of glass waste is not being recycled and goes to landfill instead. Waste glass is used to replace the constituents of concrete. It is used as partial substitution for either fine or coarseaggregate or both combined and is also used in the form of glass powder in partial substitutionfor cement because of its pozzolanic nature.

Translucent glass concrete- (TGC) block gets its name due to its property of light emission through optical fiber strands in it. Its creative design can make great aesthetic ambience to structures where it is used. In TGC building blocks aggregate used is crushed glass pellets an translucency is facilitated through optical fiber embedded across the blocks. The main purpose is to use sunlight as a light source to reduce the power consumption of illumination and to use the optical fiber to sense the stress of structures and also use this concrete as an architectural purpose for good aesthetical view of the building. (Suguna *et.al, Babu et.al, M. et.al, 2016*)

- (Tiarella *et al*. int j concur struct mater (2018)) mixed color waste glass can be recycled for manufacturing decorative architectural mortars; the possibilities have been investigated. in mortars, recycled glass culets are used to substitute 0–33–66–100% of calcareous gravel volume, with no other inorganic addition. to attenuate the possible alkali–silica reaction, mixeswith a hydrophobic admixture were also compared.
- *Road construction:* crumb rubber is obtained from the waste tires. crumb rubber modified bitumen (crumb) is hydrocarbon binder attained through the physical and chemical interaction of crumb rubber which is made by recycling of used tires with bitumen and some particular additives. Conventional bituminous mixtures include stone aggregate and about 3 to 5 percent bitumen by weight of the aggregate. The scrap tire rubber can be combined with bitumen, which is abbreviated as modified bitumen and granulated or ground rubber or crumb rubber can be used to replace a portion of the fine stone aggregate. The advantage of using waste in hot bituminous mixes is enhanced pavement performance, protection of environment and provision of low cost and quieter roads. (Baraiya *et al*, 2013)
- *Bitumen:* Rubberized bitumen has higher softening point, giving more stability to the pavement during hot months. Much improved Elastic Recovery over 60, giving resistance to fatigue. Water-repellent properties improve resistance to stripping More resistance to varying daily and seasonal temperatures. Better age resistance properties. Much improved Elastic Modulus increases load carrying capacity. Delay's oxidization of mixes thus enhanced pavement life.
- *Plastic blocks:* Shredded plastic waste bonded with foundry dust/sand waste can be used to manufacture masonry blocks. By using plastic as a bonding agent, the necessity for water during mixing and thereafter curing is completely eliminated. The 'silica-plastic blocks' can be directly used after cooling down from moulding process. These plastic blocks are 2.5 times the strength of normal clay bricks and consume around 70–80% of the foundry dust with 80% lesser use of natural resources. Plastic waste can be recycled in many ways to manufacture new plastic, incineration for energyin the form of RDF or using pyrolysis to obtain pyrolysis oil which is a diesel like fuel.

  Plastic bottle-studiokca's pavilion is a cloud-shaped structure that seeks to create a space where dreamers who inhabit the "city of dreams" can dream; a place to put your head (and body) in the clouds and dream that city of dreams. Over months studiokca collected used bottles from organizations, businesses, schools, and individuals throughout new York city and beyond; the bottles were then repurposed to construct the pavilion by more than 200 volunteers. the project was funded in part through a successful kickstarter campaign, which can be seen here "the head in the clouds pavilion not only stands as a visual and physical example of the more than 60 million plastic bottles thrown away in the u.s. every day, we hope the process of creating the structure provides an example of a viable design and construction strategy for a more sustainable way of living and building hir studio began by recycling plastic bottles collected from the riverside town, having them processed and further remodeled into new public benches. these benches were then installed in the sha tin district's town hall for pedestrians to enjoy at the end of the two-month period, a total of 500 kg of plastics were collected—a majority of which were hdpe bottles of washing liquids, detergents, bleaching agents, and other household products. The plastics were then cleaned, processed, and ground into pellets, prior to being transported to a local furniture factory where they were molded in a large oven.

Fly ash- Fly ash is a by-product from burning pulverized coal in electric power generating plants. Duringcombustion, mineral impurities within the coal like feldspar, quartz, clay and shale fuse whilebeing suspended and float out of the combustion chamber with the exhaust gases. The fused material rises and as it cools it solidifies into spherical glassy particles called fly ash.Fly ash is used as a supplementary cementitious material (SCM) in the production of Portland cement concrete. A SCM, enhances the properties of the hardened concrete through pozzolanic or hydraulic activity, or both, when it is used in conjunction with Portland cement. Waste incineration plant at the transfer station produces ash as by- product. MSW (Municipal SolidWaste) ash is being used to manufacture concrete blocks. Gypsum, lime, manufactured sandand MSW fly ash are the constituentsof the concrete block. Kalaivani *et al.*, 2018 investigated. That 20% replacement of M-sand by MSW ash is optimum with a compressive Strength for 7 days of12.34 Mpa and water absorption of 17.66%.

- Recycled Concrete Aggregate: Recycling of concrete is important as it protects the natural resources and eliminates the need for new aggregates for producing fresh concrete. Concrete is recycled at the C&D waste treatment plants. The treatment involves crushing, screening and washing of the recycled concrete. This process extracts well graded aggregates which are bonded by hardened cement paste. Can be used as a substitute for natural aggregates. The specific gravity is reduced and the porosity is increased of hydrated cement paste in comparison with similar conventional aggregates. Higher porosity of RCA results in a higher absorption. Recycled aggregates are 40% cost effective than natural aggregates.
- Landscaping and Art Installations: Recycled plastic bottles or cans can be used directly for landscaping purposes like vertical gardening. There are various examples of creative art installations or landmarks made using waste plastic. Waste tires can be reused in multiple ways in gardening and other landscape features concernedwith environmental protection. Innovative furniture can be designed using waste tyres. Rubber tires have great flexuralstrength and durability.

5. CONCLUSION

Use of recycled waste products reduces carbon footprint and provides sustainability in severalways. Recycling reduces the need for more landfill spaces and also the energy needs for the manufacturing or procurement of new materials. Moreover, the substitution of natural materials by waste products also enhances the properties of the building material like fly-ash bricks and CRMB for roads. Overall economic impact of the project is reduced. Lack of technical knowledge and market for recycled products has slowed the progress of the recycling industry. Awareness is necessary about the various applications of using waste products and exploring their potential for innovative and sustainable architectural solutions. Any design of architecture must always reflect a sense and context that produced it. Architecture is more than merely providing shelter to someone or something.

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Study of Elements, Spatial Planning, and Semiotics of Queer Architecture in Residential Building

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ABSTRACT: Architecture is a way our society is formed, and how people use it gives meaning to it. By considering gender and sexuality as a representation of living in a space, it can change the function, planning, and elements of structure which could be termed as Queer Architecture. This research paper analyzes how Queer Architecture works in urban cities, especially in residential design, taking examples around the world and understanding the elements, symbols, and planning of queer space and how it challenges hetero-normative design notion. The abstract idea of 'Queering' is essential to the framework, in the context of the paper, as to how architects understand their clients' needs as queer individuals and construct a gay-friendly environment in an era where people are not queer-friendly. Through an examination and compilation of available examples, case studies, and comparative analysis of existing design, we can identify the difference between hetero-normative and homo-normative design notions.

Keywords: *Queer architecture, queer space, inclusive, voyeurism, heteronormative, homonormative.*

1. INTRODUCTION AMD BACKGROUND OF THE STUDY

The formation of gay or queer space as distinguishable elements in society as a place without judgment and discrimination should be understood as an alternative to a hetero-normative mentality. Gay neighborhoods as evidence of vibrant areas and deepening the notion of the cities started incorporating into the urban landscape of the western cities, which puts focus on making queer identities visible and acknowledging the different categories of identity such as class, ethnicity, gender as well as sexuality. While in an Indian context, cruising spaces are developing as queer elements. The difference between Western and Indian geography helps us to examine the inclusiveness of queer space not only in terms of sexuality, but also in, terms of necessity, purpose, and use of space according to respective sexuality. But, all they have in common is the experiences based on gender expression and sexual orientation in public and private spaces. Taking design not just based on gender but extending its depth to sexuality helps few architects to understand their client's needs in pursuance of orientation.

2. WHAT IS QUEER SPACE?

Connections between sexuality, gender, and sex, can be found in almost any architectural realm which not only changes the perspective of design but the use of space too. Visibility of such spaces in an urban environment by challenging hetero-normative design notion is termed as Queer Space. This research paper contributes to the learning of literature that familiarizes the intimate relationship between sexuality and home. The addition of LGBTQ people, allows us to rethink architectural domesticity which is one of the main aims of this paper. Drawing it from architectural work and clarifying queer theory can be represented as a feature of sexuality to learn the domestic planning and function. The concept of "queering" of space in homemaking not only changes the function of space but also allows the exploration of new spatial planning approaches and interior spaces, which also have a huge role in making a space queer. Though it's an argument that queering of space is nothing but political activism, this paper will present, how queering home breaks the heteronormative-based design and unfold a new paradigm of planning and the concept of living. This research studies and analysis the past work of a few architects who took queer theory as a design medium to explore residential design into a new chapter. Concerning study, the planning and elements of queer spaces are not well defined according to geographical region. Through interpretation of spatial planning with the context of queer elements and symbols helps us to understand the development of the residential design. The objective of this paper is to highlight the importance of an intersectional perspective of residential planning with a focus on queer aspects through centering queer people's experiences. This is made

by analyzing the planning process of H.H Harris and William Alexander and their design, planning, and elements of queer residential space.

The scope of the study helps architects in the future to understand the element and keys of queer planning to develop a queer-friendly environment for the gender-fluid generation. The study focuses only on the exploration of residential design into different geographies with respect to the understanding of queer architecture.

3. LITERATURE REVIEW

As Dasgupta said, "Identities are complicated, to begin with, and become more complicated when relating them with nation and sexuality." The literature review included literature and documentation of queer space in residential, in particular, historical architecture of California (U.S) and contemporary architecture of Lucknow (India) to distinguish queer space planning, elements, and semiotics. Putting residential in a larger context of queer space, comparisons of living situations, inspired architects to develop the homonormative design and use of space. This study is important to understand how to reframe planning practice to be more inclusive for queer people. Before the discussion on the queer space, definitions of the terms like "queer", "gay", "hetero-normative", "homonormative" and "voyeurism" are stated below:

1. **Queer:** An umbrella term to refer to LGBTQ+ people. It is also a non-binary term used by individuals who see their sexual orientation/identity as fluid.
2. **Gay:** Men who experience sexual, romantic, and/or emotional attraction to other men.
3. **Heteronormative:** The comprehension that everyone is straight. The idea is that romantic and sexual relationships are always between the same gender. Heteronormativity assumes heterosexuality as the default sexual orientation, and natural way to express sexuality and attraction.
4. **Homonormative-** Refers to the belief that sexual minorities can and should conform to heteronormative institutions and the idea that romantic and sexual relationships can be on a broader spectrum.
3. **Voyeurism:** Voyeurism can be experienced as sexual arousal. Intimidating and reflecting human expression in the form of intentionally and unintentionally expressed desire.

The architecture allows experience with a variety of elements not just in space but in connection with people's desires. This space facilitates to work, live, create, reflect and connect to the surrounding. The gay spaces which appeared are secluded, according to Aaron Betsky (1997).

> "to grow up homosexual is to live with secrets and within secrets." These secret places are not just hideouts but spaces to create or live in a queer way, which in other terms is known as Closet space. Considering the intended purpose of the study, it is important to understand the queer theory. For example, Betsky's architectural treatment of queer space in the 1997 book, "Queer Space: Architecture and same-sex desire", explained the specific element of queer space as "The goal of queer space is orgasm. It is the space in which your body dissolves into the world and your senses smooth all reality into a continuous wave of pleasure…Orgasmic spaces leave you vulnerable and happy that vulnerability because you are the center of your experiences. It is an unreal space with no endurance, and yet is very real…Queer space is built out of three elements. Out of the recesses of the self, it constructs a mirror in which you appear, then dissolves into orgasm." Architecture that is itself unique might also qualify as queer space. Still, architecture had a great impact on the interpretation of queerness because it is part of the cluster constituent of forces that shape gender performance. But, contradicting the above statement Architects Benjamin Gianni and Scott Weir in the Wexner Center's 1994 House Rules Show rejects the links with the flexibility of the term queer and said "Sexuality exceeds the realm of the architects" they also say, "queerness is more a strategy than a space."

This search of definitions of queer space and elements in residential design emphasizes architectural vision to underline the fluidity of spatial planning and semiotic references of how small architectural elements convert space into the gender-friendly design. This study identifies and explains the key elements of queer space - closet, mirror, gesture, seduction, and voyeurism with the context of case studies. It also defines how heteronormative space planning is different from homonormative planning.

4. MATERIAL AND METHODOLOGY

The methodology addresses the analysis of recent and past works on architecture based on queer spaces. The research was generated through the literature review, interview, and case study analysis to include qualitative data on queer peoples' needs and their experiences of private space (residential).

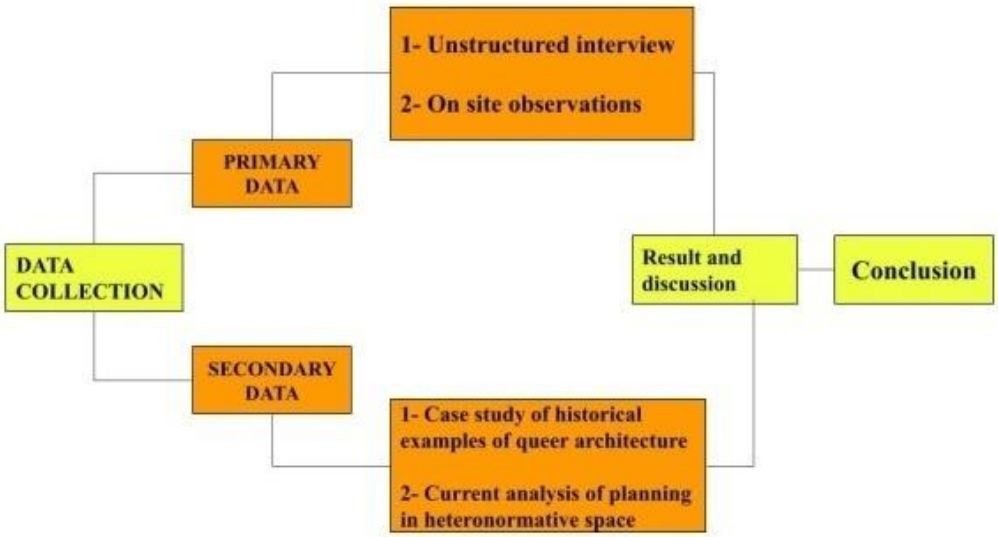

Figure 1: Showing the Data Collection Process

5. CASE STUDIES

The following section analyses and describes the elements of queer spatial planning. The first section is considered as the homonormative perspective of designing a space in the western world (California) which showcases how queer spaces work in the development of residential buildings in an urban environment. The second section will showcase how queer space works in heteronormative-based planning in India (Lucknow).

4.1 H.H. Harris's Entenza House in Santa Monica (1938)

The first one is Entenza House in Santa Monica designed by Harwell Hamilton Harris. The client was the publisher-editor of Art & Architecture (A&A) who commissioned H.H. Harris to build his residence on the small plot (of 757" by 638") in Santa Monica Canyon. It is a small-budget house that stands out because of client needs. Explaining the location of the site exhibits seclusion of his private landholding to the adjacent neighborhood. As mentioned in the above statement in review, this seclusion of space is a closet element of queer architecture. Accordingly, Architect Harris designed compact closet space, with all necessities including garage, utility, kitchen, living room, guest room, study room, and master bedroom. The planning of the house was different from the house based on heteronormative design notions, it mostly consists of major public and minor private spaces.

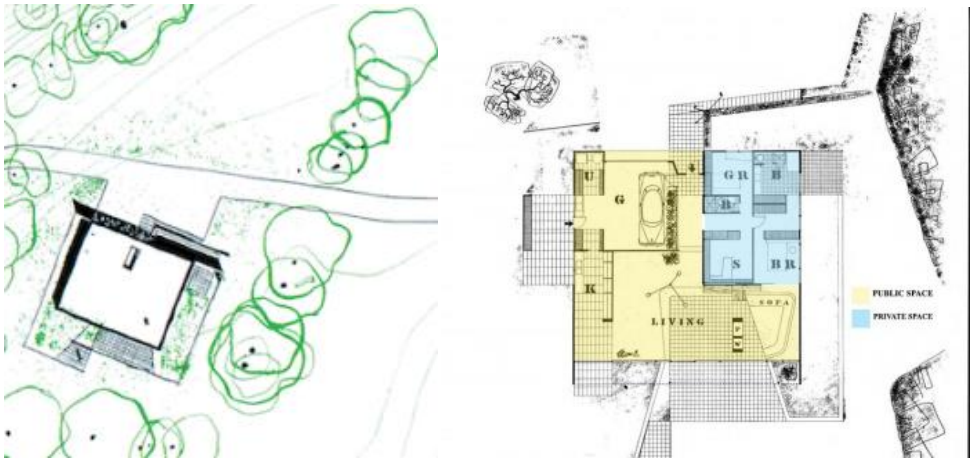

Figure 2: Showing the Site Location of Entenza House and Detailed Ground Floor Plan

Source: #9's case study.

4.2 H.H. Harris's Havens House in Berkeley (1941)

The John Weston Havens House, 255 Panoramic Way, Berkeley CA was commissioned in 1940. It was Harri's most appreciated architectural work. Construction of the site was on the steep slope and to distance it from the street, a three-level floor plan was designed according to

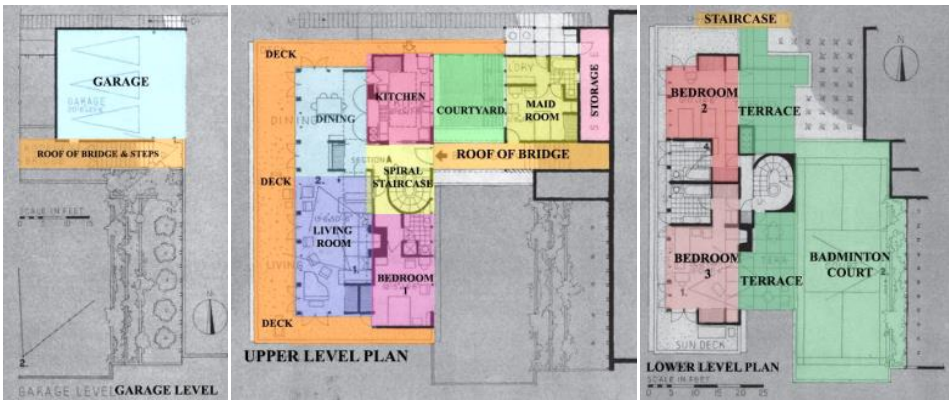

Figure 3: Showing Garage Level, Upper-level, and Lower-level Plan of Haven's House

Source: UC Berkeley.

Haven's need for privacy but directly connecting to public places. The first is one story which houses a garage and housekeeper's apartment directly accessible from the street. The Roof of Bridge was constructed to connect the garage level to the lower and upper levels of the house. The upper level was used as a public space having a view of San Francisco Bay and an internal courtyard, consisting of a living room, dining, kitchen, deck, and a spiral staircase. On the lower level, two bedrooms open towards a balcony that spans the length of the house. Bedrooms are accessible and connected via the courtyard so that outdoor and indoor fuses completely. It was seen that spaces in the house have queer elements like closet, mirror, voyeurism, and seduction. Haven's bedroom shows seduction and voyeurism of the space because it was separated by a spiral staircase yet accessible through the deck and connecting private space directly to public space. Spaces created in the house promote voyeurism since it is an expression of human nature, which reflects and shapes, this reflection can be mentioned as a mirror of space, as seen in bathrooms of the lower-level plan. Each bathroom contains a wall-to-wall mirror that reflects, which effectively creates transparent walls in bathrooms and bedrooms. Thus the mirrors became a key element queer space, creating a relationship between the two closed spaces. It was also recalled by Katarina Bonnevier's queer criticism of Eileen Gray's E.1027 Villa, defining the living room, by the presence of a large bed, accommodating various private and public functions. A multi-use space for rest, study, meetings, and even parties, showcasing the feminine atmosphere and seductive pleasure. Likewise, Haven's bedroom is an unclear space that is intimate yet also the most public space in the house. In the upper-level plan, the kitchen act as a gesture (as a queer element) of invitation for all public events in the house, social gatherings, informal meetings, and intimate dinner. Havens House was truly a combination of queer elements and semiotics which shows openness against inclusive planning and privacy indulging with publicity.

4.3 William Alexander's Halliburton (Hangover) House (1937)

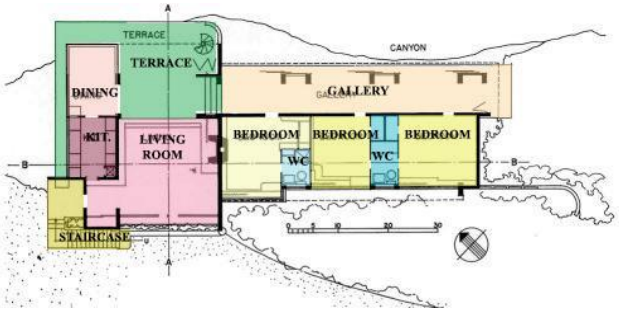

Figure 4: Ground Floor Plan of Hangover House

Source: Floor plan from Architectural Record ('House for Writer Affords Privacy and Spectacular View', 1938).

The owner (Halliburton) of the Hangover house was a celebrity of his time. His closet gay persona and heterosexual lifestyle narrates the idea behind queer planning of hangover house. The Architect focused on the persona and not the person, the owner's relationship with three men navigated him to design a closet, voyeuristic and open plan at the same time. On the main floor or ground floor, the kitchen and dining room connects to the living room which opens onto the terrace. Living space is planned to create an indoor and outdoor vision that gives access to the ocean and bay and also connects to a long gallery that leads to three bedrooms. The bedroom closet to the living room was Halliburton's personal space while the other two bedrooms belongs to his gay friends. Opposing the traditional heteronormative home design, the long gallery plays as a public space that directly connects private areas like a hotel. Use of living room, kitchen, and dining changes as per the activities like a public or private meetings or gay parties. The kitchen had a moveable partition wall which acts as a semiotic of queer planning affecting the usage of space. Two bedrooms on the southern part connect with one washroom space acting as a place of seduction and representing the owner's open relationship with the two gay friends.

4.4 Hazratganj and Vipul Khand House (Lucknow)

Due to the discretion of the owners, identities won't be revealed in this particular case study.

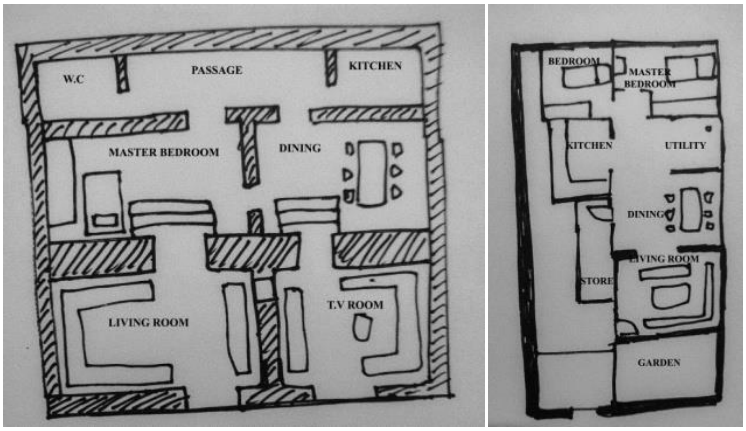

Figure 5: Ground Floor Plan of Hazratganj and Vipul Khand House

Source: Author.

Both the owner of the houses identify themselves as gay. The Resident of Hazratganj house was a retired army guy and the other one worked in the medical sector for HIV. Both the houses are constructed based on heteronormative design, like the house in Hazratganj was a corridor in Mughal Era which was later converted into housing, while on the other hand house in Vipul Khand is rented space. The owner of Hazratganj house changed the heteronormative-based design into queer/ homonormative by adding and creating gay interior spaces. The living room can be used as an LGBTQ+ gathering, meeting spot, and documentary presentation, therefore its public space in his house is directly connected to the bedroom. During the interview, he mentioned the bedroom as a seductive space and also represents voyeurism. He also added a nude portrait of him to dominate queer identity. On the other hand, Vipul Khand's's house was rented therefore, usage of space was restricted still few spaces like the living room and dining area is used as a queer gathering, meeting spot as well as a small theatre for LGBTQ+ movies and documentaries.

5. RESULT AND DISCUSSION

The following section analyses the difference between heteronormative based design and homonormative based design with the help of queer planning, elements, and semiotics of queer architecture gathered by the above case studies are as follows-

1. The houses Hazratganj and Vipul Khand house are based on heteronormative design and have restrictions of use. They are planned in a queer perspective, whereas houses of Havens, Entenza, and Hangover are homonormative-based design houses with clear use of queer elements and planning.
2. Homonormative design was based on the client's person, not on the person, spaces are created to give seclusion and closet to the society still act as part of the city.

3. Taking queer as elements of spatial planning breaks norms created for the residential design which has nothing to do with people's sexuality or gesture of representation. It widens the spectrum of planning of residential buildings.
4. Queer elements like closet, mirror, gesture, seduction, and voyeurism explains the functionality of residential space sensually and help to create open yet closed spaces.
5. Queer planning is based on one factor, an indulgence of private space into public and vice versa gives the new idea of creating intimate spaces in residential.
6. Western and Indian queer space design clearly state the function of the spaces is widened because of the community brotherhood. Most of the spaces classify themselves as public to accommodate more activities according to the need.
7. During the case studies, the interior of the houses plays an important role as queer elements, placement of beds, portraits, even the staircase act as barrier still functional to the public areas.
8. Heteronormative-based design limits the use of space which not only affects the planning but suppresses the gender-fluid community to grow and thrive.

6. CONCLUSION

This research paper has raised several critical questions for planning practitioners and scholars, highlighting the ways that current heteronormative planning practices have treated the queer community as invisible, immoral, and insignificant identities. Reframing planning practice requires a minute approach. Rather than neglecting individuals and communities as static, planners and architects may revolutionize the design by being more open and less shallow to design queer-friendly spaces in residential planning by decoding a set of pseudo assumptions about the communities.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my guide Associate Prof. Sarika Thakoor for her valuable guidance, inspiration, and encouragement. Her keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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Potential of E-Waste Byproducts in Architecture

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ABSTRACT: Advances in the field of science and technology brought about the industrial revolution in the 18th century which marked a new era in human civilization. With the advancement in technologies and expansion of software, Industries have led to the production of e-waste in a large amount which is increasing day by day. This hazardous waste is a threat to human health and the environment and hence needs to be addressed for achieving sustainable development. This study aims at the different processes to recycle E-waste whose by-products can be used in architecture. This study not only aims at the processes but also gives an overview in understanding the different aspects of sustainability and how E-waste By-products obtained after the recycling process can be used in architecture.

Keywords: *Electronic-waste, Recycle, Sustainability, Construction Material.*

1. INTRODUCTION

The electronic industry is the largest and fastest-growing industry in the whole world. Rapid expansion in any form has its own set of unavoidable repercussions. E-waste is described as discarded electrical and electronic equipment that is near or at end of its useful life. Information technology has tremendously transformed our day-to-day lives. It has provided innumerable benefits to all the users by reducing the communication gaps providing many facilities on their fingers and making our lives easier and more comfortable. In the last two decades with the increase in demand and rapid changes in equipment, features, and capabilities product obsolescence with a decrease in prices and increase in internet use has generated a huge quantity of out-of-date electric and digital devices. However, it has also resulted in unfettered resources consumption and alarming waste generation. E-Waste encompasses a whole range of electrical and electronic equipment such as computers, printers, scanners, monitors, mobile phones, refrigerators, Tv's, cameras, batteries, CD-DVD, automobile equipment, etc. Many of them contain hazardous metals and chemicals which are a threat to human health and the environment and hence need to be addressed while maintaining economic viability growth and improvement of one's quality of life. Maharashtra being the top contributor of E-waste in India raises a concern for the management to be done properly. The objective of the paper is to study the various parameters by which management of e-waste is done and what are the by-products obtained in the process can be used in architecture by contributing to overall sustainable development.

2. HISTORY AND BACKGROUND

The electronic revolution began in the mid-century when advances and inventions were being made, and the electronic industry took off in many nations, with digitalization in many sectors seen as a step toward the countries' progress. The electronics manufacturing business has established itself as one of the most innovative in the world. It is constantly developing and implementing new technology. This has also facilitated the development of what is known as inherent product obsolescence. As it is generally cheaper to buy new items than to fix or update a damaged or outdated one, a growing number of electronics and electrical appliances are being discarded. This resulted in the generation of e-waste.

3. LITERATURE REVIEW

Electronic gadgets are nowadays an integral part of human lives and with advancement in technology and competition in the market, the rate of production of gadgets has increased which is resulting in the generation of e-waste as there are no alternatives or designs produced which can replace the old gadgets in such a way that after the damage it should not be dumped. The software industries along with educational institutes to government organizations switched over to digitalization. Studies suggest that around 95% of e-waste is handled in the informal sector and most of the processes are crude waste processing techniques, which are adopted leading to various health and environmental hazards. E-waste generation globally has increased over the past 10 years, where India ranks 3rd in the e-waste generation in Asia generating 1.8 Million tons of

e-waste. The report released by Assocham and NEC ahead of Environment Day on 5 June 2019, [ii] the studies showed the practice of Recycling e-waste is been carried out in India but has only specific cities, and the rest is dumped. Initiatives by the government have been taken into consideration and rules have been set up for E-waste management.

4. METHODOLOGY

This study examines the many approaches to developing a long-term solution to the problem of e-waste management. This study was conducted to determine the fundamental cause of the problem and how it is damaging people's livelihoods, causing dangerous health concerns, and negatively impacting the environment on a large scale.

The formal and informal methods of treatment and disposal of e-waste were studied. The research was carried out in 5 stages-

4.1 What is E-waste

Discarded electronic or electrical equipment and gadgets are referred to as "electronic waste." E-waste refers to used electronics that are intended for reuse, salvage, resale, disposal, or recycling.

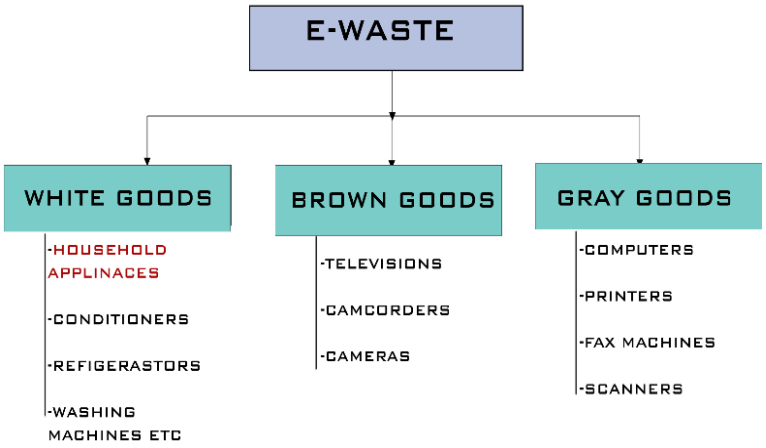

Figure 1: Flowchart Showing Classification of E-waste

E-waste is generally classified into three categories.

- **White Goods**—which contains all the household items and is a major contributor to the e-waste generation. These are also called consumers equipment.
- **Brown Goods**—This contains electronic digital items which are more complex to recycle due to the multilayered configuration and higher toxic chemical composition.
- **Gray Goods**—These especially contain It and Telecommunication equipment which has the most potential to be recycled.

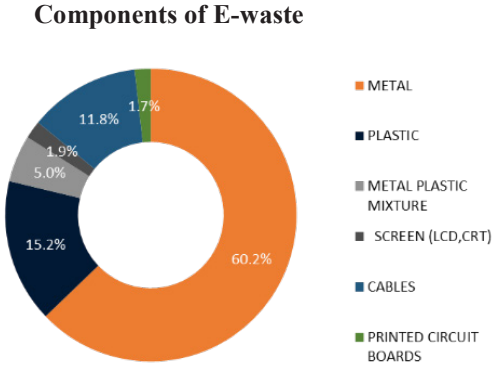

Figure 2: Different Components of E-waste[ix]

Majorly the components of E-waste are classified into 5 general categories of materials: ferrous metals, non-ferrous metals glass plastic, and others.

Metals are the major common material found in e-waste representing 60% and generally contain metals like aluminium, copper, lead, etc.

Ferrous metal contributes 50%, non-ferrous metal 10% and plastic 15.2% in electronic components. A non-ferrous metal consists mainly of heavy and precious metals like Pb, Hg, Cd, Zn, Cu, Al, Ag, Au, Se, etc.

Plastic like High Impact Polystyrene (HIPS), Acrylonitrile Butadiene Styrene (ABS), Polycarbonate (PC), Polyphenylene oxide (PPO), etc.

4.1.1 *E-waste a Global Scenario*

The inevitable result of incremental penetration of IT in many areas of day-to-day activity, which adds to the municipal solid waste stream, is the increased creation of e-waste over time. In 2019, the globe created around 53.6 million MT of e-waste, according to the Global E-waste Monitor 2020. However, only 9.3 million MT of e-waste was collected and recycled in a formalized manner. [iii] The sheer volume of e-waste is a concern, but the global waste stream is becoming much more so with the complex's rapid expansion. E-waste is one of the world's fastest-growing sources of waste. In the future scenario, e-waste generation would increase by 4% annually giving rise to 2 times the generation of e-waste.

USA	China	Japan	Germany	India
11.7 Million Tonnes	6.17 Million Tonnes	2.2 Million Tonnes	2.0 Million Tonnes	1.8 Million Tonnes

Figure 3: India Stands as the Fifth Producer of E-waste in the World [x]

4.2 E-waste Scenario in India

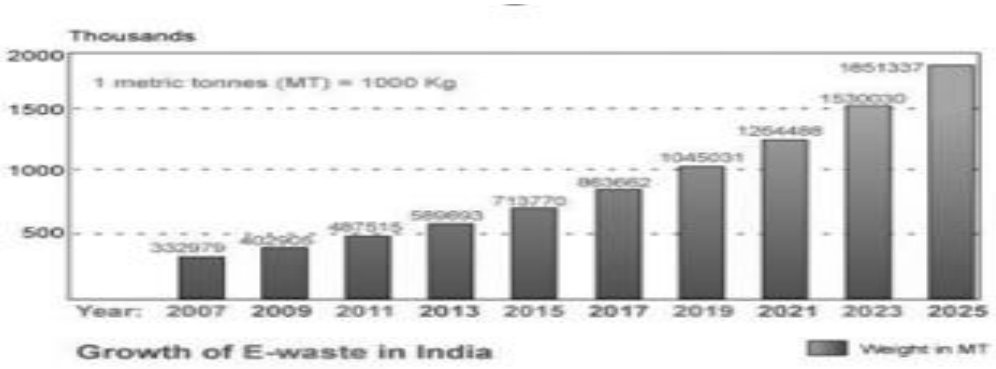

Figure 4: Growth of E-waste Generated per Year in India[xi]

Due to the lack of a specialized or systematic **c**ollecting system for e-waste in India, there is no precise data on the amount of e-waste that is really created and disposed of each year, as well as the magnitude of the resulting environmental danger. As of 2011, India's e-waste generation was predicted to exceed 470,000 metric tonnes, with Mumbai producing roughly 19,000 tonnes, Delhi 9000 tonnes, Bengaluru 13000 tonnes, and Chennai 7000–8000 tonnes each year. The state of Maharashtra (which includes Mumbai) produces 20,270 tonnes of e-waste per year. [i]Since the typical lifespan of a personal computer has been shortened to roughly two years, the Electronic Industry Association (ELCINA) [ii] in India has estimated that e-waste will grow by 11 times by 2012. In emerging nations like India, every person in India generates 2-6% of e-waste in a year. The fractions of electrical waste when compared to PCs (20%) and televisions (18%), the growth rate of mobile phones (80%) is quite significant[iv]. The entire quantity of waste created is enormous, and it is growing at an alarmingly rapid rate.

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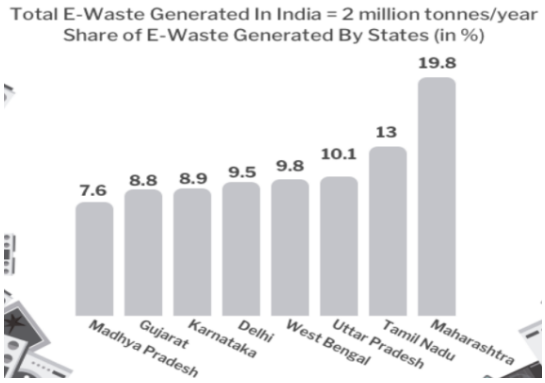

Figure 5: Maharashtra is the Top Leading E-waste Generator in India[xii]

According to the study, computers contribute 70% of total E-waste generated in India while telecommunication accounts for 12%. Where Mumbai Topped the list generating 1200,000 tonnes of e-waste annually.

Among states, Maharashtra contributes the largest e-waste of 19.8% but recycles only about 47,810 tonnes per annum.

4.3 Sources of E-waste and Growth Pattern

India moving towards digitalization, the public and private sectors are the primary contributors of e-waste in India accounting for 70% of the total e-waste generated the contribution of individual households is relatively 15–20%, but due to the extended usage and changes with advancement in technology complemented by affordable product cost and variety of products is contributing to increased e-waste output. The old products are directly disposed of and thought for refurbishment or repair is not given thus they are dumped even if their useful life has not yet expired and may fixed and used further.

4.4 Methods of E-waste Management

Various methods of e-waste management are adopted after understanding the alarming situation of the growth of e-waste and considering the future scenario. The concept of 3R's cis adopted as:

- **Reduce**—to solve the crisis of e-waste is to produce less e-waste and to use the products till their end of the life cycle has not reached but this concept of reducing fails miserably due to new gadgets in the market and their low production cost.
- **Reuse**—Reusing old gadgets or repairing them when needed till the time it reaches their end of the life cycle can help to reduce the generation of e-waste to some extent, despite their limited life span the product would end as waste.
- **Conventional Disposal in Landfills**—The traditional technique of disposing of products in landfills, where they remain for an indefinite amount of time, contaminates groundwater and soil with harmful substances on a vast scale, causing serious health and environmental issues.
- **Incineration in Open-Air**—To tackle the problem and find an alternative method other than the conventional one of disposal of waste by dumping in landfills, the non-biodegradable components of e-waste were disposed of utilizing an incineration technique. Different components are separated, and open-pit burning is employed to separate the metals from the recycled components, resulting in toxic fumes and contributing to air pollution, which causes severe lung disorders.
- **Recycling**—The reuse and reprocessing of electrical and electronic equipment of any sort that has been abandoned or considered obsolete is referred to as e-waste recycling. Many valuable, recoverable elements may be found in e-waste, including aluminum, copper, gold, silver, polymers, and ferrous metals. Recycling may help in reducing environmental risk when carried out in a proper manner and solves the problem of dumping into landfills. It has few benefits as-
- **Conserves Natural Resources**—materials recovered from recycling can be used to make new products and thus reducing the need for mining of raw materials.
- **Creates Employment**—Given that about 90% of electronic equipment is recyclable, electronics recycling may play an important role in job creation. The awareness and rising demand for e-waste recycling leading to the setup of recycling plants can create job opportunities.

4.4.1 *Reduces Environmental and Health Hazards*

Reusing and recycling electronics safely helps in keeping hazardous materials from harming humans and the environment.

4.4.2 *Informal and Formal Sector of E-waste Management*

Informal Sector: In India, scrap derived from e-waste is processed using the most common processes, including refurbishing, landfill disposal, and burning. People with little to no protective equipment or technology routinely do informal e-waste recycling. Home-based and family-run e-waste recycling is common. India is one of the countries with the most e-waste that is treated informally.

Formal Sector: The use of specialized equipment and numerous procedures, the formal sector of e-waste management works on the principle of recycling e-waste to recover the highest amount of materials that may be utilized by implementing the authorized government's laws and regulations.

The official industry arose as a result of the large-scale manufacturing of e-waste, in which the government established laws for appropriate e-waste recycling. In several places, recycling units have been established in collaboration with the informal sector, where waste is collected and disposed of properly by approved recycling units using suitable procedures and equipment. By employing Best Available Technologies (BAT), formal sector recyclers are able to treat e-waste in an ecologically sound way, resulting in improved environmental management and resource recovery.

4.5 CASE STUDY-I

4.5.1 BRP Infotech

Location: F-394, phase-I, M.G road, industrial area Hapur Dist Hapur Uttar Pradesh India

This case study was conducted at BRP Infotech in order to better understand the e-waste recycling process. The services they offer and the byproducts produced during the recycling process, as well as the amount of material, recovered and reused in various sectors.

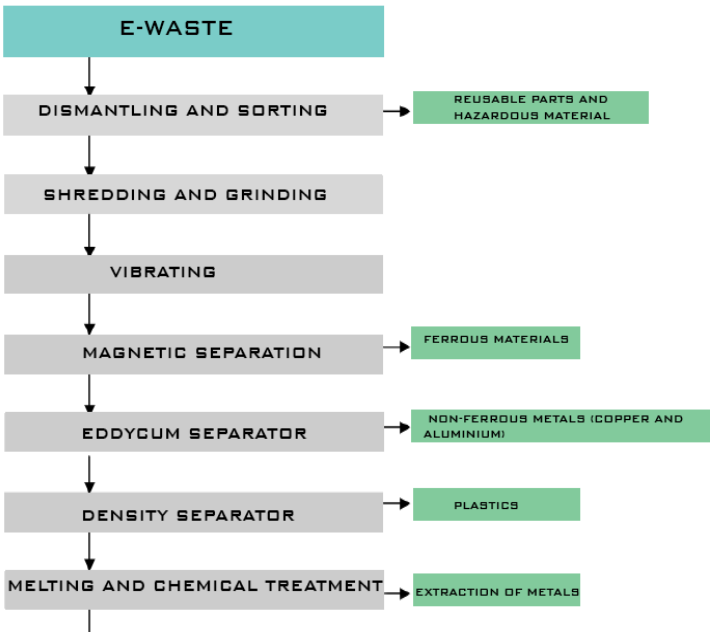

Figure 6: Stages of Recycling of E-waste (author)

After visiting the recycling unit of BRP infotech the whole process of E-waste recycling was studied along with the advancement in equipment that is used in the process of recycling.

The process is generally carried out in 2 stages.

Stage 1: E-waste is collected and then sorted by product category of the equipment. Before moving on to the second step, which considers the client's data leakages privacy concerns, the Data Destruction process is completed, which involves deleting data from hard drives, SSDs, mobile phones, and other storage devices using software like BitRaser which is a NIST Tested and approved software for data wiping.

Stage 2: In the second stage the process of recycling is carried out in the following manner.

(a) **Dismantling and sorting**—dismantling is done manually to separate out materials of a similar nature, as well as reusable and non-reusable components along with hazardous material are, separated and stored in huge containers for processing.

(b) **Shredding and Grinding—**To separate the components from a unit, shredders are used to break down big components into smaller ones, allowing the smallest units of the product to be separated. This aids in the separation of polymers, metals, and other materials. Plastics is grounded into smaller, finer plastic pellets which are easy to recycle.

(c) **Vibrating—**The crushed material is passed through a vibrator which removes the lightweight particles and unwanted dust from the materials.

(d) **Magnetic separation**—The breakdown of smaller units is passed through a magnetic belt by which ferrous metals get separated out.

(e) **Eddycum separator—**The material is passed through an eddycum separator which works on the phenomenon of magnetic induction and conductive metals are separated out.

(f) **Density separator—**After passing through the eddycum separator the material is passed through trammel which separates out glass and ceramics and them through an optical sorter to remove remaining impurities

(g) **Melting and chemical treatment-**The the last process includes the recovery of metals by various processes such as the **Pryometullergic** process where the waste is melted at high temperature and then recovered it cooled down to convert into a slurry and then go through some chemical treatments, another process which is **Electrolysis** process carried out in presence of electricity and works on the phenomenon of ions present in the metal. copper, gold, cadmium, silver are such metals that are recovered from this process.

5. RESULTS & DISCUSSION

E-waste is produced at a global pace of 50 million tonnes per year, and it has the 'potential' to expand at a considerably higher rate than any other waste stream. It is interesting to notice that If e-waste recycling is done through proper procedure e-waste contains 92% recoverable and reusable materials. the by-products obtained after the recycling process metals such as copper, aluminium, nickel, gold, silver, cadmium, iron, tin, lead, and zinc can be used in even in smallest amounts and has the potential to be fully used in various products. The concept of circular economy is been supported by recycling waste through innovative methods and recovering productive elements which give a convenient solution to manage it and electronic assets by providing a sustainable solution.

Recovered metal	Weight
Gold	279.93 g
Precious metals (Pt, Pd, In)	93.31 g
Copper	190.512 Kg
Aluminum	142.152 Kg
Lead and Tin (Pb/Sn)	30.844 Kg
Silver	450 g

Figure 7: The Recovered amount of Metals from 1 Tonne of E-waste after the Recycling Process [ii]

The graph above shows how metals are recovered, with copper and aluminium having the highest recovery rates and being frequently used in the field of architecture.

No	Reagents	Recovery Method	%Recovery
1	Nitric acid LIX-984	Hydrometallurgy Solvent Extraction	99.7 (Cu)
2	Sodium Cyanide	Leaching Column technique	46.6(Au), 51.3(Ag),47.2(Nb),62.3(Cu)
3	Sulfuric acid, Hydrogen peroxide, Thiourea, sodium hypochlorite, Hydrochloric acid,	Hydrometallurgy Precipitation	100(Pd), 100(Au)
4	Sulfuric acid, hydrogen peroxide, Thiourea	Bio-recovery	Cu(75), Au(69)
5	Acidithiobacillus ferrooxidans	Bio-recovery	100(Cu),100(Ni)
7	Ammonium thio sulphates, Ammonia	Hydrometallurgy	90(Au)
8	Ammonium thio sulphates, Copper sulphates	Hydrometallurgy	98(Au),93(Ag)

Figure 8: Recovery of Different Metals from E-waste[xiii]

This diagram depicts the potential of e-waste as a supply of raw material from scrap that is recovered using a biochemical method that is both ecologically friendly and sustainable.

5.1 Use of E-waste by-Products in Architecture

"The growing role of minerals and metals for low-carbon future" shows how widespread use of solar, wind, and batteries would raise demand for metals including aluminium, copper, lithium, and others.

1. **Copper:** It is never an exaggeration to say that copper is a green substance. This is because, in addition to its limitless recycling potential, it develops a greenish tinge when exposed to the elements, which acts as a thin layer of protection while leaving the core portion of the sculpture intact. Copper can be recycled indefinitely, making it a valuable resource for future generations. This is a metal that has a wide spectrum of colors, from orange to greenish, grey, and even black.

Figure 9: Skelleftea Kraft Office Building/General Architecture [xiv]

The image above displays the usage of copper in façade treatment, where recycled copper is utilized to bring the building's various volumes together. Copper was an environmentally friendly exterior material. It is long-lasting and recyclable, making it environmentally friendly. It also ages well and develops a lovely patina over time."

2. **Aluminium:** The features and characteristics of aluminium as a material has resulted in revolutionary and new developments in architectural projects. From Window frames and other glazed structures, ranging from the roof of shops to stadiums and curtain walling, as well as cast door handles, catches for windows, staircases, and heating and air-conditioning systems, are all common uses of aluminium. The outstanding corrosion and weathering resistance lowers maintenance and increases the product's lifespan. The material's reflectivity provides significant insulating benefits, when used components are recycled, remelting consumes just 5% of the energy consumed.

Figure 10: Aluminium Frame Combined with Polycarbonate Roofing Sheet Used for Roofing [xv]

3. **Plastic:** Plastic obtained from e-waste can be reformed into filaments that can be reused to print various types of products and may help to reproduce the framework for electronic items using 3D printing technology. In architecture, this would assist in the creation of physical 3D models for presentation, which will assist in mastering the level of details and visual simplification desires. In the future, this might potentially allow for the creation of 3D printed small-structures.

6. CONCLUSION

The study clearly helped in understanding the procedures and aspects of e-waste management, as well as the possibility for e-waste to be utilized in various forms and industries. The research conducted not only helped to understand the recycling process and the various forms in which they can be used but also gave a perspective of sustainable development considering the various factors which would not only contribute to the architectural society but will also control the mining and demand of natural raw material to be used in the architecture.

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Adaptive Strategies for Mumbai in View of Global Mean Sea Level Rise

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ABSTRACT: Global mean sea level (GMSL) rise can result in a series of devastating effects in coastal regions. Most of world's largest cities are near coastlines and have highly vulnerable. Mumbai metropolitan region (MMR) is one of the most vulnerable cities and where it is imperative to adopt mitigation strategies. The aim of this study, therefore, is to understand the effects of GMSL rise on MMR and study the mitigation strategies that can be applied. Projections of GMSL rise are made by various organisations. These projections indicate affected regions of MMR. Research and case studies of various mitigation strategies are studied. For the MMR specifically, the coastal regions are examined to understand applicable strategies. The conclusion of the research is demonstrated as three types of suggestions where natural defences should be protected, technical interventions like sea walls, storm-water pumps should be introduced and a managed retreat from vulnerable regions is advocated.

Keywords: *GMSL Rise, MMR, Sea Walls, Managed Retreat.*

1. INTRODUCTION

Global mean sea level (GMSL) rise is defined as the average rise in sea levels which could result in various devastating effects on coastal regions. GMSL rise is one of the major consequences of global warming. Primary factors which cause GMSL rise is the increase in water quantities in the sea due to melting ice sheets and glaciers and the expansion of sea water due to the increase in water temperature [1].

In the past two centuries, the GMSL has risen by about 8 to 9 inches, a third of which has come about within the past two decades. In 2020, the GMSL was around 3.6 inches above the 1993 average, which makes it the highest annual average in the period between 1993 upto the present time [2]. GMSL rise has varied effects on different coastal regions due to several local geographical factors.

According to the United Nation atlas of oceans, eight out of world's ten largest cities are near coastlines. The reason for the development of these cities were maritime trade which resulted in a high population density, economic activities and investments in terms of supporting infrastructure. Most of it now faces risk due to GMSL rise.

Mumbai, the capital of the state of Maharashtra and the financial capital of India, has an estimated population of around 20 million people. It is also known as the 'economic powerhouse' and 'industrial hub' of India. It is the biggest and the most populous city in the country and ranks among the top five of the most populous cities in the world [3]. Mumbai has evolved from being a collection of seven islands into a metropolitan city with an area of 438 square kilometers of land. This has been made possible by a rigorous process of reclamation from 1708 (check?? And add citation) for which embankments were built, hills were flattened and rubble was dumped into marshes. The land thus created through reclamation tends to sink and is easily erodible over time, making Mumbai highly vulnerable to GMSL rise [4].

To reduce the risk potential of the Mumbai aMetropolitan Region (MMR) due to GMSL rise, it is imperative to understand the effects of GMSL rise and study the mitigation strategies that can be applied in response to these effects. Therefore, the aim of the study is to understand the strategies for MMR coastline that can be used to mitigate GMSL rise. This will be carried out by completing the following objectives:

1. To study the causes and impacts of GMSL rise in the world.
2. To understand the risk potential faced by MMR due to GMSL rise.
3. To collate the current infrastructural developments and their impact on MMR's risk potential.
4. To examine the global attempts to adapt to the effects of GMSL rise with respect to their respective geological and geographical conditions.
5. To analyze the strategies applicable to MMR coastline according to its geological and geographical condition.

2. LITERATURE REVIEW

To understand the rate of GMSL rise, the reports by the NASA Technical Report Server, 2017 [5] and the Ministry of Earth Sciences (MoES) [6] have been studied, which have shown the rate of GMSL rise. The report also further estimates the expected rise by the year 2100 due to depletion of glaciers and ice sheets in Greenland and Antarctica. This naturally brings into consideration the coastal populations under threat due to the GMSL rise, especially in the major coastal cities like New York, Shanghai and Mumbai [7]. The National Maritime Foundation estimates that more than 51 million people living along the Indian coast are vulnerable to danger [8].

Mumbai is particularly vulnerable to this maritime threat. Nikhil Anand [9] points out that the megalopolis needs to take significant action in the next three decades or else the sea will reclaim much of the landfill that the city has been built upon. Adaptive strategies for GSML rise to mitigate the risk potential of Mumbai have been studied through reports and research papers. In his paper *Sea Level Rise: Evaluating Adaption Strategies and Options*, Ridwan Bello [10] talks about the method of 'retreat, accommodate and protect' for coastal cities by building protective and adaptive infrastructure. That which cannot be protected or accommodated should be retreated from the vulnerable region. Nicholls [11] advocates a two-fold approach at the global and local levels. While the first includes strategies to cut down carbon emission, the latter reiterates the 'retreat, accommodate, and protect' approach. The report *Synthesis of Adaptation Options for Coastal Areas* [12] addresses the risk potential of coastal cities and suggests adaptation strategies for buildings, infrastructure and areas vulnerable to GMSL rise. Both, the U.S. Environment Protection Agency (EPA) and Lebbe *et al.* [13] prescribe the method of hard protection such as sea walls and bunds and soft protection, made up of wetlands and mangroves.

The coastal regions in Mumbai have been studied through the coastal zone management plan (CZMP) of Mumbai MCZMA [14] to identify applicable strategies.

3. METHODOLOGY

To meet the above-mentioned objectives, mainly secondary sources were studied. Reports and research papers by experts on GMSL rise were considered to understand its causes and global impacts. Further, the history of Mumbai was studied to understand the geographic and economic evolution up to contemporary times. This was compared with the projection maps of GMSL rise by Climate Central (CC) and National Aeronautics and Space Administration (NASA) specifically for Mumbai to understand their impact on the city. This has helped in understanding the reasons for MMR's vulnerability and the risk potential. The environment impact assessment (EIA) reports of various large scale infrastructure projects planned in the city were studied to understand their impact on MMR and the city's preparedness towards the predicted phenomena.

To understand the available strategies that can be applied to mitigate the effects of GMSL rise globally, research papers and reports by experts helped to understand their application and efficacy, along with case studies where their use has been demonstrated. Finally, different types of coastal regions around Mumbai were examined to determine the suitability of applicable strategies.

4. RESULTS AND DISCUSSION

4.1 GMSL Rise in the World

GMSL rise is one of the three major consequences of climate change, the other two being global temperature rise and drastic weather conditions. GMSL has been rising between 16 to 19 cm since 1900 at the rate of around 3 cm per decade. The biggest deposits of water are glaciers and ice sheets found in Greenland and Antarctica which are as deep as 3.2 km. It has been estimated that the rate of depletion of the ice sheets will cause the sea levels to rise by at least 1.5 to 1.8 m by 2100 [5].

The primary cause of GMSL rise is the rapid increase in global temperatures. These lead the ocean to expand as well as melt the glaciers on land and ice sheets on the ocean. This adds even more water to the already expanding sea resulting in a rise in water levels. The rise in global temperatures is defined by the value of representative concentration pathway (RCP) which is the warming in watts per cubic meter of atmosphere. Hence, higher the carbon emission on earth, higher the RCP value. According to Moftakhari *et al.* [15], GMSL rise is exponentially proportionate to the RCP value. This means that if the RCP value is reduced, projected sea level rise will reduce as well. Most of the major economies of the world is present in the form of densely populate coastal cities. These cities face a huge threat to its population and infrastructure because of

GMSL rise. The most vulnerable cities of the world are ranked based on the exposure of their population and value of infrastructure assets.

Table 1: The Table Ranks Some of the Important Coastal Cities Based on Their Exposure Towards Rising Sea

Sr.	*Ranking by Population Exposure (From highest to lowest)*	*Ranking by Value of Property and Infrastructure Assets Exposure (From highest to lowest)*
1.	Kolkata (India)	Miami (US)
2.	Mumbai (India)	Guangzhou (China)
3.	Dhaka (Bangladesh)	New York (US)
4.	Guangzhou (China)	Kolkata (India)
5.	Ho Chi Minh City (Vietnam)	Shanghai (China)
6.	Shanghai (China)	Mumbai (India)
7.	Bangkok (Thailand)	Tianjin (China)
8.	Rangoon (Myanmar)	Tokyo (Japan)
9.	Miami (US)	Hong Kong (China)

Source: Adapted by Author from Global Report on Human Settlements [7].

4.1.1 *Maeslant Barrier*

This is a storm surge barrier built in 1997 protecting Rotterdam which is 90% below sea level. During storm surges, the water rises by 3 m. This activates the barrier to close, shutting off the 360-metre-wide waterway [16].

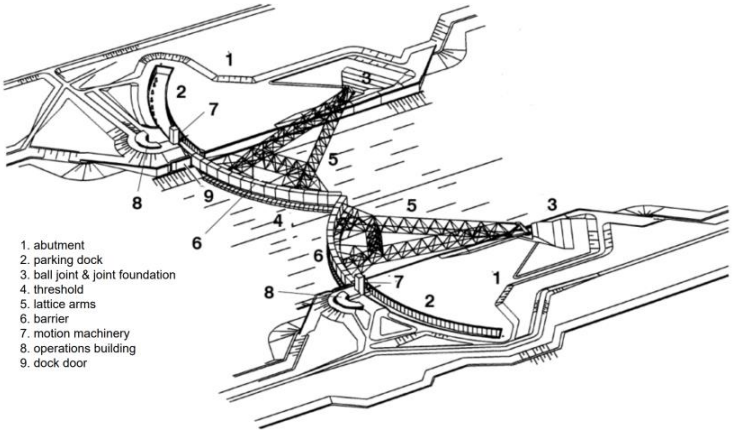

Figure 2a: Maeslant Barrier

Source: Ministerie van Infrastructure en Milieu [18].

Advantages: The barrier provides an important measure to Rotterdam. Due to the moving nature of the barrier, it is only employed during storm surges. This doesn't disconnect the coast from the sea permanently.

Disadvantages: Although the barrier has been proved successful in saving the city from floods, it is estimated that it will be good enough only until mid-century since the rate of sea level rise accelerates every year.

An anticipatory strategy has been hence devised where new development can be immune to sea level rise and extreme weather events. One example for such development are the floating homes of Ijburg district [17].

4.1.2(a) *Floating Homes of Ijburg District*

Ijburg is an urban development in eastern Amsterdam built in response to the growing infrastructural needs of the city, as well as to minimize population density in the flood-prone region. The district, once completed, will accommodate about 18000 homes with an average density of 71 homes per hectare [19]. The district is partly on reclaimed land and partly has floating houses. These floating houses are prefabricated and transported directly to the site where they are connected to jetties and anchored to the waterbed. The only movement allowed is vertical which makes the house immune to water level rise.

Advantages: Floating structures have successfully made sure that they are rendered immune to GMSL rise.

Disadvantages: The idea of having individual floating structures connected by jetties have caused various restrictions in the movement across settlements.

Figure 2b: Floating Homes of Ijburg District
(*Source:* Archdaily [20])

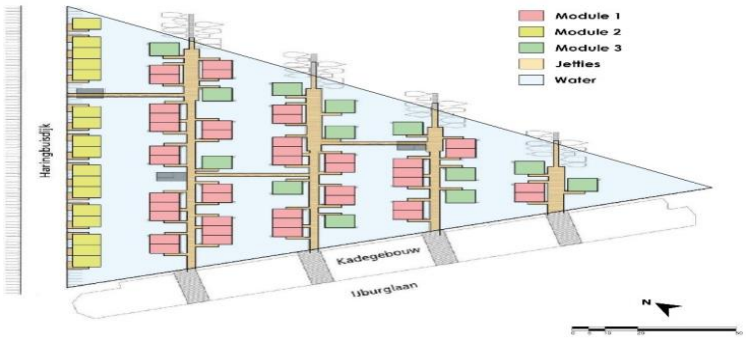

Figure 2c: Layout of the Floating Homes of Ijburg District
(*Source:* Author, Adapted from: Archdaily [20])

4.1.2(b) *Manhattan Dryline, New York*

New York is one of the most densely populated coastal cities in the world. According to the United Nations Habitat Report, it is the third most vulnerable city in the world with respect to the infrastructural exposure (refer Table 1). According to Owen Mulhern [21], 37% of lower Manhattan will be exposed to storm surges by 2050. Another study by Adele Peters [22] suggests that by 2100 around 20,000 acres of the city and about 280,000 residents will be affected by GMSL rise. The city has started to respond to this threat and one of the prominent actions taken is the proposal of a massive system of floodwalls and floodgates at the lower tip of Manhattan. This large-scaled controversial project plans to elevate the coastland with 2.5 to 3 m of landfill and build a public waterfront on its top.

The Manhattan Dryline is an excellent example of how the seawalls and anti-erosion sea bunds can be utilized for public purposes as public waterfront spaces and natural defences. The Dryline is a 12 km long protective strip that wraps around southern Manhattan. It incorporates public spaces and seawalls doubling as parks, seating, bicycle shelters and skateboard ramps [23].

Advantages: This model of flood protection system provides a good opportunity to combine public amenity spaces and increase the urban landscape of the city along with providing flood protection.

Disadvantages: In the process of developing this project, it is estimated that many trees will be cut down from existing coastal parks. This is an expensive project with the cost estimation of up to 1.45 billion USD and yet it covers only one part of New York City.

This case study has proved instrumental in understanding how a seawall can be designed to increase the engagement of citizens with the sea and protect the mainland from flooding at the same time.

Figure 3a: Location Plan of New York Dryline at the Lower Tip of Manhattan with Various Public Amenities Incorporated
(*Source:* Adapted by Author from Google Maps)

Figure 3b: Manhattan Dryline Proposal
(*Source:* The Guardian, 2015 [24])

4.1.2(c) *Kutubdia Island, Bangladesh*

Bangladesh is one of the nations which are most vulnerable to GMSL rise. It is estimated that by 2050, up to 13.3 million people will be displaced. The case study selected is of Kutubdia Island, off the southern coast of Bangladesh which has been rapidly eroding due to GMSL, rise causing both land and life to retreat [25]. To protect the island, a solution was devised by Mohammed Shah Nawaz Chowdhury, a research associate at the Institute of Marine Sciences, at the University of Chittagong in Bangladesh. He suggested that the island's shore could be protected by natural defences like reefs which are an ecological hotspot for marine life and a potential source of income for the villagers. The basis of Chowdhury's solution envisages oyster reefs as a defence mechanism against storm surges and coastal erosions. Oysters engineer their environment by clustering on submerged hard surfaces to create reef structures which protect the coast from being buffeted by strong waves as well as induces sedimentation behind the reef structure. The reduction in the wave impact energy before it reaches the shore results in more foreshore and calmer waves [26]. Thus, instead of traditional structures, oyster breakwaters were built.

Advantages: Along with being a low-cost solution, implementation of such systems improves coastal ecologies and marine life quality. They can prove to be very instrumental in providing breakwaters and intermediate regions in vulnerable coastal regions.

Disadvantages: Nature-based solutions cannot be implemented everywhere. To develop oyster reef structures, the biological conditions of the region should be very specific and hence this cannot be directly replicated in other vulnerable regions.

This case study is a good example of how live ecological defences can be implemented as well as their advantages over traditional protective infrastructure like sea walls etc.

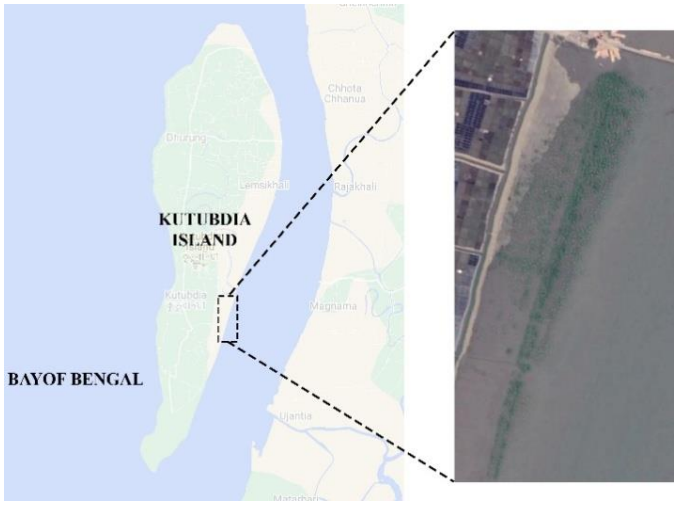

Figure 4a: Map Locating the Experimental Reef Sites in Kutubdia Island
(*Source:* Adapted by Author from Google Maps)

Figure 4b: Artificially Grown Oyster Reefs on Submerged Concrete
(*Source:* Future Planet, 2021 [26])

4.1.3 *Overview of Strategies for Mitigating the Effects of GMSL Rise*

In addition to the case studies above, various research papers, articles, reports also mention strategies that can be employed for mitigating the effects of GMSL rise. These can be classified under three categories. These categories are as follows:

(a) *Restoration and Maintenance of Natural Coastal Buffers*

Coastal wetlands form a buffer between the land and the water bodies of freshwater as well as the sea. This wetland includes mangroves, salt marshes, mudflats, seabed grass and coral reefs. Studies have shown that these ecosystems can attenuate wave power, decrease coastal erosion and enhance coastal protection [13]. Through the aggressive urban development of various coastal cities around the world, coastal wetlands have been encroached upon by various direct and indirect methods. These include building infrastructural facilities for transportation of goods as well as for the commute of people and defence infrastructure. Wetlands are also at risk due to reclamation and their degradation through drainage and landfill. In the last three centuries, the world has lost around 87% of natural wetlands, 35% of which has disappeared since the 1970s [27]. Due to rapid urbanization, agricultural expansion and pollution over the last four decades India has lost one-third of its natural wetlands with MMR losing the maximum at 71% according to a report published in Hindustan Times [28]. Wetlands are a vital part of the strategies to mitigate floods and control soil erosion. Therefore, the coastal wetlands need to be left untouched and restored if needed and allowed to expand and grow.

(b) *Protecting the Coast by Building Necessary Infrastructure*

Cities and coastal management authorities can take various measures in terms of developing infrastructure solutions. These solutions take a long time to execute and hence it is important to understand the projections of the sea level rise and its consequences for the region and start developing the required infrastructural ution as soon as possible. These infrastructure solutions include sea walls, elevated coastal roads, storm water pumps and holding ponds [12] ds very high value. The desire for urban population to live near the sea has caused high population density along the shoreline, resulting in huge populations which are at-risk because of GMSL rise. In place of building protective infrastructure, this response focuses on technological, architectural and urban planning responses to make our cities immune to the threat. In this approach the urban land distribution is reorganized to reduce the population density along the shoreline as much as possible. Since this can cause migration of coastal populations to highlands, we need to be careful that we do not encroach on forest as well as agricultural land and re-distribute the population with minimum migration [11].

(c) *Modification and Accommodation of Coastal Development*

Table 2: Evaluation of Various Mitigation Strategies for MMR

Geographical Location	*Strategy*	*Durability*	*Environmental Damage*	*Impact*
Intertidal zones	Building natural infrastructure like mangroves and reef structures which can act as barriers and reduce the impact of storm surges	Moderate	Low	Low
Developed coast with less intertidal zone	Artificial barriers or seawalls to prevent floods and storm surges	Moderate	High	Low
Low lying regions	Storm Water Pumps to improve drainage of storm water	Moderate	High	Moderate
Rivers, streams and reservoirs	Storm surge gates or flood gates to control the flow of water	High	Moderate	High
Human Population	Managed Retreat (migration)	High	High	Moderate
Coastal Urban regions	Elevated structures to adapt to the effects of GMSL rise	Moderate	Moderate	Moderate
Water body	Floating Structures	High	High	High

Source: Compiled by Author from [10–13, 18, 23, 25].

Coastal Real Estate Hol

Table 3: The Table Defines Various Coastal Region of MMR and Applicable Mitigation Strategies

Coastal Region	*Definition*	*Geology*	*Applicable Mitigation Strategies*
CRZ-I	Ecologically sensitive areas	This region comprises of swamps and marshlands. These regions form an intermediate between the mainland and the sea. They are coastal ecological hotspots like mangroves, seagrass beds saltmarshes etc.	Policies encouraging conservation and redevelopment of these regions as well as introduction of ecosystems like reef structures in compatible intertidal regions.
CRZ-II	Developed areas	This region comprises of the developed areas of the coast. Therefore, this region is mainly flat and hardscaped with infrastructural facilities like drainage and water supply, sewerage mains and roads.	Interventions like artificial barriers and sea walls are required. Drainage and sewage systems needs to be upgraded to function during high tide floods. Low lying regions require storm water pumps to drain the flood waters.
CRZ-III	Rural and urban areas not substantially developed- based on the population of the coastal areas	This region comprises of undeveloped coastal regions and usually fall under rural areas. The natural terrain of the region is retained and is classified under no development zone (NDZ).	This region should be left undeveloped with introduction of coastal ecosystems like reef structures in compatible environments. Sea wall or barriers may be required in some places to protect agricultural land.
CRZ-IV	12 NM into the sea and inside tidal water bodies with salinity upto 5 ppt.	This region consists of the sea and estuaries.	Wave breakers can be introduced at strategic location which does not disrupt coastal ecosystem. Storm surge gates or flood gates needs to be introduced at the openings of bays and estuaries.

Source: Adapted by author from Coastal Zone Management Plan [14].

4.1.4 *GMSL Rise for Mumbai Metropolitan Region*

Mumbai is one of the most important cities of India with a population of over 20 million people. As shown in Table 1, it ranks the second most vulnerable in terms of population exposure.

The cause for its vulnerability is its process of development. Mumbai evolved into a metropolitan economic hotspot to include the infrastructural development and of the land on which that infrastructure was built. The original seven islands were separated by sea and swamps which were reclaimed by the British who built embankments, flattened hills and dumped rubble into the marshes. Slowly the city of Bombay grew into a 438 sq. km of solid land-chunk jutting out from the Indian Peninsula [4].

MMR being developed majorly on reclaimed land is highly vulnerable since reclaimed land tends to erode easily and sink overtime. This is the reason that the projection maps look a lot like the Bombay of 1700. Despite this, MMR continues to follow the unsustainable footsteps of the British. It is evident from the pact assessment [29] of the 29.2 km coastal road project which is along the western coast of Mumbai which analyses the risk from sea level rise using the projection data from the 20th century. The data indicates that average sea level rise will be 1.27 mm annually. The rate of sea level rise has increased drastically since the 20th century: the average rate of GMSL annual rise has increased to 3.2 mm during the period from 1993 to 2012 [5].

Impacts of GMSL Rise in MMR

Mumbai now consistently appears in the list of cities endangered by climate change along with New York, Miami, Shanghai etc. Nikhil Anand, an Associate Professor of Anthropology at the University of Pennsylvania, predicts that anthropogenic climate change will inundate significant sections of MMR by 2050 [9]. Along with floods, MMR will also face drastic weather conditions and cyclones because of GMSL rise. Figure 5 shows the map of Bombay in 1700 as well as the projections made by Climate Central [30] for the year 2050, showing the regions of Mumbai affected by high tide

flooding and storm surges. Immediate and significant action needs to be taken by the authorities to ensure that we can protect and adapt to the rising seas. To understand which strategies can be employed, we need to understand the types of coastal region of MMR.

Coastal Regions of MMR

To understand different coastal regions, Coastal Regulation Zone (CRZ) regulations and Coastal Zone Management Plan (CZMP) for MMR have been studied. According to the CRZ notification, coastal regions are mainly classified into four categories which are CRZ-I CRZ-II, CRZ-III & CRZ-IV. The applicable mitigation strategy depends on the type of region as mentioned in Table 3.

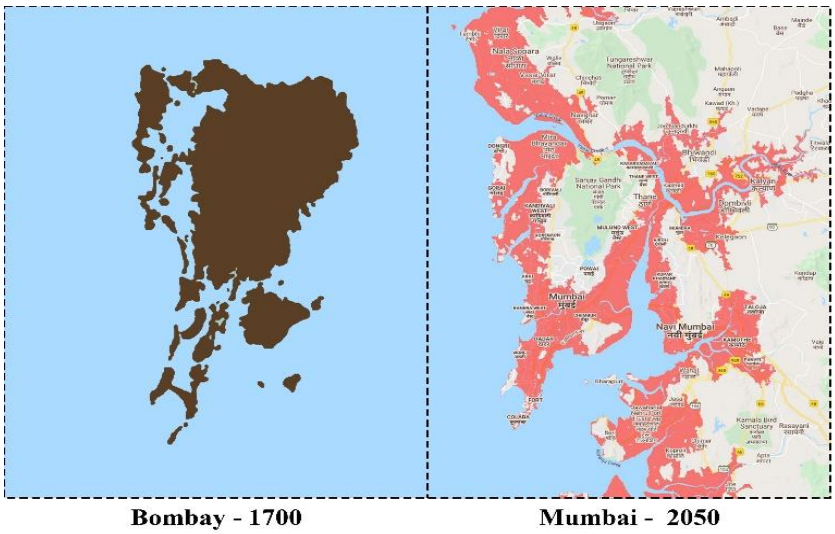

Figure 5: Bombay during 1700s and Projected Vulnerable Regions in 2050 due to GMSL
(*Source:* [4], [30])

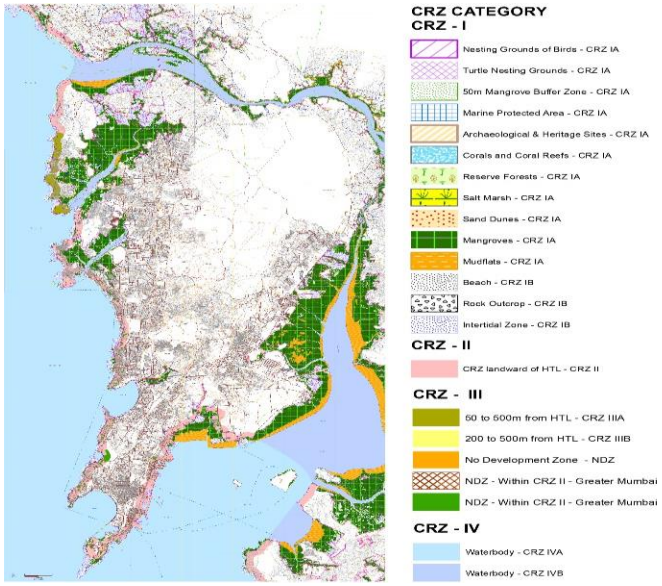

Figure 6: Zone Management Plan Indicating Different Types of Coastal Regions of MMR
(Source: Coastal Zone Management Plan [14]).

Coastal

5. CONCLUSION

GMSL rise caused by anthropogenic climate change is a great threat facing humanity. It can impact coastal region by inducing severe floods, drastic weather conditions and can even submerge various coastal developments. Mumbai being one of the most densely populated cities in the world ranks second most vulnerable towards GMSL rise in terms of population exposure. With a population of 20 million people most of whom are at risk, immediate action is needed to mitigate the effects of GMSL rise.

There are various examples and research which provides strategies to mitigate the effects of GMSL rise. The applicability of these strategies varies based on the geological as well as other contextual constraints and opportunities. Applicable strategies can be selected according to the typologies of vulnerable coastal regions. As Table 3 shows, the coastal regions of MMR as studied from CRZ by-laws are mainly categorized under four coastal region zones. CRZ-I to IV. To prepare MMR against the effects of GMSL rise, a strategic combination of approaches is necessary.

Prima facie, the natural defenses of MMR which falls under CRZ-I typology need to be conserved and enhanced through policies for protecting and encouraging redevelopment of these defenses. Along with it, alternatives for unsustainable infrastructure development needs to be found. Based on the projection of vulnerable regions in MMR, sea walls and storm water pumps need to be installed strategically in the CRZ-II region to protect existing infrastructure from high tide flooding. Reclaimed coastal lands must be protected with anti-erosion sea bunds. The CRZ-III region should be left untouched unless agricultural lands is at risk in which case sea walls and anti-erosion bunds are required. The CRZ-IV region can be intervened with wave breakers which can reduce the energy of wave impacts on the coast. This will protect the coast from aggressive tides and waves.

Finally, a long-term action plan needs to be devised which would include managed retreat from highly vulnerable regions. Based on the case studies and research papers, this managed retreat can also include advancing on the water in the form of floating structures. Floating structures can prove to be very sustainable option for MMR since it has access to a large area of protected waters in Mumbai harbor. Hence, further research and trials need to be conducted in floating structures and sustainable measures.

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Assessing Government Primary School Education Quality and Effectiveness in Surat Southwest Zone

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ABSTRACT: Education is quintessential for creating equality and eliminating barriers and discrimination based on race, gender, and economic status. The study aims to understand and evaluate the current situation of government schools in the Athwa zone in Surat. It focuses on measuring the quality of education imparted and its effectiveness in government primary schools.

Stratified sampling method was used to identify schools from the zone which were selected based on their varying student population and medium of instruction. Each school was evaluated through identifying quantifiable parameters, questionnaires and interviews. The schools are then graded and ranked from excellent to sub-par.

The result suggests lack of hiring staff, human resource mismanagement and lack of coordination between various governments departments are the main issues plaguing the government primary schools. The findings will help frame future government education policies and act as a template for conducting similar studies somewhere else.

Keywords: *Primary School, Government School, Quality Education, Effective Education, Right To Education, Sarva Siksha Abhiyan.*

1. INTRODUCTION

"Indian education system needs to change completely."

—A.P.J. Abdul Kalam

1.1 Background

India currently has around 287 million illiterate people which is roughly 37% of all illiterate people in the world (UNESCO, 2014). This is an alarming number as we have the largest number of youths in the world as well, the result of the current education system will be one of the greatest workforce resource mismanagement the world has ever seen. The right to education act (Parliament, 2009) gave every citizen the right to be educated from the age of 6-14 regardless of their gender, caste, socio-economic status. Within India's school going population, more than 74% are in elementary education meaning that they are in their formative years and many of these students belong from poor households who cannot afford private schools and are dependent upon the government schools for their education.

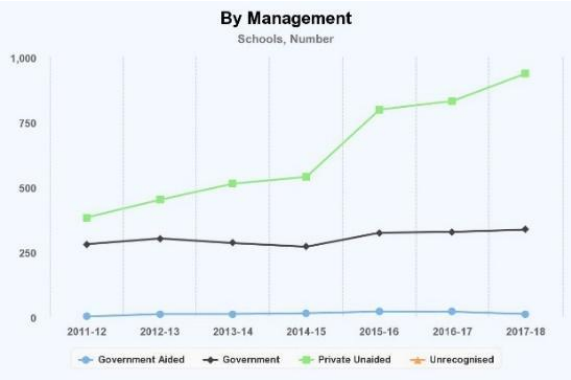

Figure 1: Number of Schools by Management in Surat
(*Source:* UDISE)

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This is especially worrying as although the government schools are 68.5% of the total, it has only 51% of teachers and 49.5% students overall. (NIEPA, 2018–19). This means that there is an uneven distribution of resources between the government and private schools and that the government schools are not being preferred over private and aided schools.

This is seen in the drop in percentage in the overall primary school enrolment to enrolment in government primary schools from 65.3% in 2011 to 56.3% in 2017. (NIEPA, 2018–19)**.** Due to lack of enrolment in government schools, many students who do not have access to other schools are unable to enrol leading to the drop in enrolment in elementary classes in India.

The situation of Surat is no different from the country as a whole. Since the past few years, the number of schools have almost doubled from 667 in 2011–12 to 1287 in 2017–18 (NIEPA, 2018–19)**.** Most of this growth has come from the rise of private schools while the number of government-run schools has remained nearly the same. This has caused the proportion of total enrolments to enrolments in government schools to fall at an alarming rate from 42.1% in 2011–12 to 26.1% in 2017–18 (NIEPA, 2018–19).

Figure 2: Enrolment in Elementary Classes
(*Source:* UDISE)

All of these reasons call for the need of an intervention and evaluation of the current situation of the system of education in the government primary schools. It would not only be limited to the evaluation of infrastructure of the schools but also evaluation of the management and policies that affect the day to day of the schools.

1.2 Aim and Objective

The aim is to produce a set of parameters to measure quality and effective education which would help assess the current situation of primary government schools in Surat.

Objectives

1. Defining quality and effective education and identifying them into measurable parameters to study government primary schools and creating a database of the school's current situation.
2. Assessing the schools based on the findings of the identified parameters and then grading them in a point system according to their quality and effectiveness.
3. Suggesting improvements to the schools to improve the education quality and effectiveness.

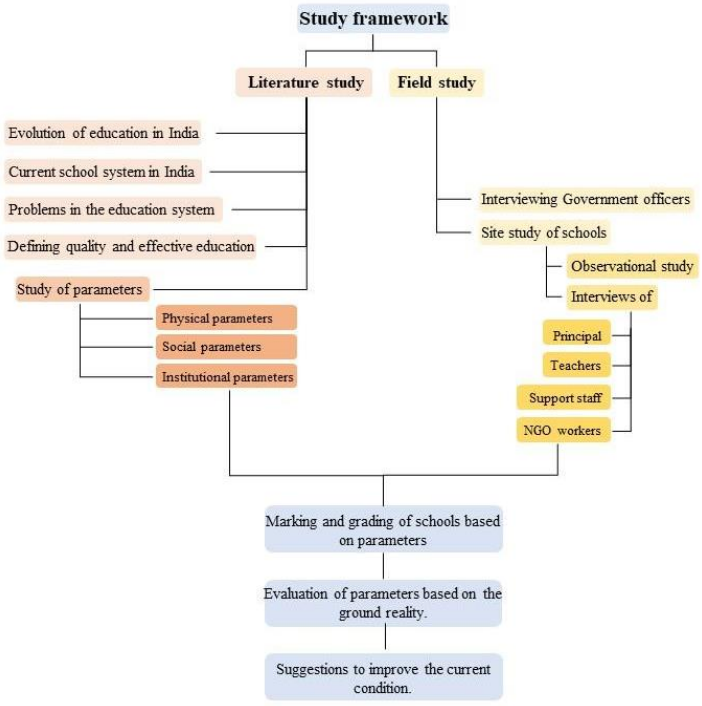
1.3 Scope of Work

The scope of the research will be limited to identifying parameters for measuring quality and effectiveness in primary government schools in southwest zone (A) of Surat and sampling the schools to see their current conditions and suggest measures to improve upon.

2. LITERATURE REVIEW

2.1 Education Institutions in India

- **Evolution of education:** In India, educational institutions have existed since the emergence of civilization (Keay, 1972). Education in India has evolved in two major time periods, pre independence era and post-independence era. The education system moved from practical knowledge based learning during the Vedic era which aimed to equip the students with a good quality of education focused on the enrichment of culture, character, and personality, development, and cultivation of noble ideals. To rote memorization during the British era, the objective behind the education in this era was to prepare a workforce for to serve the British crown and act as assistants to help the British officers in India. Post-independence, There have been many commissions from the university education commission in 1948 to the national education policy in 2020.
- **Current schooling system:** There are three school types that can be identified in India: government, aided, and private. Schools run by the central or state governments are called government schools whereas schools which are run by private managements but funded largely by government grant-in-aid are known as private aided or aided school.
- **Major problems in government schools:** private schools are bring preferred over government schools due to multiple factors such as quality of education, co-curricular activities, and academic standards, availability of facilities, individual attention and dedicated teachers.
- **Quality and Effective education:** Various definitions of quality and effective education have certain common aspects as they all state that inclusiveness is one of the foremost aspects to improve education. Inclusiveness includes gender equality, disabilities and socio-economic divide. To tackle this the school needs to be looked as an environment which would act as an equalizer for the student's future prospects where their education can level the playing field for even the disenfranchised students. The student alone cannot tackle the burden of education by themselves, that is where the role of the parents and the teachers come in. communication and collaboration between parents and teachers and both of their support to the students lead toward better performance in school. (UNESCO, 2014) Quality and effective education is also dependent on the school facilities and infrastructure-built environment which can improve the learning ability of the children by about 40% which is also reflective in the results of the standardized tests, (Schneider, 2002).One of the ways to ensure equality for the students is to provide them nutrition and health facilities so that the students can improve their attendance and their families are relieved from their financial burden. Proper hygiene practices in the schools also reduce the risk of contracting diseases and help the children lead a healthier life (USDH, 2021).



- **Measuring quality and effective education:** The various parameters of measuring quality and effective education can be divided into three major parts: physical, social and institutional parameters. The physical parameters consist of the aspects which can be solved with a direct intervention in the school while the social parameters are the ones which consists of the aspects which are consequent to our society as a whole. The institutional parameters include government policies and initiatives for the betterment of education.
- **Research Gap:** Although the government evaluates the performance and quality of education in government schools through its National Achievement Survey and Gunotsav survey, there is currently a lack of research available on government schools by private institutions and individuals which could substantiate the claims by the government and help us understand the current situation of the schools.

3. METHODOLOGY

The research methodology would consist of primary data sources, i.e. (site studies, questionnaires, interviews etc.) and secondary data sources, i.e. (case studies, articles, internet, research papers etc.).

Secondary data is used to understand the evolution of education in India, its current school systems, problems in the education system and later by defining and translating into measurable parameters.

For the site study, Athwa zone was selected at random and out of its twenty-five schools, nineteen were selected based on student population and medium of instruction. Stratified sampling is being used to select the schools which are then graded upon the parameters and the marks allotted to them.

Table 1: parameter-wise Scoring Criteria

Parameter	*Score*
Accessibility	18
Infrastructure	43
Safety and security	23
Hygiene	21
Pupil teacher ratio	5
Total	**110**

Source: Author.

After the schools are chosen, they are ranked according to the parameters and observations, resulting in providing inferences that will help in providing the overall findings of the site.

Table 1: Grading of Schools

	Grade	*Total Schools*	*Schools*
110–95	**Excellent**	0	
94–70	**Good**	9	No. 5, 6, 7, 13, 14, 73, 124, 324, 325
69–55	**Average**	8	No. 2, 265, 11, 12, 15, 52, 160, No. 337
54–40	**Poor**	2	No. 64, 101
Below 40	**Sub-par**	0	
	Total no of schools 19		

Source: Author.

4. RESULTS AND DISCUSSION

Parameter Wise Findings: The findings of the paper are divided into three main parameters: physical, social and institutional.

4.1 Physical Parameters

Accessibility: in terms of accessibility, accessibility to the school is good but many children are forced to study in school medium other than their mother tongue as they cannot afford the transportation fees. As per accessibility within school, every school fared badly with an average score of 3.8 out of 18 marks.

Infrastructure: 61% school buildings are more than 15 years old and 54% schools have not been painted in the last five years. Amenities like computer lab and library are present in 92% and 85% of the schools respectively, but around 69% schools lack a staffroom.

Safety and security: 85% of schools have a compound wall and all schools have CCTV cameras throughout the school. There is no watchman during school hours in any school and only 22% schools have hired a watchman to guard the school building after school hours. The rest use peons who stay in school as their watchman. There is inadequate fire safety measures in all the schools, there are not enough fire extinguishers and no water hose in any school. 40% of school have no clear exit and none of the schools have a dedicated fire exit or a fire staircase.

Hygiene: There is garbage pickup facility in 85% of schools and the rest either burn or bury their garbage. Only contractual employees are hired for janitorial and cleaning staff whose monthly compensation is around 1000–2600 rupees per month which makes the job very unattractive for workers and the schools are left without a full tie janitorial staff.

4.2 Social Parameters

Gender Inclusivity: Gender inclusivity in the schools need to be looked at in two parts, gender ratio in regional medium schools and gender ratio in other medium schools. Since the past few years government policies have helped improve gender ratio in the schools as the current gender ratio for students in the regional medium as well as in the other mediums is almost 50/50.

The difference shows when the gender ratio for the teachers is looked at as the regional medium educators are 80% women but that reduces to 45% in other mediums. This means that there is a lack of trained female teachers in the other mediums which needs to be worked upon.

Health: The government provides mid-day meals to every student everyday which ensures good nutritious food to the students. Currently due to Covid-19 the scheme has been suspended creating problems for the students and their parents alike. The students are also given a full health check-up once a year and are provided with flu medication and vaccinations.

Socio-economic Inclusivity: 70% of students come from either economically backward background or below poverty line. This means that they do not have money for fees, uniform or even basic stationary. For this the government has schemes which provide the children with uniform, stationary, books and bag. The government also offers a grant for the kids with no schools within 2.5 km of where they live so that they can travel to their school and not miss out on education.

Children with Special Needs: There are currently no schools in the zone with children with special needs enrolled and no schools are a CWSN inclusive schools. This means that the CWSN are missing out on their chance to be educated because of a lack of schools in the city.

Parental Involvement: In order to increase parental enrolment, there is a school management committee in every school with 75% of its members being parents to involve parents in school decisions. There is also the PTA which meets once in two months to discuss the child's progress but there is no involvement of the parents in the children's extra-curricular activities which needs to be improved and the meeting duration of the PTA and the SMC needs to be shortened to meet more frequently. This is tough as most of the parents are daily labourers who earn daily so it is hard for them to come to school frequently.

4.3 Institutional Parameters

Teacher Qualifications: The teachers are qualified with a minimum qualification of a graduation and a B.Ed. or completed the PTC (primary teacher certificate). The teachers have to teach 45 hours a week and all eight periods a day with no proxy or free periods to prepare for their classes. The teachers are overworked and burdened with non-teaching duties which keeps them out of class. This happens so frequently that the teachers sometimes need to take on of the 12 paid leaves they get a year to complete the non-teaching duty that they have been assigned.

Student Outcome: The Right to education policies state that no child can be failed till 8th standard and children are aware that no matter what they do, they are going to pass. Another problem that has been created by the R.T.E. act is that the students who have never been to school must be given admission in a class appropriate to their age. These policies have caused the teachers to spend disproportionate amount of time on weaker students and in the process the bright students are often neglected.

Technology Integration: In an effort to modernize the schools, the government has installed virtual boards to help students visualize better when they are learning. There are virtual boards in more than 30% of the schools and more will be added in the future. There is an issue regarding the maintenance of the virtual boards as due to lack of a technical support staff, they are not repaired for the long time and even when they are, they are too expensive the schools to get them repaired. There are PC in class in only two schools in the zone, school 324 and 325 for the teachers to conduct online classes from during the pandemic.

Efforts in Covid-19: In order to keep the education going even during the pandemic, the government started a scheme called "Sheri Shala" which is for the teachers to go to residence of the students and teach them there. This has been a success in localized areas where the children reside nearby like schools in Althan, Rundh and Dumas. In schools of other medium like school 6 and 12 this was not possible as the students came from different parts of the city and it was not possible to get many students to teach at one place.

5. CONCLUSION

Recommendations: The education system at the school level is facing a huge human resource crisis as there is no appointed clerical and administrative staff, janitorial and support staff, and no security guards. The schools face an acute shortage of teachers, especially for subjects like sports and music. No substitute teacher in any school can take care of the class when a teacher is out on other duties or leave. For this, the government must start hiring qualified professionals for every job as soon as possible.

The R.T.E. norms specify that no child can be turned away from school, and they must be admitted to a government school if they are between the ages of 6–14 regardless of their previous education. This and the no-fail policy have caused teachers to not be able to focus on their classes and instead focus on this one student. This calls for a special course for students like these to bring them up to speed.

Due to a lack of coordination between departments, the teachers have to go through more than 50 inspections each year from different levels of government which wastes the time they could have spent teaching. If there is a common database for all levels of government, then the process would be smoother for both the teachers and the government officials.

There is a lack of focus on other medium schools as they are found to be in a worse-off condition with fewer resources than their regional medium counterparts. Moreover, as Surat is home to many industries, there is a huge influx of migrants from all over the country. The migrants travel back to their hometown for a few months and take their children with them, causing them to miss out on their education. This can be solved by creating a seasonal hostel for the children to not be left behind.

Many students drop out after the eighth standard to help out their family financially, and even after studying till the eighth standard, they do not have an employable skill. Therefore, there needs to be a training program for the children to acquire employable skills once they leave school to live a meaningful life.

Suggestions for further study: The study was limited to three months and due to the pandemic, it was possible to only interact with the teachers and principals at school level. In the future this topic can be studied to provide a broader understanding of the subject of education.

- Deeper look into the positives and negatives of the R.T.E and the S.S.A.
- Effect of Political agenda in education
- Student outcome assessment

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Walk to Work and Work-Life Balance

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ABSTRACT: We stay in a fast-paced environment that affects our fitness and work-life balance. It is crucial to study the workplace dynamics and results of alternative work patterns to achieve them. The paper supports the idea of walk-to-work as a healthy lifestyle change. For decades, the West has embraced work-from-home, remote working, coworking, and other similar practices. Considering these concepts are new to India with limited resources, detailed research is necessary. This study collected mixed-type data by surveying white-collar professionals in Pune-one of India's premier education and IT cities, on how they view changes in their work culture, their existing work-life patterns, and the impact on their productivity and wellbeing. According to the survey, walkability to the workplaces remains desirable to working individuals from varied disciplines, with many recognising its advantages. The inquiry concludes with strategic questions designed to determine the feasibility and implications of the walk-to-work approach.

Keywords: *Walk to Work, Work-Life Balance, Lifestyle, Remote Working, Walkable, Work Culture.*

1. INTRODUCTION

For decades, the shift in work culture and technological advancements has influenced workplace designs to a significant extent. Workspace is where a person spends most of his time throughout the day, whether it be a time-bound office, their home, or somewhere else outdoors. The well-being and growth of an individual have received extremely little attention. Exercising a proper work-life balance ensures a healthy lifestyle. Work-life balance not only involves finishing daily tasks and returning home, but also balancing work time with other daily activities that are equally important. Rather than focusing on productivity and innovation, most people are more preoccupied with completing their duties. In traditional work culture, employees were required to leave their work at their jobs because of which they used to have some free time after work for various social and extracurricular activities. Today, people can access their work from anywhere on any device. As a result, they prefer to work with flexibility without having to worry about daily commutes to work while still meeting deadlines. A healthy body and a healthy mind are primary factors in the overall growth of people and society. The traditional neighbourhoods did not face the challenges of exertion caused by travelling for work while maintaining a stable and healthy lifestyle. The neighbourhood's walkability is an indicator of the neighbourhood's friendliness, liveability and self-sufficiency. A person's tendency to walk has a long-term impact on their lifestyle. Although so many people suffer from the negative consequences of existing poor lifestyle balance, changing such long-standing practices is challenging. Understanding the need to keep up with emerging trends is therefore critical.

2. LITERATURE REVIEW

Remote working cultures have become more prominent in recent years, putting the viability of an office building in jeopardy. Working outside of the office, breaking the cubicle culture's 9 AM to 5 PM working hours, is the new way of life. Jason Fried and David Heinemeier Hansson's book 'Remote — Office not required' discusses the advantages of remote working and the problems that workers experience in a day-to-day lifestyle. It explains various ways how individuals can easily cope with these dilemmas, manage their personal lives and work responsibilities, and use technology to connect with anyone, anywhere around the globe than being bound to a particular office or town. Their company '37 Signals' is used as an example to show how various employees in the organisation cooperate differently to overcome these obstacles in the everyday environment while still producing excellent quality work.

For many generations, we have been familiar with the concept of live-and-work. Our workspaces have evolved, along with our changing lifestyles, throughout history. The traditional neighbourhoods depicted mixed-income housing and mixed land use where the living spaces were above workspaces or connected to them. The residential, commercial, infrastructural, transport, and other similar facilities belonged to the same locality or were within walking distance. Hence, these

neighbourhoods were self-sustained and healthy leading to a better live-work scenario. The IT sector in Pune expanded swiftly with the growth of technology, changing the pace of work in the city, thanks to its cosmopolitan nature and prospects. The prominence of work-life balance grew as our working style transformed into desk work or cubicle work. But, with industrialisation and mass production, land use and live-work typologies were affected, resulting in large footprints of built-up areas away from residential zones, longer travel times, and increased global warming. The notion of live-work and emerging work styles again came into question during the Covid-19 pandemic.

The 15-minute city is a residential urban concept created by French professor Carlos Moreno in 2019 and popularised by Paris Mayor Anne Hidalgo during the 2020 elections, greatly affecting New York. All residents of a 15-minute city could meet most of their needs within a short walk or bicycle ride from their houses. Traditional Neighbourhood Development (TND) communities, according to the handbook 'Traditional Neighbourhood Development Handbook—State of Florida Department of Transportation 2011', rely on deeper integration of land use and transportation than CSD communities. CSD is characterised by separate land uses, such as housing, retail, office, and industrial uses located in different buildings or parts of a neighbourhood. TND, on the other hand, is a strong supporter of pedestrian, bicycle, and public transportation options. Retail, office, civic buildings, and residential are all intertwined throughout the neighbourhood, often in the same structure.

While cities, towns, and villages transitioned from mixed land use to zonal town development, several difficulties arose. Poor road connectivity, long-distance travel for work, urban poor migration leading to irregular city expansion, mass housing, poor land use, irregular workforce density in different parts of the city, lack of infrastructure, poor streets, workload pressure and increased work hours, lack of availability of time for oneself, rising pollution and health issues, poor workplace environment, and so on were a few noticeable factors. With vast networking margins across the world, we're once again debating whether a specialised building—'The office' - is even necessary. Today, people are wondering whether we could work more effectively and remotely, resulting in healthier walkable neighbourhoods with more socio-economic interaction, as well as greater integration in the live-work lifestyle.

Clarence Perry, an American urban planner, defined a neighbourhood as a one-fourth mile radius or a five-minute walkable neighbourhood. It was built with a hierarchy of major arterial and secondary routes. The internal roadways were bent to slow traffic, making them safer for children and the elderly. Within this walkable radius, every neighbourhood has all the residential zones, green areas, commercial, infrastructural, educational, religious, and other resources. The unifying purpose of building walkable neighbourhoods is to encourage healthy living and sustainability, as defined by the notion of a walkable city. Such communities work as a self-contained system, making them less vulnerable to metropolitan issues. In a nutshell, a walkable neighbourhood is vital for a society's socio-economic, physical, and emotional well-being.

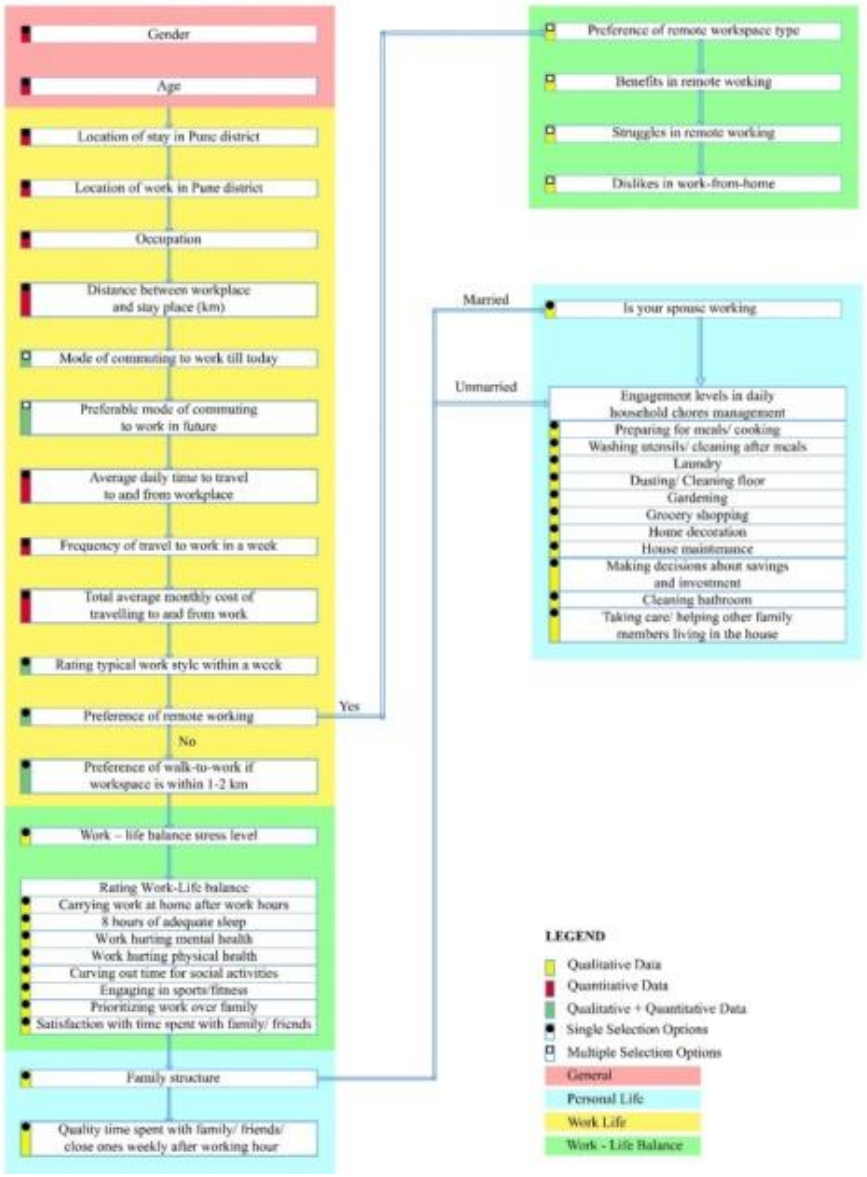
With walkable neighbourhoods having living and working spaces nearby, a new type of workspace is emerging—The Coworking space. Coworking spaces have lately emerged as a platform for social contact and collaboration between diverse autonomous entities, as well as a workspace option. 'Coworking' refers to persons sharing workspace and working separately while still getting together to collaborate. Such workspaces are rapidly thriving in the dense urban fabric of the 21st century, as people's awareness is rising along with technical innovation. As a result, the demand for coworking spaces is growing, as is the demand for increased innovation and efficiency. Bringing a group of people together with similar ideologies and work styles enhances social interaction and helps to form a supporting network. As a result, coworking spaces are closely linked to community development and their role in the modern economy.

3. MATERIAL AND METHODOLOGY

The study was initiated with the rising live-work culture in mind. To further explore the concepts, several studies, theories, books, journals, newspapers, and articles were reviewed. Topics covered in the literature included the evolution of workspaces and work habits, health, lifestyle, proposed theories, and other information on the topic. Following the refinement of the questionnaire, an online survey was conducted in Pune, with white-collar workers as respondents. The survey was conducted using a Google form on an online platform. IT experts, freelancers, designers, start-ups, individuals working from home, entrepreneurs, coworkers, and remote workers were among those surveyed.

The closed-ended style of inquiry included multiple-choice, dichotomous, scaled, matrix, and contingencies. Personal information such as gender, age, and family, cost and time management during commuting and work, challenges and perks of their present work style, current patterns of managing personal life, and work-life balance were all included in the questionnaire. Because of the variety of responses, several questions were made optional. The basic idea of the research

was to fathom the varied attitudes of people from a range of disciplines. The data was analysed using qualitative and quantitative methods using literature, images, tables, and charts based on the responses. The digital format was used to collect, analyse, and store data. This was purely a pilot study with limited responses in Pune only. However, the study can be extended to other towns and cities as well.

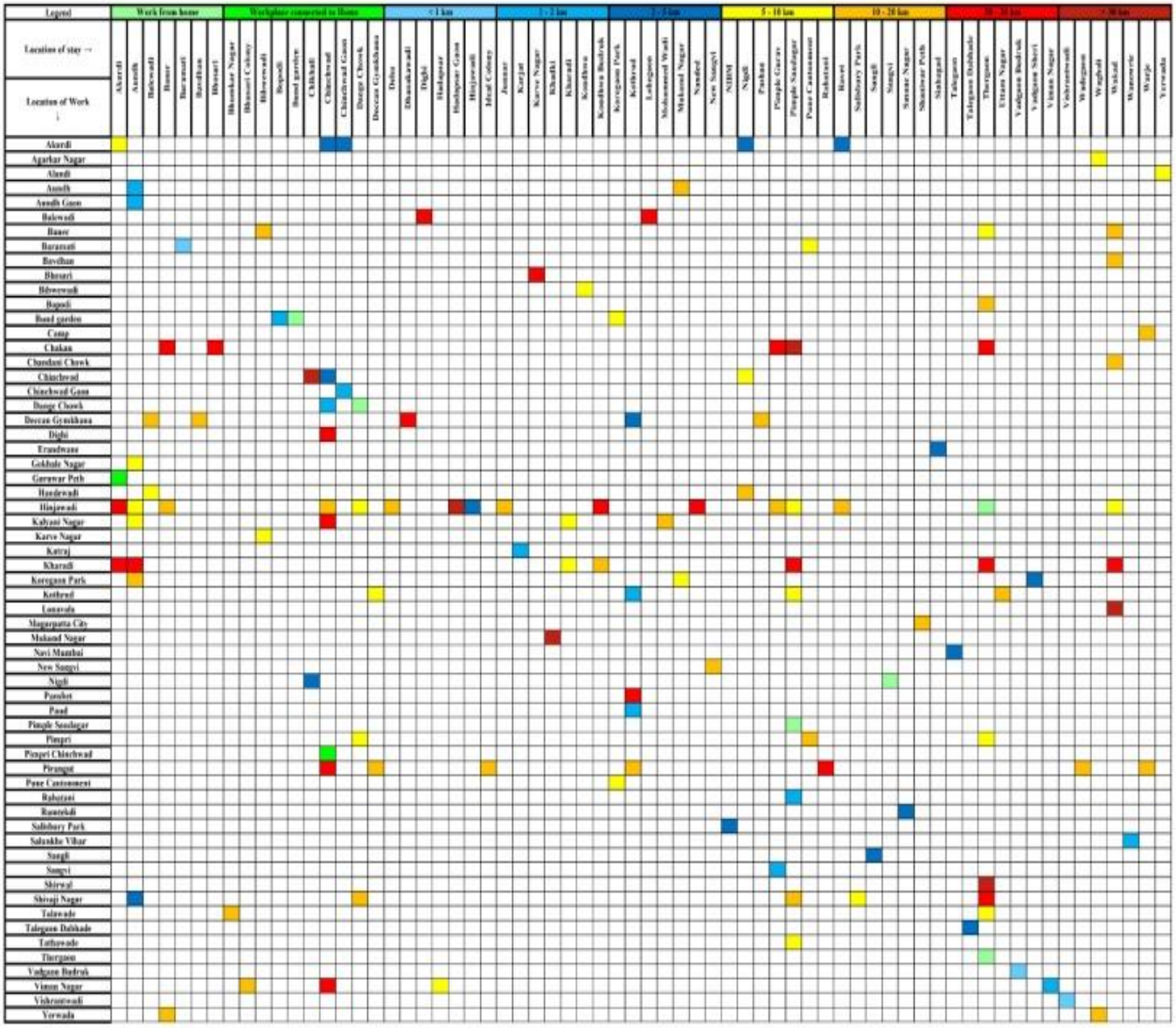


Flowchart 1: Showing Distribution of Questionnaire Circulated for the Survey

4. RESULTS AND DISCUSSION

The survey gathered 202 responses from individuals of diverse disciplines from all across Pune, with 68% of men and 32% of women participating. This included architects, bankers, businessmen, designers, doctors, educators, IT professionals, government employees, engineers, lawyers, professional chartered accountants, writers, directors, and self-employed individuals. The study was primarily aimed at white-collar workers who work in offices and on desktops. The majority of respondents (56%) were between the ages of 16 and 34, while the remaining 44% were over the age of 34. Approximately 70% of the total number of responders had to commute more than 5 Km to and from work. 67% of the 70% of respondents mentioned that they used to travel more than 10 Km to and from work. This had an impact on their stress levels as well as their productivity.

Table 1: Showing the Living and Working Locations of Respondents.
The Colour Coding Represents Distance of Travel within the City (202 responses)



It was observed that the contemporary work style required respondents to attend their workplaces more than four times per week and involved a lot of collaborative work as well as individual work. As a result, over 60% of respondents utilised private vehicles, taxis, or carpooling to travel, while the rest employed sustainable modes of transportation such as public transportation, bicycles, walking to work, company-sponsored transportation, and so on. Before the survey, roughly 23% of respondents worked from home. In the future, 45% of respondents said they would prefer to travel to and from work in a private vehicle. Even if their partner did not work for any occupation, almost 75% of women preferred working from home to manage household duties and have more flexible work hours. Also, the majority of the housework was done by the ladies themselves or by the maid, and men were not heavily involved in-home activities. Before and after the survey, the number of men and women commuting to and from work increased from 8% to 15% and 0% to 23%, respectively. Although the number of people wanting to work from home had significantly increased, very few people considered walking to work amid the current state of lockdown and lengthier commute distances (around 3% women and 20% men). 55% of respondents said they spend between Rs. 1,500 and Rs. 7,000 per month on travel, while some mentioned they spend up to Rs. 20,000 or more every month. Only 33% of respondents invested less than Rs. 1500 every month.

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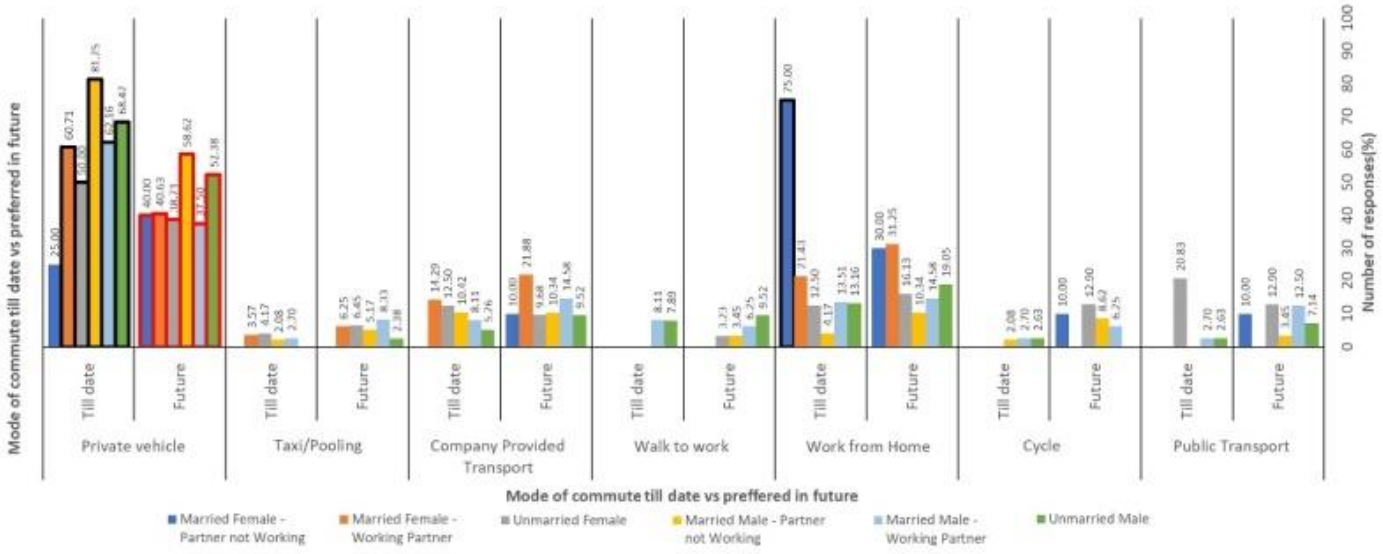

Figure 1: Showing the Preferred Mode of Commuting to and from Work by the Respondents Till Date Versus in Future (202 responses)

Even though the majority of the population resided 30 minutes to 2 hours away from their workplace, approximately 49% of people wanted to work remotely, and nearly 82% of people agreed to walk to work if their workplaces were within a 1 to 2 km radius, i.e., a 10-to-15-minute walk. Men and women had similar preferences for that, but the males preferred it more. Work-from-home or places within walking distance of their homes, such as co-working spaces, cafes, and libraries, were desired by over 74% of respondents. In addition, about 25% of people chose to continue working in an office. People sought to save time and energy by not having to travel, and there was also a demand for job flexibility. While participants considered remote working to be useful in terms of saving time and energy, spending time with their loved ones, and having the ability to work from home, they also faced several other issues. These difficulties were most common in both 'remote working' and 'work from home,' such as dealing with technical issues or a lack of work-life balance, distractions, a lack of efficiency in working, and poor time and project management. The percentage of working men in the married population living in a small or joint family was found to be higher than the percentage of working women.

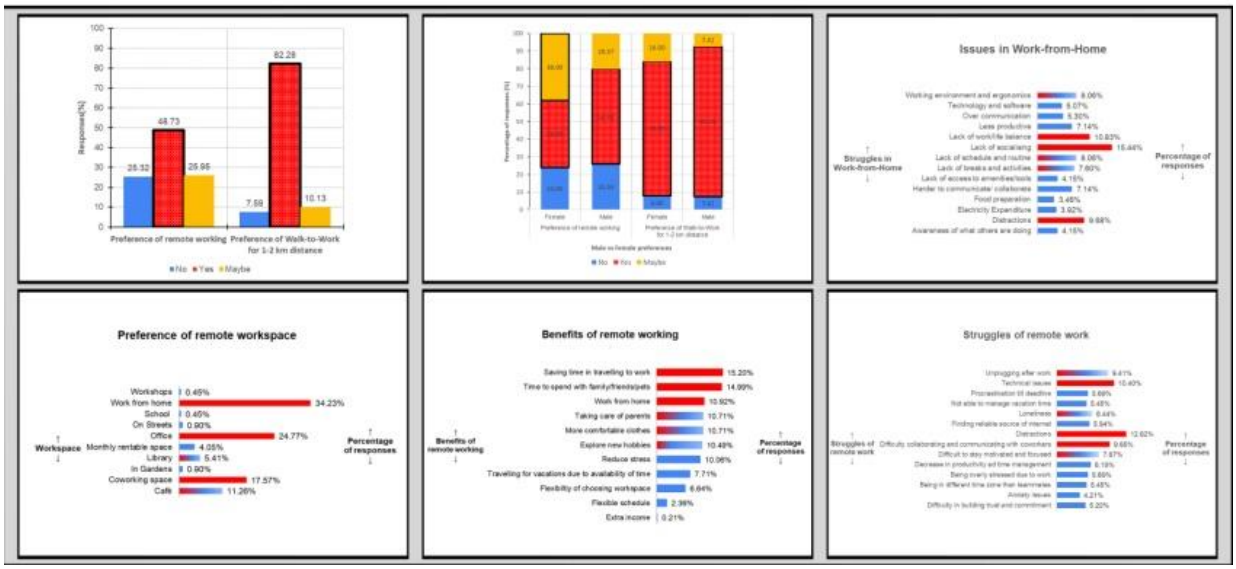

Figure 2: Analysis of Concerns of Respondents Preferring to Work Remotely or to Walk to Work (151 responses)

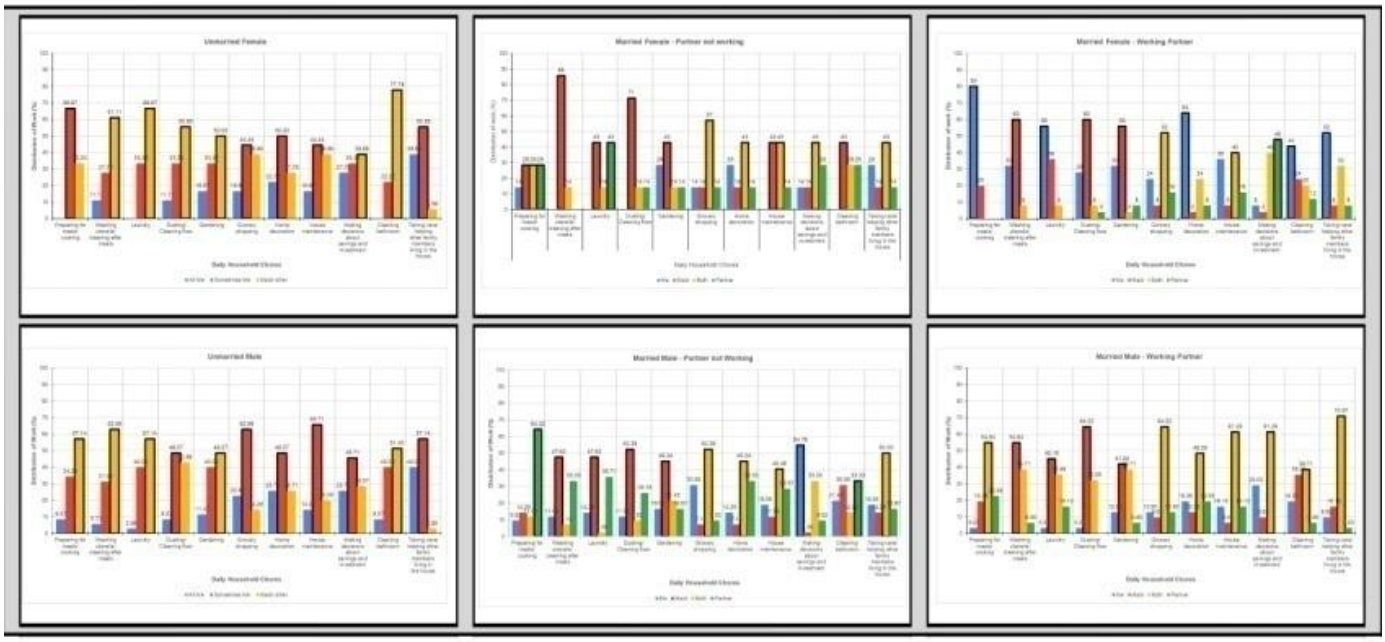

Figure 3: Comparative study of responses showing the distribution of daily household work of individuals (Total 202 responses); Categories: Unmarried female, Unmarried male, Married Female-Working partner, Married Female-Non-working partner, Married Male-Working partner, Married Male-Non-working partner.

Note: Here working resembles waged practice.

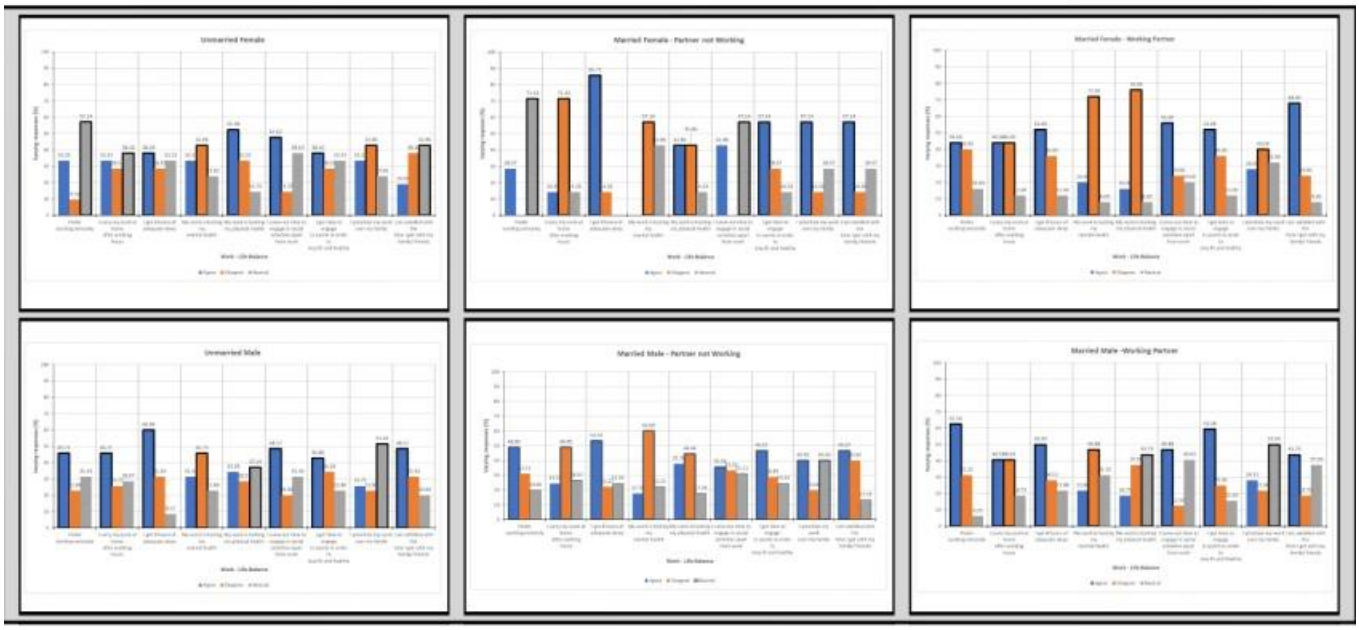

Figure 4: Comparative study of responses showing work-life balance of individuals (Total 202 responses); Categories: Unmarried female, Unmarried male, Married Female-Working partner, Married Female-Non-working partner, Married Male-Working partner, Married Male-Non-working partner.

Note: Here working resembles waged practice.

Many respondents mentioned they prioritised work over family and health, but that they still managed to socialise with their peers. While most participants tried to make time for sports and exercise, they also reported that they were stressed at work

and that their physical and mental health was suffering as a result. People used digital mobility to bring their work home after work hours instead of taking mental breaks. As a result, many people reported trouble reconciling their professional and personal lives. Because most males worked to earn money while their partners took care of the housework, it was discovered that in married couples where both partners worked, the majority of the housework was distributed amongst themselves, with a large portion of the chores being done by a secondary person, usually the maid. While the females were in charge of activities such as cooking, cleaning, and decorating, the males were in charge of investments, house upkeep, and decision-making. Only a few housewives made financial and savings decisions, and only a few men helped with activities like cooking and dishwashing, laundry, and so on. Unmarried people living with their family or in a paid guest facility performed far fewer home chores on their own, with someone from the family or the maid taking care of the rest. The distribution of work is visible in the following graphs. These graphs depict the average work distribution within a married couple living in a small or joint family, as well as the typical work distribution and management of unmarried people living in a small family, joint family, or a PG.

5. CONCLUSION

In the 1970s, Indian work-life culture comprised a normal 9-5 workday, with women being neither allowed nor offered the opportunity to work outside the home. Due to this, women were expected to do the household chores while men were expected to handle the family's socio-economic needs. Government jobs were a top concern for the man, ensuring that he had a steady job. People began hustling to earn money as soon as private occupations became available, and quantity became more important than quality. As a result, they worked long hours and earned the labels "productive" and "dedicated." As the culture shifted, long work hours and distance travel were realised as one of the major sources of stress. Women were also stepping out to find work, although smaller in numbers than men. The growth of technology, the culture of remote work, and the value placed on work-life balance contributed to the rise of coworking spaces, work-from-home arrangements, and other styles of work styles. While towns used to be self-sufficient, with people walking to work or commuting short distances to work, the rise of metro cities divided the city into distinct zones. This transition can also be seen in Pune as we travel away from the historic central city and into newly built zones. Today, individuals have access to digital media, allowing them to communicate and collaborate with people across the world from one single location. For decades, safety and security have improved, making it easier to work online. People nowadays value comfort above all else when it comes to working. Because of this prioritization, production levels have increased as well as liveability scores. However, it is also important to recognise that face-to-face interactions are crucial since they promote greater connection and do not separate a person from their workspace. Many issues, such as rising stress levels, working from home and after hours, not managing break times, and so on, must be recognized. Keeping in mind that all these problems and concerns are also a part of– 'The Office', we should also rethink if we genuinely need massive office premises that are far distant from our homes.

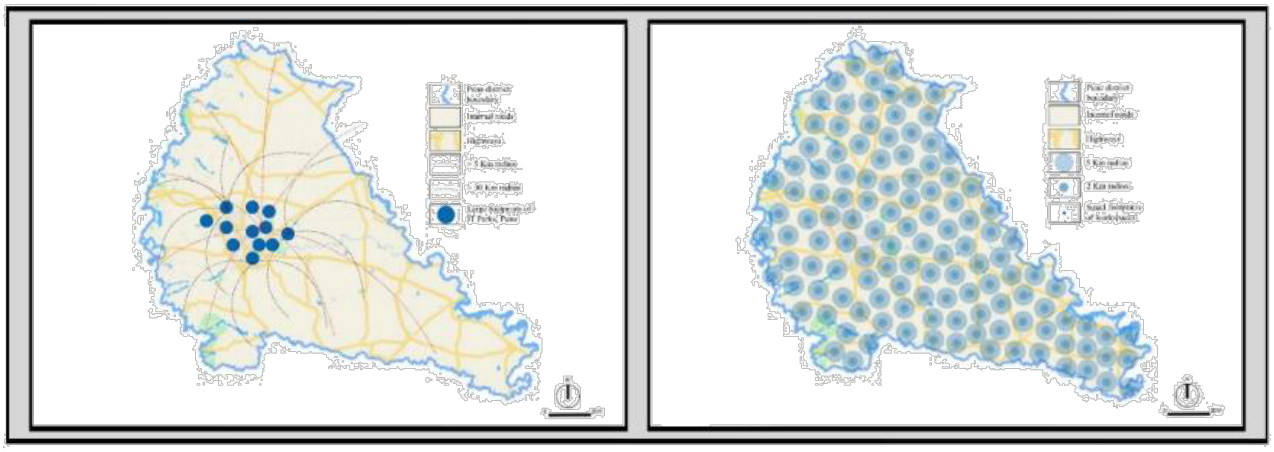

Figure 4: Maps of Pune District Depicting IT Parks and Major Workforce;
Left: Current Travel Radii, Right: Proposed Multi-Utility Satellite Workspaces and Reduced Travel Radii

The diagrams are Pune district maps that depict the current state of concentrated IT parks that employ more than half of Pune's workforce. As can be seen, a huge workforce commutes to and from their homes to these workplaces every day via

main connecting roads, using private vehicles, carpooling, and other modes of transportation. People have to commit their money, time, and energy just to travel such large distances due to the concentration of these workspaces. The diagram depicts how, if workplaces are scattered across the city, smaller multi-utility satellite workplaces will cater to the neighbourhood, making it more self-sufficient and walkable, saving travel time and energy consumption. Distributing these workspaces and improving employee work shifts daily might address concerns such as pollution, global warming, energy and fuel burning, deforestation for infrastructure construction, resource wastage, and more, while also lowering travel costs. Cities will change into online communities in the coming future, while all paperwork and other manual labour will be managed from anywhere around the world. People will walk to work, improving their health and longevity, and will eat healthy meals from the comfort of their homes. Walking to work will also help reduce community isolation, and roadways will become more pedestrian-friendly and 'For-the-People'. As more people become accustomed to working in this manner daily, they will be able to carve out more time for themselves and their loved ones. But, with flexibility comes responsibility, and everyone must be accountable for maintaining discipline and balancing their new work-life balance. More and more people in India have realised the vast array of options and possibilities that work-life balance and walking to work can provide, and are approaching a breakthrough in the near future.

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I'd like to express my gratitude to everyone who has assisted me in conducting my research, advised me, and helped me collect data. I'd want to express my gratitude to Mrs Aarthi Chandrasekhar, my primary supervisor, and the rest of the academic staff for assisting me in completing the project and guiding me throughout the process. My family and friends have supported me during this process. I'd want to express my gratitude to my parents, who enabled me to contact some of the respondents directly, allowing me to expand the reach of the questionnaire and therefore take my research ahead.

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Architectural Spaces and Their Effect on Human Psychology

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ABSTRACT: Architectural psychology is also known as the 'Psychology of built environment' which is a relatively new field for research. Architectural psychology intensively deals with the questions of how the environment affects our lives and personality. Our cognitive abilities, mental and physical well- being and our emotions are affected by Architecture. A learning space must motivate students to study and progress. Hence designing for Physical, Physiological, and Psychological well-being is becoming relevant.Considering the age group from 4 to 17 years, the study aims at exploring the questions of how architecture affects students' thinking, their cognitive abilities, their mental and physical well-being, and their emotions. The paper also describes how designers have created spaces to fulfil student's requirements and provided them with spaces for learning.

Keywords: *Architecture, Human Psychology, Awareness, Scale, Colour, Light Quality.*

1. INTRODUCTION

Most of our time spent indoors is surrounded by forms, artificial lighting, colours, and soundscapes. The human psyche is best expressed with the help of the architecture of the buildings. Psychology and Architecture are domains interconnected with human experience. Building Design is the physical illustration of the creative perception of the human psyche. The interaction of the human with the built environment prompts the senses to perceive and react to it in different logical manners, exemplified through the unique spatial expression of every single designer. Studies on student performance and physical learning space indicated that students are influenced more because of the physical environment that influences their performance. The spaces and environments where students spend the time learning affect how well they learn. The physical environment can stimulate emotions, give a secure feeling and prepare the students to learn. Design characteristics such as poor acoustics, poor ventilation quality, insufficient lighting, and noisy environments deteriorate the quality of learning. School environments must motivate the student and help in the teaching and learning process. It would help students to learn to work collaboratively which would improve their cognitive functioning if provided with an effective educational environment. A group of important considerations can be introduced to help designers choose and apply a suitable architectural design that matches psychological needs by developing relations between architecture, the psychological status of students and users of the space. The fact that every single design is dominated by the thoughts created during the design process is interesting to note, as is the variance in a design influenced by each student's personality. The Domains of Architectural Psychology study include Natural Environments, Spatial Interaction, and Built environments (Malik & Jamil, 2019), which are further focused on in this paper.

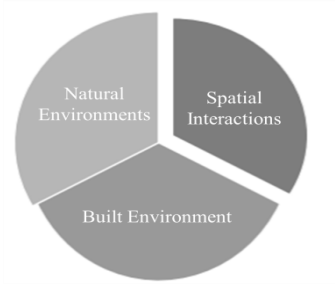


Figure 1: Domains of Architectural Psychology
(*Source:* Malik & Jamil, 2019)

2. SCOPE AND LIMITATIONS

The area of study for research is limited to school kids from kindergarten to 12th grade (4–17 years.) and the architectural design of schools and its effect on human psychology. The elements that have been studied are the feature of the open space, aesthetic sense, the scale of spaces the effect of colour and textures, light quality, spatial experience, acoustics safety impacts, health concerns, accessibility degree. The architectural elements have been limited as these are the main elements that affect a student's performance in schools.

3. LITERATURE REVIEW

The article dealt with questions such as how much these built environments affect our personality and how architecture affects our thinking, cognitive abilities, mental and physical well-being, and emotions. The article poses many more such questions for different residential, working, and recreational spaces. It was studied that an ill-conceived and inferior architecture combined with different factors can induce stress, promote exhaustion, and other psychosomatic symptoms that would create physical discomfort. Achieving a comfortable environment with only an indoor climate is not enough. Light, plants, materials, construction methods, temperature, and conditioning of air also play a major role. The holistic approach of humans and their senses influence their thinking, feelings, actions, and entire body. Positive stimulation to their senses can have an invigorating and calming effect. Hence, the response of humans to different spatial characteristics can help us develop a responsive architecture. (Margarete, 2018) Ariani (2016) studied how a student's performance is influenced by school design. This study consisted of 150 student participants of a public school to validate the research. It was noted that spaces and environments in which students spend time learning affect how well they learn. To stimulate emotions, create a sense of security, and prepare the students to learn, some physical features should be provided the paper informed how different factors such as acoustics, ventilation, lighting, and noise undermine the learning process. Connecting with the outside world and new technologies should be incorporated in new schools to provide students with various self-learning opportunities. (Ariani, 2016)Mehta (2021) focused on the perception of playschools as second homes for children. Various factors like environmental, pedagogical, socio-culture, curricular, motivational, and socioeconomic act as building blocks for child development in playschools. There is a relationship between building design & a child's performance and development. (Mehta, 2021)The human mind can be expressed through architecture and explains the interconnection of human interaction with the built environment. In the study carried out on students of architecture, the researcher observed that students had started developing their own spatial experience while doing the design project. This gave an insight into how students perceive the spaces with different qualitative elements. The interview gave an understanding of their psychological approach regarding spatial thinking and translating it into designs. The construction and building design industry get impacted by the architectural psychology of the designer and the psychological influences of the environment. There is a direct relation of psychology with culture, art, and architecture. Using color, space and size appropriately can enlighten the atmosphere. (Malik & Jamil, 2019)The literature review revealed that very few studies discusses the design attributes like semi-open spaces, classroom spaces, daylighting, ventilation, colors/textures, visual connections, vegetation, proportions/sizes.

4. METHODOLOGY

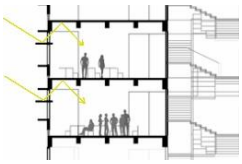
The methodology for this research is a literature review consisting of articles, related research papers, and design case studies. Literature reading focused on investigating the relationship between architectural elements and their effect on students.

Case Study of different government and private institutions/schools with grades from kindergarten to 12th. (4 years–17 years). An analysis of the effects of the built environment on the students' performance was carried out post-reviewing the cases.

The comparison was done based on open spaces feature, aesthetic sense, the scale of spaces, the color of spaces, light quality, spatial experience, safety impacts, health concerns, accessibility degree.

5. CASE STUDY

Table 1: Case Study Comparison

Project name/ Attributes	The Green Acres Academy, Tushar Desai Architects, Mumbai, India.	The Newtown School, Abin Design Studio, Kolkata, India.	Rane Vidyalaya School, Shanmugam Associates, Theerampalayam, India.
Project Image	 *Source:* (The Green Acres Academy/Tushar Desai Associates, 07 Apr 2016)	 *Source:* (The Newtown School/Abin Design Studio, 02 July 2015)	 *Source:* (Rane Vidyalaya School/Shanmugam Associates, 06 May 2020)
School type	K+12, CBSE.	K+12, CBSE.	K+12, CBSE.
Semi-open spaces	There are semi-open spaces distributed throughout the building with double-height spaces situated in the center block such that two floors of classrooms could access common activities.	The semi-open space in this building is a courtyard where common activities take place.	The triple-height central courtyard opens up the volume and is visually connected at all levels. The courtyard is used for assembly and other activities like indoor games, meetings and as a lunch dining space for children.
Classroom spaces	The classrooms designed are situated on the left and the right wing. The classrooms are designed to be day-lit with the help of light shelves.	The generic design of placing 6 floors of classrooms around the courtyard was used. The classrooms for the junior school were designed to be vibrant whereas the other classrooms were given a neutral color palate.	To provide a seamless outdoor and indoor interaction of space, the kindergarten classrooms are designed to have individual gardens. On the other hand, with every increasing grade, the classrooms became more functional to induce structured learning.
Daylighting	Light shelves have been provided along with the windows to provide efficient lighting throughout the spaces.  *Source:* (The Green Acres Academy/Tushar Desai Associates, 07 Apr 2016)	The covered courtyard at the top provides internal daylighting along with the windows on the façade. The design of the façade cuts the excess lighting.   *Source:* (The Newtown School/Abin Design Studio, 02 July 2015)	The courtyard has been provided and the roof has perforations that provide ample daylighting.  *Source:* (Rane Vidyalaya School/Shanmugam Associates, 06 May 2020)

Ventilation	The massing has been broken down according to the prevailing wind directions such that the whole structure remains well ventilated.	A stack effect has been provided to provide natural ventilation in the building.	The massing has been broken down according to the prevailing wind direction and a courtyard has been provided to enhance the wind movement in the structure.
Colours/Textures	To have a playful environment the designer has also made use of different colors which makes the spaces informal and easy to relate for the children.	The designers have used different textured materials that are providing good contrast. This has been done to give a premium feel to the school.	Layering, starting from huge random rubble and stone at the bottom is used for the façade, along with finer solid brickwork, mud, and slate on top. The layering of red wire cut bricks from local kiln and grey fly ash brick recycled from industrial cement waste has been used.
Visual Connections	The central block consisting of common spaces is staggered to create a double-height space ensuring two floors of classrooms can access it.	The internal section of the spaces sharing the wall with the courtyard has windows in the courtyard spaces. That opens up looking into the courtyard.	The ground floor of the structure is an open space with only common activities taking place and the whole building can be experienced from the ground floor courtyard itself.
Vegetation	There is very minimal vegetation on the campus of the building.	The Compounds are surrounded by plantations and there is a playground in the center of the two buildings.	There are plantations throughout the building which makes it feel more connected to nature and the surrounding.
Proportions/ Sizes	The sizes of the classrooms were kept so that they are neither too big nor too small. And the common spaces were double height to highlight openness. This created a play between the spaces.	Play in heights of the vegetation was used depicting a beautiful play to create interest.	The proportions of the buildings were kept similar to the surroundings so that the children could relate to them easily. The amount of openness when you enter the building gives you a sense of freedom.

5.1 Comparative Analysis

- The parameters that were chosen for comparison are spatial attributes that contribute to the space-making of the school. The three case studies of the schools compared are completely different in terms of location namely Mumbai, Kolkata, and Theerampalayam.
- The target audience for the three projects was the same which were students from age groups 4–17 years of age.
- The design of the space in each of the structures is different depending on the context and climate which is a scoring criterion of each.
- The approaches for each of the designs are different. Green Acres Academy building was designed so that the design is valid for generations of children. The school was designed beyond 3rd dimension of spaces and catered to the 4th dimension of time.
- The Newtown School has a generic design with 6 floors of classrooms, labs, and other facilities arranged towards the periphery. Based on the location and the surrounding the school wanted to create an identity, so the architects decided to use a screen that also shades the interiors of the building.
- Rane Vidyalaya, the intent was to create a building that would have a positive impact socially on the community and also showcase the core values of Rane. The construction techniques used are from the regional context making it feel similar to the other buildings.

6. RESULTS/DISCUSSIONS

The studied cases demonstrated that a school with a variety of users, the majority of whom are youngsters, needs to be designed in a way that appeals to each of the user groups. They should be able to relate to some element of the building in the locations where they study, which will make learning easier, make them feel safe, and enhance their learning.visiting a

few of the situations described in the report and seeking to understand kids' and other users' take on the environment developed inside the school can provide extra information and help boost the research work.

7. RECOMMENDATIONS FOR DESIGN

A school building is an important place for a child where it enters as a toddler and leaves as a teenager. So the design must remain validated for generations of children. To help designers some important points that one needs to focus on are mentioned below:

- The space should be designed to create a positive environment so that the children are always happy to enter the building.
- There should be enough social spaces provided for the development of social skills.
- For the toddler means to develop their motor skills should be given.
- Use of different colors will make the corridors lively and also develop the color perception.
- There should be enough amount of natural light inside the spaces to keep up the mood, ward off depression, and also improve the working abilities.
- Achieving thermal comfort for spaces is necessary to improve productivity as well as improve health.
- Inducing the feeling of safety and security within the children inside the school will make sure they feel at home.
- One should also look at the climatic factor before designing for the spaces.

Keeping these points in mind while designing will create good learning and teaching experience.

8. CONCLUSION

The criteria considered while designing a school building are based on creating a comfortable environment. It is also important to consider different age groups of the users and design accordingly such that it is comfortable for all the users. These considerations would help in creating a good learning environment with a balance between the built and the unbuilt. Considering the above design factors will help in creating a comfortable and healthy space for learning, fulfilling the 'Sustainable development goal (SDG) 3'- Ensuring healthy lives and promoting well-being for all at all ages.

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Backdoor—Escape from Dementia

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ABSTRACT: This research is a study about 'Dementia' but predominantly concentrates on how space can unconsciously stimulate minds, how we can involve different orientations into architecture to avoid the morbid process of this disease, and gives them purely subjective experience to heal from the neurodegenerative disorders. Secondly, it highlights the current situations in India concerning the increasing prevalence of dementia and ignorance about effective alternate therapies in facilities. This study is about how conscious, user-oriented design strategies can help to reduce and slow the progressive effect of disease along with, it would be capable of erasing deceptive beliefs in society by spreading awareness and guiding younger generations to prevent these disorders by giving them experience through architectural intervention.

Keywords*: Dementia, Ignorance, Unconscious Mind, Healing, Architecture.*

1. INTRODUCTION

'It hurts to know you will never remember things I will never forget.'

—Anonymous

There are people out there with various stories forming special memories with their close ones, and 'Dementia' is a 'Shut down' button for their remembrances. This disease has become deadly over the years and kills humankind, but fewer people seem to do the right thing due to ignorance. In India, we have had an increasing number of patients with 'Dementia' with a higher prevalence of elders, but now the younger population also get affected by this disease. Unfortunately, this disease has no permanent cure, and many families are going through trauma due to improper facilities and sources. It has been found that a better lifestyle can help cure; apart from that, some alternative treatments turned out to be effective, but they are halted due to poor planning. This research is a study about 'Dementia' but concentrates on how the spaces can impact minds and heal the disorders and how we can embrace different methods to prevent this disease and execute it architecturally. In India, few organizations genuinely look after them. However, even though they are clueless about alternate treatments like sound study is about how a better user-oriented design can help reduce and slow the progressive effect of this disease along with, it would be capable of spreading awareness and guiding younger generations to prevent these disorders by giving them experience through architectural interventions.

Aim: To study 'Dementia patients' and how architectural spaces can encourage progressive neurologic disorders to slow down and lead towards a better lifestyle.

Objectives

1. To study about effects of dementia and similar disorders on human life.
2. To study where current programs/centers are lacking and how to design a user-friendly architecture by understanding ongoing and new healing methods.
3. Analyze different techniques that help to spread awareness in society.

Need for Study: Dementia is a neurological disorder that damages the brain cells, and its progressive effects lead to compromising physical and mental conditions (Alzheimer is one of the standard forms of the disease). The ignorance about dementia in society is disrupting a probe into this field, and as a result, this disease is growing fearlessly and ruining lives.

Increasing Prevalence of Dementia: In 2015 India, not only 4.1 million people were diagnosed with dementia, but 4.1 million families suffered. In 2021, this number went to 5 million. Moreover, by 2030, it is estimated to go beyond 7.1 million [1].

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Age Group: As per the 2011 census, India is home to about 65 million elderlies aged 65 and above, creating 5.5% of the total population. The prevalence of dementia in India is 2.7%. With increasing age, the prevalence of dementia increases. In India, most elderly live with their families, and most patients with dementia are taken care of by their families. With the increasing elderly population and reducing the joint family system in our country, dementia poses a significant challenge [2].

Facilities Related to Curing: Only one in ten people are getting diagnosis treatment in India [3]. Furthermore, the current people could not find appropriate centers to take care of their close once, so they prefer an old age house. Usually, this disease hunts old people above age 60, but now younger generations are also affected by the medical term "young onset dementia". India is the second most country suffering from dementia [4]. A combination of healthy lifestyle traits may substantially lower the risk for a disease which can control the spreading of this disease.

2. RESEARCH METHODOLOGY

This thesis structure follows a design through a research approach, studying causes, reactions, and treatment of dementia and how dementia affects the person and families. Following that, it will include a literature review, current global and Indian scenario, which supports outline the problem and the design objectives towards enhancing health care services for patients with dementia. These design aspects were formed to evaluate case studies and test the objectives within the international and local context.

3. LIMITATION

As this is a delicate topic, most facilities do not allow to lead case studies or interviews regarding privacy and policies with clients. In addition to that, there are no such provisions as typical medical facilities, as this is still an unexplored topic in India. We need to depend on secondary information most. This project focuses on Maharashtra state.

4. LITERATURE REVIEW

"Over 90 million of Indians or 7.5% of Indian population suffer from mental health issues", according to the world health organization and even though the world's fifth-largest economy, India only spends 0.05% of its health budget annually on mental health over the past years, much lower than the average spending of low-income countries. In 2018 India's healthcare budget was 528 billion rupees, out of which 6.6 million was for mental health, which reduced to 400 million in the following year and has spent only 50 million rupees annually on mental health. The amount spent per person is 33 paisa, and 150 million people require urgent mental care. India has 9000 psychiatrists or one doctor for every 100,000 people, and the desirable number is 3 for 100,000 people, which means India has a shortage of 18000 mental doctors.

Rathore, H. (2020). How Committed Is India to Mental Health?—The Diplomat. The Diplomat. https://thediplomat.com/2020/03/how-committed-is-india-to mental-health/

In 2015, 4.1 million people over 60 years had dementia in India. It is estimated to rise to 6.3 million by 2025 and 13 million by 2050. It indicates that the burden of dementia in India is already significant and expected to rise rapidly over the next two to three decades. A study in 2010 found the prevalence of dementia in Pune city to be 4.1% in those aged above 65 years. It indicates a significant burden of illness in the local region of India; only one in ten people with dementia receive diagnosis treatment or care.

Nulkar, A., Paralikar, V. and Juvekar, S. (2019). Dementia in India—a call for action. Journal of Global Health Reports, 3. https://doi.org/10.29392/joghr.3.e2019078

Residential care has provision for much-needed respite for a patient with Dementia and their family for the short term, which works in favor to manage behavioral problems and enabling the family to care for longer the takers for care centers have been steadily progressing over the years as awareness is increasing among family. As this disease is unexplored and due to ignorance in society, caregivers are not getting any support. Said Sruthi Sivaraman, team lead—Dementia Care, and psychologist, NMT.

As per S. Subramanya, a director of NIKISA HealthCare service, In-home care facilities do not allow nurse assistants for 24 hours as it means changing people after shift, which is not helpful for dementia patients as they live in different circumstances

Deepika, K.C. (2019). Demand for residential care for dementia patients rising in Bengaluru. https://www.thehindu.com/news/cities/bangalore/demandfor-residential-care-for-dementia-patients-rising-in bengaluru/article28237766.ece

5. METHODOLOGY

In India, not precisely, but a lot of the population followed the notion of "second inning," which is life after retirement. They sacrifice their dreams to fulfill their current needs or responsibilities. There have been cases in which Patients with Dementia get disappointed because they could not get a chance to live the second inning as they planned.

6. ABOUT SURVEY

The survey was designed with five casual questions and was more subjective as this topic is sensitive. This survey aimed to understand how many Indian populations worked in which fields, their dreams that they could not complete but were willing to resume after retirement, and how many of them are aware of neurological disorders.

6.1 Questions

- Name
- Age
- Designation

Sector suffer from depression or an anxiety disorder, which almost every second employee.

- Specify the department you're in. (e.g., IT, Government, Hospital, business)
- So! At what age you're willing to retire and wanted to have a peaceful life? (E.g., 40s or 50s or never)
- Did you know or ever heard about dementia? (From friends or colleagues or newspaper)

6.2 Answers

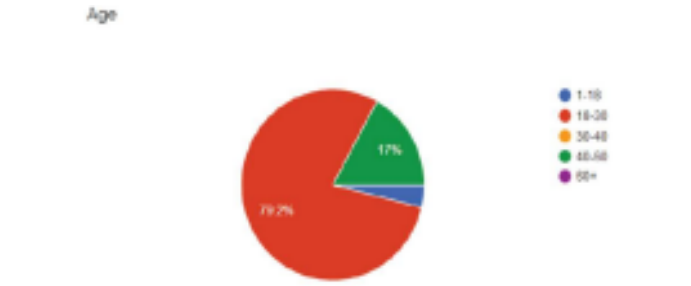

Figure 1: Age

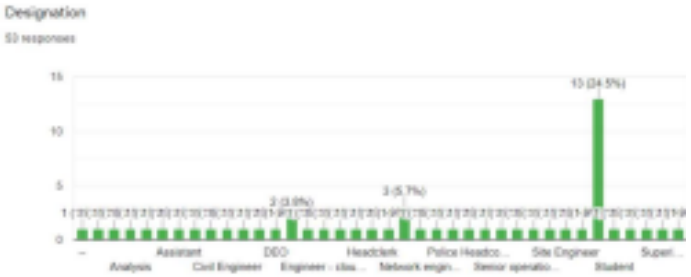

Figure 2: Designation

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In the past years, we have heard the news about depression anxieties or bipolar and even big film stars or wealthy class affected. As we can see, many people are working in different sectors by crushing their dreams due to responsibilities. The question is placed subjectively to understand feeling even though casual questions bring out the absolute joy of one's life. The question is arranged to understand the types of activities most people enjoy to provide specific programs as part of therapy. "Most suicides are related to psychiatrics disease with WHO predicted that by 2020 Approximately 20% of depression and disorders" By U.S. national center for population will suffer from mental illnesses, biotechnology information, 2017 which means today, 200 million Indians have Mental illnesses. From this pie, we can evaluate that we have a younger population, but he green portion, which shows age between 40-60, is an indication that in coming years the ratio is going to change, and as dementia affect the elderly, we have to have the provision of services to prevent it at the right time.

Figure 3

7. ABOUT RETIREMENT

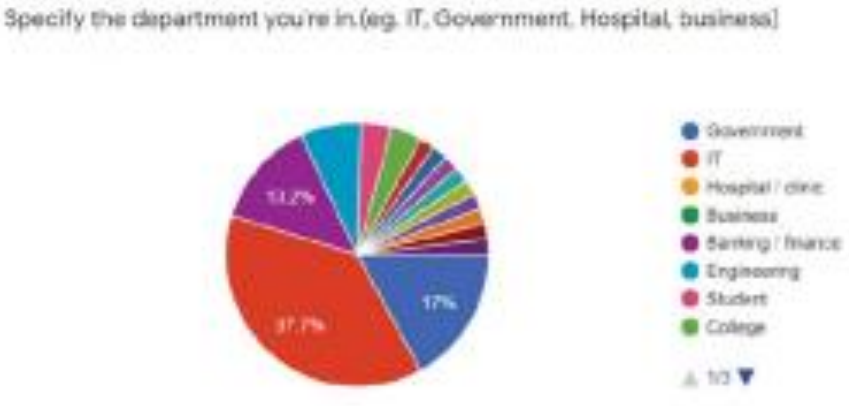


Figure 4: Department

Many people believe in the second inning or life after retirement, and concerning that, they set some goals to achieve which they could not achieve in the working period, but dementia does not require anyone's permission to arise. Many people regret it when it occurs during this second inning period. "35% of India's population is between 15–34 age as per government stats, and suicide was the leading cause of deaths among young people aged 15–39 in 2016" as In India, most people work either in it sectors for a

Lancet global Health Study. multinational company or government. This pie is proof that most of our younger eneration is working in the department where they need to work with technology or computers dementia does not occur anonymously there are some actions that we do in daily living which indirectly damaging our brains. Other small activities have been damaging our brains unknowingly. Staring at a screen for hours is one of them which damages our macula, a brain behind our eyes. In 2019 Study by a British charity, Mental Health Research U.K. found that 42.5% of the employees in India's corporate.

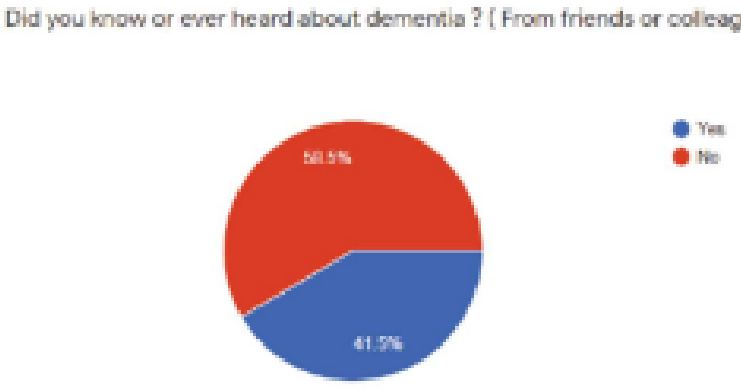


Figure 5: Awareness

Table 1: Dementia India Report 2020 [5]

Estimated number of people with dementia among elderly persons (aged 60+) in states 'of India during 2020-2021

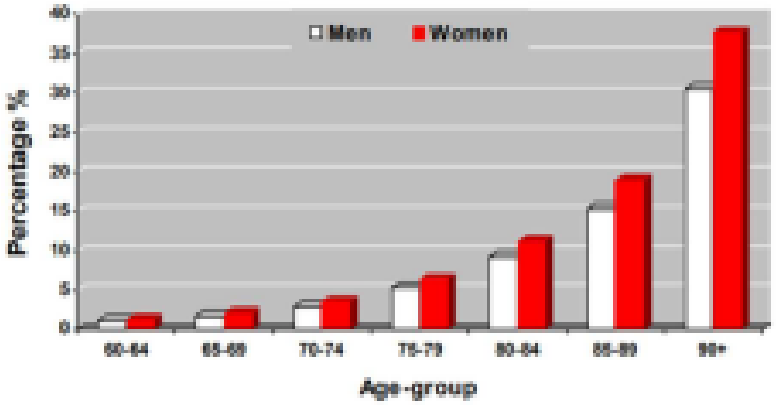
States	% Of elderly people in total population of State 2020-21	No. of elderly persons (in 1000s) 2020-21	No. of elderly persons with Dementia (in 1000s) 2020-21 ****	No. of elderly persons with MCI likely to develop dementia in one year (in 1000s)
Andhra Pradesh	12.2	11152	413	134
Assam	9.1	3098	115	37
Bihar	9.5	10365	384	124
Chhattisgarh	10	2729	101	33
Delhi	8.7	2131	79	26
Gujrat	11.6	7687	284	92
Haryana	9.7	2862	106	34
Himachal Pradesh	12.9	953	35	11
Jammu & Kashmir	10.5	1364	50	16
Jharkhand	9.7	3456	128	42
Karnataka	12.5	8074	299	97
Kerala	16	5833	216	70
Madhya Pradesh	9.9	7379	273	89
Maharashtra	11.2	14247	527	171
Odisha	11.8	5185	192	62
Punjab	12.6	3814	141	46
Rajasthan	9.4	7266	269	87
Tamil Nadu	14.8	10507	389	126
Uttar Pradesh	8.7	20189	754	244
Uttarakhand	10.4	1172	43	14
West Bengal	11.9	11573	428	139
In India	10.7	143244	5300	1719

*States in yellow color have more than 400 patients of dementia

It is a good sign that many people have heard about There are ten million-plus new cases of dementia every year dementia, but whom to approach if diagnosed with it? and a new case in every 3.2 seconds. Between 2014 and a good architecture intervention can become a support for 2050, It is estimated that the number of older people them to achieve satisfactory service. increases by 185% in lower-middle-income countries: today, the most common form of dementia [5] most of the population is working in the IT field, banking, and government sectors. Most of them wanted to retire between 40–50 Age and, surprisingly, their dreams or Gender Differences in Dementia: hobbies are entirely contradictory with their respective fields. Results and Discussions: After analyzing the dementia report 2010, we find that gender is not a risk factor as there is no difference between males and females in the age-specific incidence of Dementia. Epidemiology is a process in which we would able to As per ADI 2015, there is a higher amount of Dementia in identify the affected people and the risk factors to understand women as they live longer, as well as the influence of risk and study the diseases in a population where

prevalence is factors, also may be different between men and women. As about what is current count or how many patients we have in in men's has habits like alcohol or smoking, whereas women the present and incidences the count of new patients. As have depression both are risk factors for Dementia. prevalence denotes, history and incidences present the ratio between these two matters to understand society's impact and upcoming economic issues. GLOBAL AND INDIAN FIGURES: Alzheimer Report 2015: Young-Onset Dementia: When the symptoms start before age 65, it will describe as young-onset Dementia. It is a rare condition as quoted in ADI report 2015 up to 8% of all patients with Dementia have an early onset in this ndition; they may get a delay in this report was one of the complete documents about the receiving as symptoms are undetectable due to lack of global impact of dementia. After reviewing 273 studies, the quality data the unique need of those affected and families report evaluates that 46.8 million people live with dementia are often neglect. In this particular area, we require more worldwide, and this counting could increase to 74.7 million research in 2030 and 131.5 million in 2050, As an accurate report or counting would not be possible, as per report 2015, the estimate counting increased 12-13% compared to 2009.

WHO 2017:



Dementia is the second largest cause of disability for a person age 70 and up and the seventh leading cause of death.

As per the World health organization in 2017, dementia affects 50 million people (tentatively, due to quality of shreds of evidence and constant increasing no of older population estimates can vary.) Moreover, by 2030 it will go Chart 1: Dementia India report 2010 [6] beyond 82 million and then 182 million by 2050

WHO 2019:

Mild Cognitive Impairments (MCI):

MCI is a phase between Normal cognitive functioning and Dementia. In MCI, cognitive functions get affected, but early interventions, including lifestyle changes, can help to cure.

Table 2: Dementia India report 2020 [5]

Adi Estimated Prevalence of Dementia (World Alzheimer Report 2015) Top 10 Countries	
China	9.5 million
USA	4.2 million
India	4.1 million
Brazil	1.6 million
Germany	1.6 million
Russia	1.3 million
Italy	1.2 million
Indonesia	1.2 million
France	1.2 million
Japan	3.1 million

8. CHALLENGES

The presence of multiple symptoms and behavioral activities makes patients unconfident, and as a result of this, sometimes they cannot communicate with people, which reduces their quality of life and increases their chances of morality. A risk factor is undefined in dementia, and age is one of the non-modified risk factors because as age increases, the risk also deteriorates.

In India, we have a younger population, but there has been a rise in greying population in the last few years. The issue is that we do not have a well-organized and accessible health care system in this medical area, and as a result, caregivers family members are suffering from the burden and bearing all costs of illness.

The cost of dementia is challenging as multiple variations have been found in the prevalence of dementia worldwide due to differences in screening tools and methodology used; the costing depends on how the healthcare system is organized locally and what resources are available in urban and rural regions as the cost of patients differs as per disease and as per cities.

The estimated cost per person per year was 2229 USD in 2004 for direct care, which then updated in 2015 to 20187 USD, and for India, it was 3865 USD; Rao and Bharath 2013 conducted a costing exercise from which they came across that the annual cost of caring for the person with dementia ranged between 45,600–2,02,450 in an urban setting and 20,000–66,025 in the rural setting. Whereas, Nikisa dementia village Bangalore costs 38,000 a month 2018–20. In this cost, 20–35% cost accounted for Medicines whereas 60% cost accounted for indirect costs like home care and residential care. Medical cost accounted for a smaller Ratio than total costs; therefore, improvement in medical technology and health care will impact the overall cost burden of dementia.

Their data constraints about the prevalence of dementia and development in social support systems to care for persons with dementia are required, and all of these needs to be accessible, available, and affordable.

9. CONCLUSION

9.1 Current Situation

In most cases of dementia at early stages people thought about becoming a caregiver to their close ones with dementia to avoid humiliation in society However, they failed to get satisfying help as it is very difficult to find the right sources for disease. Dementia is reversible in the earlier stages but due to lack of sources, unfortunately most patients end up moving forward into the next stage and then it becomes very difficult to pull back from advance stage.

9.2 Architectural Solution

Architecture unconsciously plays a significant role in the life of patients with dementia. All analysis pointing that there is a need for infrastructure in the area of dementia, specifically in India, but at the same time, providing comforting space and programs has become essential. Apart from a health center there could be multiple interventions supports the structure by understanding the behavior of patients with dementia and has a potential to spread awareness.

9.3 Other Supporting Interventions

Dementia Library: It will become a design component as it is a public library where everyone could find everything about dementia. It will make people come for the right source a certain fee or donation will be made, which will automatically work as an asset for the center and at the same time there would be many people who can share or interchange their knowledge about dementia, and it will raise great awareness.

Theatre: Most of the Indian culture appreciates a visual medium or live experience like the theaters. A domestic film across India will generate 122 billion rupees across cinema and theatres in 2020 by the statista research department. By understanding the adaptive medium of Indians, in design providing a theatre in which patients with different backgrounds or caregiver can share their stories to audiences which help them to understand this subject closely.

Light as Therapy: "As a light therapy is most effective in treating circadian misalignment if administered shortly after awaking" (gooley 670, 2012) problematic symptoms such as disrupted sleep cycle and nighttime wandering have been reduced by using light as a therapy. Specifying light exposure at different times of the day can help to regulate the body's natural rhythm. "Exposure to light at night can disturb sleep and suppress melatonin production" (fedderson 107).

So by understanding cyclical patterns of light as a design tool to enhance Circadian rhythms. As distribution in natural rhythms put a tremendous strain on the body which indirectly increases the risk of numbers of severe disease including cancer, heart disease, and depression and it can also impair the ability to think.

Movement as Therapy: "A combination of bright light therapy and walking has shown additional benefits for attention, memory and orientation in residents and reduced caregiver burden" (desiree).

Although wandering is one of the symptoms of dementia, it can be diminished by including movement therapy, exercises, walking, and Other physical activities.

Design Aspects:

- Patients can move around rooms in the interior by following the sunlight clock or signs should be there to guide them to decreased Wandering and aggravation.
- Avoid visual confusion, and design should be glare free.
- Broader walkways have been introduced to ease assisted ambulant or wheelchairs to move quickly. and the toilet should be located within a very short distance of social areas and visible from beds in the bedroom.
- The lighting should design in such a way that helps to minimize glare and shadow.
- The use of color and tone differentiates floor skirting and walls; no patterns are used, creating confusion and no Sharpe shadows.
- The door should be color-coded to distinguish between room and toilet.
- No dark corridors or dead ends.
- Natural wandering loops are incorporated.
- Handrails are installed on walls everywhere to navigate and as a support system.
- The entrance is easy to find while going in but almost invisible once they get inside; it reduces anxiety.
- Allowing staff to work on duty while maintaining constant passive contact with a client.
- If we provide reassurance giving environment activities that give pleasure and confidence.
- Help person find the answer like if they keep asking time keep the clock at a visible place so that they could find by themselves
- If the lost provide underlying themes from which they could able to find a destination.

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Article 1: https://www.google.com/search?q=what+is+corporate+author&oq=what+is+corporate+author&aqs=chrome. 69i57 j0i512l3j0i22i30l6.7249j0j15&sourceid=chrome&ie=UTF-8
Article 2: https://www.joghr.org/article/12221-dementia-in india-a-call-for-action
Article 3: https://www.thehindu.com/news/cities/bangalore/demandfor-residential-care-for-dementia-patients-rising-inbengaluru/article28237766.ece

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Analyzing the Potential of MR (Mixed Reality) and AI (Artificial intelligence) in Space Interpretation

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ABSTRACT: With the increase in technological advancement, its involvement in designing our living spaces has greatly increased. Researchers have explored the benefits and applications of mixed reality (MR) and AI (Artificial intelligence) in various scenarios. It possesses great potential and its application in architecture has lots of fields to uncover. The spatial perception of any space can be skillfully altered as per the needs and proficiency of the designer. Eventually, it will help envision the future aspects and their outcomes, in shaping the future for the human personal and social life. And finding options on how newer technologies can help to spread the outreach of the work done using the research ideas.

Keywords: *AI, NFT, Machine Learning, AR, VR, MR, Photogrammetry.*

1. INTRODUCTION AND BACKGROUND OF THE STUDY

Human society has come a long way on the path of development. Making an overall observation we can consider interactions or connections playing a major role in this development which happens in a staged manner:

Stage 1: Humans were generally individually living species that eventually started living in bigger communities.

But what brought them together was the very first interactions via some random sign language, which further developed into a written and oral way of communication. Just through stage one, human society moved from the stone age to forming larger n larger empires. Individuals started sharing personal experiences, which helped in developing and evolving ideas and technologies easing the day-to-day lives of humans. Stage 1 reached its peak once humans began creating and sharing written manuscripts. But still there remained a scene of disconnect between people over long distances

Stage 2: As technology developed, the sharing of P-S interactions became easier. Initially, this medium was through locally fixed instruments such as radio, fax, and telephones. The pager technology made sharing of information motile. Eventually, leading to the evolution of current-day keypad phones. It enabled us to share both vocal and textual information over long distances.

Stage 3 (ongoing): The range of these connections further expanded with the creation of the internet. Initially, the internet just demonstrated static information, vaguely also called "Web 1". As more and more people had access to the internet evolution of dynamic and interactive websites began. The information highway got a major boost with the creation of mobile utility devices like laptops and eventually our current day smartphones. This all is considered to be a part of "Web 2.0"

Stage 4 (ongoing and future): But still, there is a huge gap between what we call digital/virtual and real interactions.

Here, the development in the concepts of virtual reality augmented reality, mixed reality, and blockchain technology, portray the start of the so-called "Web 3.0".

Objectives:

The study will look into various AI & MR options which can help.

Interpret space with the help of various immersive reality hardware and software technologies.

Study how machine learning algorithms work.

Understanding human special recognition and view ways to achieve higher spatial consciousness skills in an already existing space.

Understanding the effects of the new space that can be created using the research.

And finding options how technology can help to spread the outreach of the work done using the research ideas presented.

2. RESEARCH APPROACH

Visual factors in space perception:

To understand how humans use perception to augment space around them, let's understand what neuroscience tells us about it.

As light bounces off objects and hits your retina it gets converted into electrical signals. These electrical signals containing visual information get sent to the primary visual cortex via the optic nerve.

From there the information flows mainly two ways.

The dorsal stream processing where things are, the location, position, motion.

The ventral stream processes what the objects are:

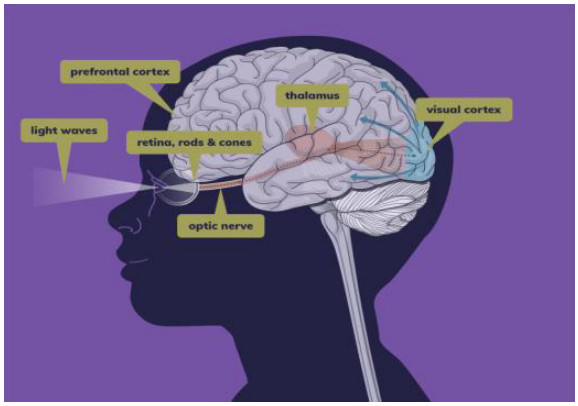


Figure 1: How the Human Brain Works while Viewing Objects[i]

The interesting thing is that the primary visual cortex is always telling what it thinks it sees, polluting the visual stream with preconceived ideas and what it wants us to believe. And that is why some scientists are arguing that actually, we're not perceiving the world we're constantly generating it. This can be a major glitch in the system. It can also be a great opportunity for humanity to concur new realms of human space perception.

Hence looking at a broader view so if the brain is already augmenting itself with preconceived ideas and memories. We can create an external way of processing that information via a processing device outside the brain and giving it back to the eye to experience the surrounding. It would be collecting the light before it hits the eye then processing externally to understand the posture and position of things and then choosing memory or memories from a data set for data processing and modification. We can then change the perception of objects and return this light to be perceived by the human eyes. Eventually giving us the power to visualize and experience a certain space with varied options of pre-defined sets of environments or even recreate new ones along the path using permutation and combinations.

3. LITERATURE REVIEW

In achieving these newer concepts there is a long way of technological development and collaborations to be observed in the upcoming years. For the time being, we can only suggest ways, how we could embark our way on achieving these feats.Virtual reality (VR) is a simulated experience that can be similar to or completely different from the real world. Currently, using virtual reality requires special devices such as headsets, goggles, gloves, etc. It allows users to explore the artificial world, move around in it, and interact with virtual worlds' features or elements. [ii]One example of this includes IKEA's "kitchen experience" initiative, which allows customers to visit the store through a VR headset. Architecture firms around the world are also starting to adopt VR for ideas presentation. It offers an exciting level of practicality, as, through the technology, they can provide a 1:1 scale model of their design to clients for a more immersive and visual experience. [iii]

Augmented reality (AR) is an interactive experience of a real-world environment where the objects that reside in the real world are enhanced by computer-generated perceptual information. AR can be defined as a system that incorporates three basic features: a combination of real and virtual worlds, real-time interaction, and accurate 3D registration of virtual and real objects. [iv]

To Mark the Difference: Augmented reality takes place in the physical world, with information or objects or virtual 3dimentional data added virtually like an overlay on the real world using visualizing display integrated tech. on the other hand, virtual reality immerses you in a fully virtual world without the intervention of the physical world with the help of wearable techs like VR headsets or goggles to experience virtual objects or environments

Mixed reality (MR) is the merging of real and virtual worlds to produce new environments and visualizations, where physical and digital objects co-exist and interact in real time. Mixed reality does not exclusively take place in either the physical world or virtual world, but is a hybrid of augmented reality and virtual reality giving a complete immersive reality experience. [v]

Artificial intelligence (AI) is intelligence demonstrated by machines or any system that perceives its environment or inputs provided to it and takes actions that maximize its chance of achieving its prespecified goals. [vi]

Machine learning (ML) is the study of computer algorithms that can improve automatically through experience and by the use of prefeed data. Machine learning algorithms build a model based on sample data, known as training data, to make predictions or decisions without being explicitly programmed to do so; with or without human intervention where ever required. [vii]

3.1 Demographics

AI and ML would play a major role in the development and working of this setup for which MR would be a source of connection between humans and technology. Let's begin with considering the development that we have made up till now and a global overview of this field.

Considering international demographics there has been an exponential rise in AI-related peer-reviewed publications and journal publications in recent years. These publications form the base for practical working projects and show a very promising rise in the future ahead, also resulting in the filing of a large number of patents related to the field. The job market in the field is in continuous demand of young more inquisitive and learned individuals to set this technology in use to achieve the best results for the products and services. [viii]

In the Indian context, country-wise research and development may need a few years to adopt these technologies in various sectors. For the current scenario, India is one of the major countries from which a large no of individuals is higher all around the world having a higher skill penetration rate that's required in the fields of AI and ML.

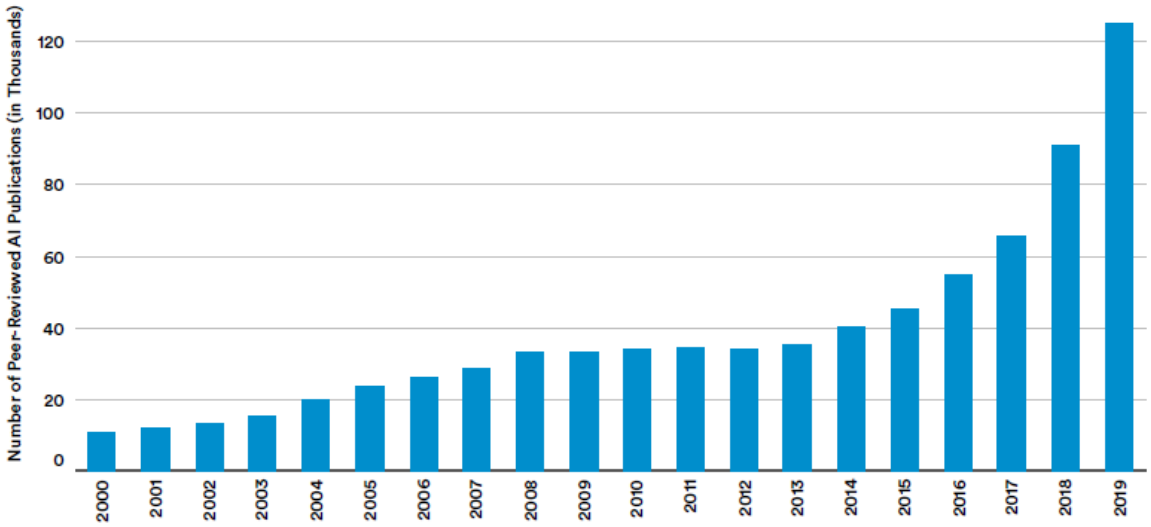


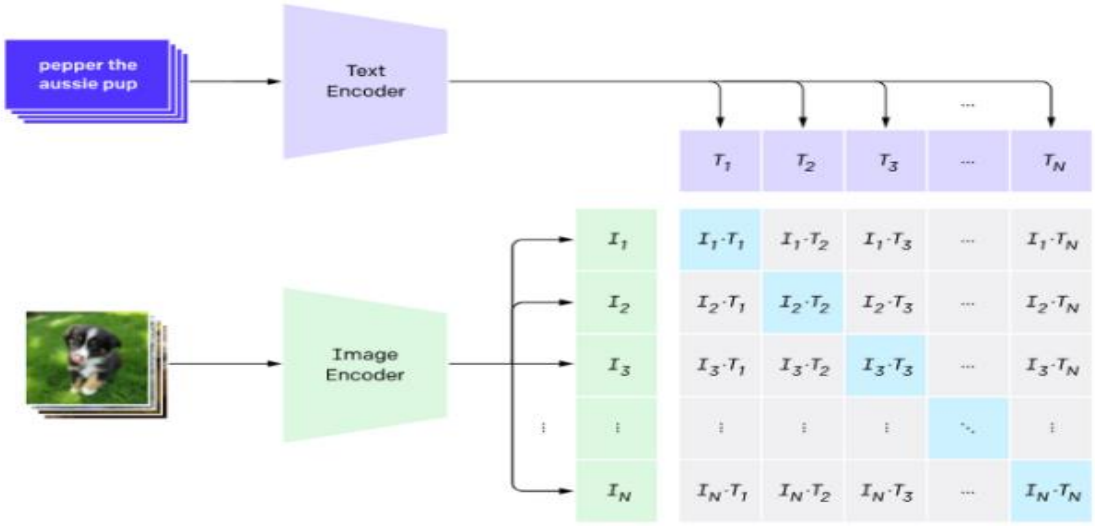
Figure 2: Growth in the Fields of AI using Peer-reviewed Publications and Patents[viii]

Many new tech companies in India have started utilizing AI, VR, and AR technologies. For example, At EdTech giant BYJUs, there is a game-based augmented reality lesson where what you scribble on pen and paper is almost magically read by a tablet, and scores are given to you.

Software giant TCS showcased a virtual chemistry lab. It has been helping to evaluate the students in real-time using algorithms which also provide data analytics on how a student performs and her/her shortcomings, mistakes, proficiencies, are as of improvement, etc.

In healthcare, there is a multitude of AR/VR solutions ranging from training to therapy. The industrial and automotive tracks too are filled with applications for training and maintenance. Gaming and entertainment are explored in the field extensively.

According to Nasscom, India's immersive media is stated to become a US $6.5 billion market by 2022. [ix]



3.2 Case Study

3.2.1 *Case Study 1: Captcha and its Hidden Motives*

While accessing various websites, we have always seen popups or security dialogue boxes appearing, asking to confirm if you are not a robot. The site uses a set of dancing letters and numbers to identify and ask users to retype it. But apart from security reasons it also has some various undisclosed applications.

The captcha system was first introduced in the early 2000s to differentiate between humans and bots. Tech companies on their way to digitize various historic documents, and manuscripts, found it difficult to identify many texts that were worn off or in bad condition which the then computer couldn't understand. Such words were then displayed to humans in form of a captcha through which the AI algorithm learned from various inputs from the human's responses and improved over years.

Today we are at such a stage where we can scan any text using our smartphones and the internet automatically processes it, which has a great help in developing apps such as google translate or text to speech apps.

In the present, captchas also come with photo identification requests. For example- Identify the traffic signals from the below sets of images, etc. This is one of the practices where humans are training the AI to identify objects and give precise search results. Its utility is highly seen in the online shopping industry. Many times we see a specific item that someone has but don't know its details and where to find it for purchase, here comes the utility of this AI where we click a photo of the required item and just tap a search button to receive all details about that similar item from various companies, different sizes, colors, prices, etc.Case study 2- Text to images

Similar to the above example AI has also been trained to recognize, translate and modify all forms of data like texts, numerical, binary, hex codes, images, or symbols. Figure 3. Diagram demonstrating how a text to image encoder works at the back end. [x]

Such inter commodity or data interactions have experienced a large number of training data sets and are now at a stage where they can produce mind-blowing outputs.

To experience one of it we can use VQGAN-CLIP, a GitHub repository created by nerdyrodent, Originally made by Katherine Crowson. It's a python (coding language) package that provides very good documentation and several intuitive examples of different types of images that can be generated using the code. The whole process can be experienced via the collab platform for noncoder individuals.

Figure 4: An AI-generated Artwork for the Inputs of "in the Distance, He could See a Giant Cave Surrounded by Huge Rocks, Oil on Canvas" [xi]

3.2.2 *Case Study 3: AI Designed Architecture Elements*

The utilization of AI in the field of architecture began with smaller projects. Trying newer designs of orders of a column which were fed data of the classic orders of columns and let the algorithms run to give innovative designs for the columns.

These were some of the designs that were developed through AI with the help of these flow charts as a guide in the process.

Figure 5: The Upper Image Shows Samples of AI-generated Column Capitals[xii] and the Lower Image is a Complete Set of Designed Columns Created by Computational Ar. Michael Hansmeyer[xiii]

3.2.3 *Case Study 4: AI Space Creation*

For this case study, Generative Adversarial Networks or GANs for short is explored. It's an approach to generative modeling using deep learning methods to expand beyond merging building blocks into new compositions.

For this study, 3D BIM models are used. GANs works based on nodes and edges. Here, from an architectural point of view.

Nodes in the algorithmic data will represent rooms and have attributes such as type, area, volume, and perimeter.

And Edges will represent the type of adjacencies between rooms—for example, door connection, an open connection, or vertical connection, such as stairs, ramps, or elevators.

Such simulations require huge computation power, GANs models can represent even more information, such as objects inside rooms, furniture, lighting fixtures, etc as per the capabilities of the hardware system and the designers, system developers.

The below design is one of the AI-generated simulations with a specified set of inputs fed to the AI, through various steps as depicted through the below flow chart:

The main observations from this study were as follows:

The AI discovers the latent topological features that constitute essential building blocks of designs—by extracting structures, connections, behaviors and so on that are important to serve a particular target function as required by the inputs provided. It then composes various building blocks into a new design that meets the requirements. It also evaluates the feasibility of generated options and also gives alternate solutions to problems that may arise (if any).

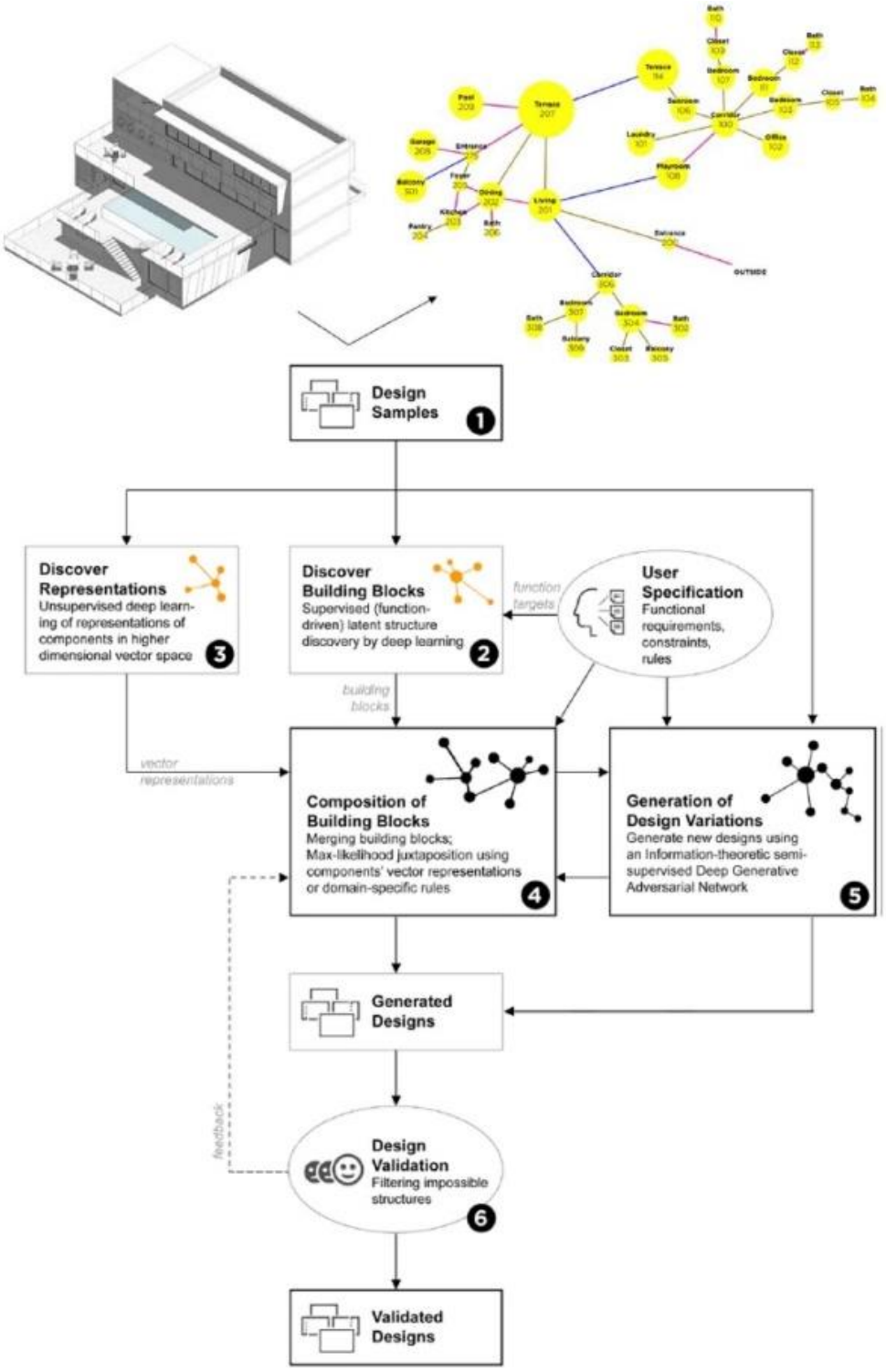


Figure 6: AI-generated Simulations Created for a Bungalow Following Specific Steps as Shown in the Flow Chart[xiv]

4. MATERIAL AND METHODOLOGY

In architecture, a typical project goes through the following phases of development: conceptual or predesign (PD), schematic design (SD), design development (DD), construction documents (CD), procurement (PR), construction administration (CA)—that is, the implementation of the project—and later continues with operations (OP) to manage the building itself.

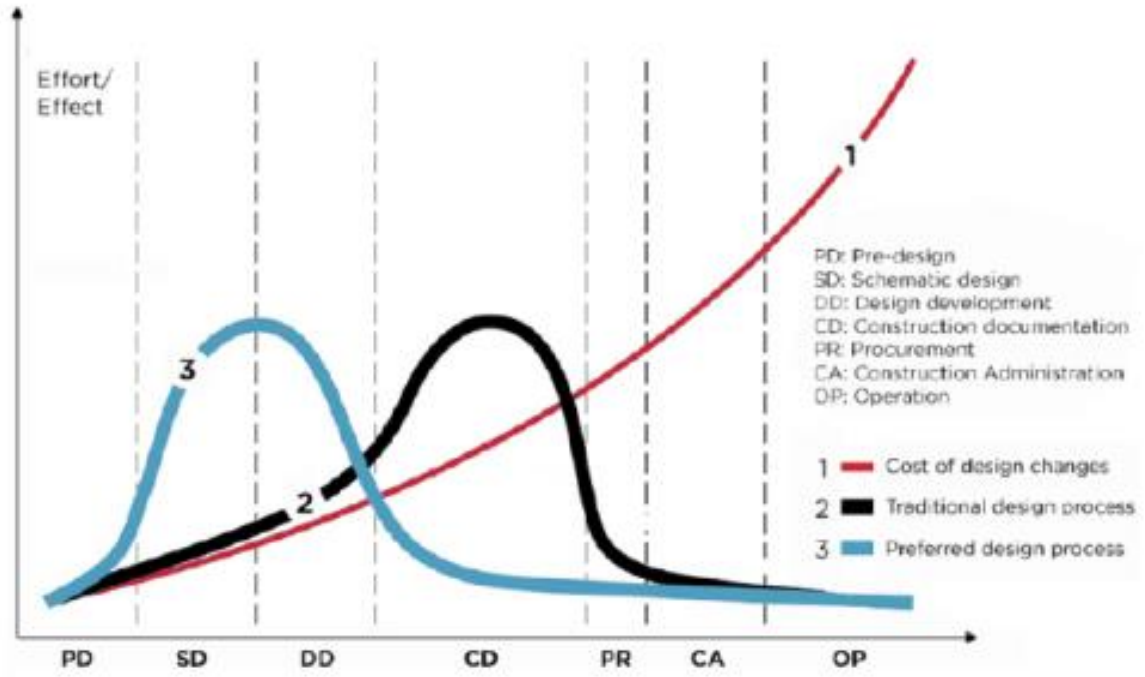


Figure 7: The MacLeamy Curve Shows the Various Building Phases Comparing Traditional and Preferred Ways of the Design Process[xiv]

Here in the case of manual or traditional work methods, the initial works take lesser time but as the design stage and detailing stage approaches the quantum of efforts and time utilized drastically increases. Even a small change or alteration in a later stage is too hectic to deal with. With the help of AI, it can be simplified. The maximum time that will be required is the algorithm creation and machine learning data set samples feeding and self-learning time. The later stages will then be of ease. Even changes in the later stage will be just a matter of changing one or two input parameters, that's it.

4.1 Design Workflow

Designing process in an immersive environment.

To design a space in a virtual environment require a fixed flow chart to be followed as explained further.

Stage 1: Firstly we need to acquire a space in the virtual realm

There are 2 major ways to acquire a space.

Either purchase a virtual space or land parcel in the metaverse (set of virtual space hosted by tech entities which are hosted on online servers), some of its examples are Decentraland or CryptoVoxels.

Or transfer our room or surrounding to a virtual entity and then self-host it on our PC or outsource to host it on an external server. Creating our room into a virtual entity requires photogrammetry.

Photogrammetry is the science and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring, and interpreting photographic images. [xv]

This method uses the parallax obtained between several pictures, taken from different points of view, and then weaves them all into creating one final 3d environment. Some of the software used to carry out this are as follows:

Reality Capture, 3DF ZEPHYR, Autodesk ReCap Pro, DroneDeploy. This virtual scape can be experienced by the individual himself or be shared with other individuals to experience it together. This created space can be a single room or set of rooms. As demonstrated in case study 4, various permutations and combinations can be made in our inputs to create the space as per the requirement.

Stage 2: Once the virtual space is created then the owner of the space can decide what he/she expects from that space and what it's going to be used for. As demonstrated below one can expect to view this virtual space as part merged with their childhood home memories. Below is the first block, there are images of certain childhood memory with green ivy all over the house. In the second block, these images are converted to computational text as demonstrated through case study 1. Further, this computational text data is then converted to computational text format through memory reconstruction.

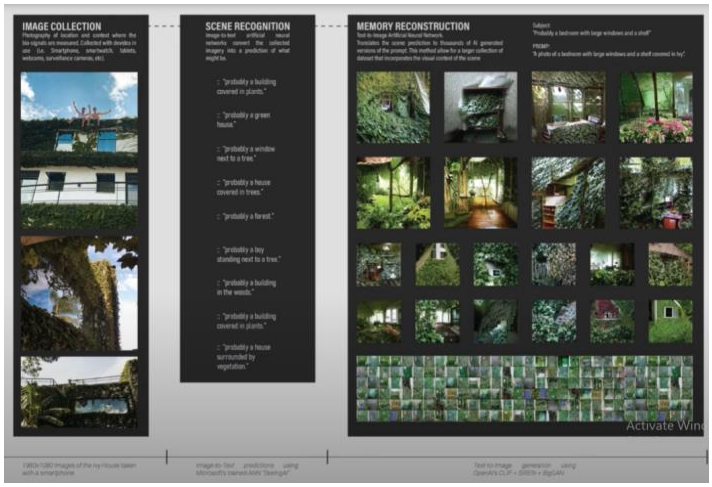


Figure 8: Memory Reconstruction Process using AI [xvi]

Stage 3: Once our virtual space and memory reconstruction is ready it can be then overlayed on our virtual space to create a new version of that space using AI such as Psycho gams neural network as demonstrated below.

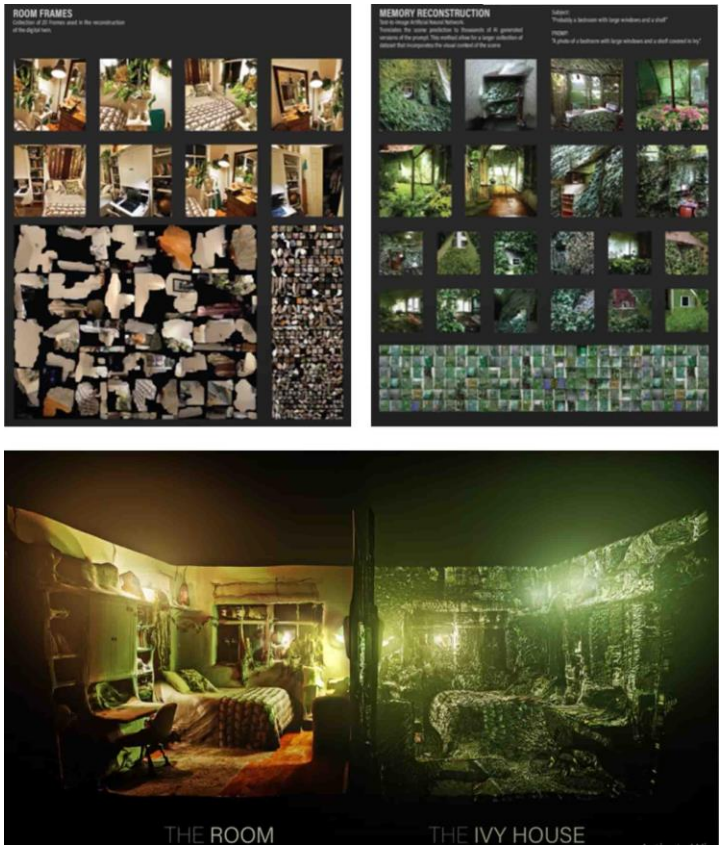


Figure 9: Overlapping of the Reconstructed Memory over the Room Virtualized using Photogrammetry [xvi]

5. RESULTS AND DISCUSSION

As architects or designers, we can provide our expertise in the above-mentioned design workflow and help evolve the AI eventually creating more and more capable systems.

In case study 4 (AI Space creation) as architects, we can provide training data sets of predesigned structures to precisely define the space that will be created by the AI. Detailed data about human anthropometry of various age groups can be provided. Crowd management data, climatic simulations, circulation patterns, all such training can be provided to the AI.

Considering case study 2 (Text to images) giving design ideas, newer concepts and innovative vision will help train the AI to create more precise and innovative images. These same images can be further used to overlay or create newer virtual spaces, so well rectified inputs for consideration should be provided like human psychology, scale, and proportions, to create well-defined pictograph data that can be overlayed on the virtual space.

6. FUTURE USES AND BUSINESS POINTS

How in the physical realm architects and designers create their unique style similar way can be followed in the integrated reality realm as well. Architects can create and train their algorithms to commission out works.

Designs can be made according to the requirements of the clients and what they expect for the space. A single space can have multiple designs made and the user can maneuver between these multiple designs as per his/her mood or activity requirement. The experience of what humans feel out of a created reality will completely differ from architect to architect or designer to designer. A single room can open up to be a beachside resort or desert oasis or Martian terra formations as well. The rise and level of business in this field will completely depend on the work a specific firm puts in training their AI, eventually creating magnificent state of art designs.

All this can be easily monetized by the means NFT (Nonfungible token), also can be considered as digital value assets where the transaction can be done through digital currencies on encrypted blockchains.

6. CONCLUSION

All the things considered we can conclude that the field of AI and MR have a large potential in its applications and its various other uses are yet to be found in the field of architecture and design. The contribution of the inquisitive and technically sound generation of architects and designers can work and refine the utilization of this asset-worthy field of knowledge and help share and propagate it.

ACKNOWLEDGMENT

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Children in Planning of Open Spaces

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ABSTRACT: The paper tackles the question of, what exactly is the role of children in the planning of open spaces? At a younger age children start connecting to their surroundings and are very sensitive to the changes that occur even if it's an added feature or a changed material. With the increasing need for places to stay, where does an open space for children to play in stand? What are some of the factors that lead to the functioning of an open space as a child's play area?

The data collected hints that the activities thought for children are usually restricted and structured, but from the study it is evident that Children perceive their surrounding with factors such as climate, material, texture, active free-play, enclosure that link directly to a complete olfactory experience. In the study the case studies show certain spaces that have been adapted as a play space, reflecting the said aspects.

Keywords: *Open Spaces, Play Area, Independent Mobility, Active Free-play, Enclosure, Textures.*

1. INTRODUCTION & BACKGROUND OF STUDY

In an urban setting such as now, how often do we consider a play area as a priority for children? Conveniently a chunk of open space labelled play ground is handed over to children with several restrictions such as a. time of play, b. instruments to play with, c. area available to play in, d. unmaintained equipment, amongst many others. If not handled with care this 'play area' may turn to a barren abandoned land. A housing project is not expected to revolve around an open space exclusively for children, but integration of child-friendly spaces needs to be also considered as a priority. For this study the preference children have from an open space can be understood along with some other intangible elements such as independence in movement to and from the play area. For younger age groups their parents are a guiding factor that influences most of their decisions when it comes to play. Some of the limitations that were observed is retrieving data from children as they could easily get confused by the statements/questions posed to them. Alternative methods such as paintings, and drawings were collected to get a better understanding of their image of an open space.

2. LITERATURE REVIEW

While looking at infrastructures dedicated for children, places like schools, and public parks are the main points of concentration, but these infrastructures are can beused by other people as well, there are very small pockets that can be used by children for their recreational unstructured active free play. There have been various theorisations on making the city hotspots more and more children friendly. The promotion of child-friendly city involves their independent mobility and adapt to development of streets, curbs, sidewalks, parks, and gardens that are pedestrian friendly (H.S., 2016). Having in light the ratio of children to adults this can only be in theory that a city had to be designed taking into consideration children and their imagination, but it is possible for us to include 'Child-friendly Integrated Public Spaces', the apparatus to be provided so that could be used by children, such as a dedicated area for unstructured playing and controlled recreation, dedicated areas for creative play that include activities which can enhance their skills. Another addition of shrubs, trees, bushes can enhance their experience significantly. One of the factors that matter in the usability of a space is the access to the space, whetherthe playground is accessible to children specifically on their own or if they depend on someone to take them to the place. The benefits of having independent mobility will ensure in additional physical activity as the mode of approach to the playground is by means of cycle, or walking (Chaudhury, 2017).

In addition to the contribution to physical activity, independent mobility also contributes in the overall development of children, qualities such as, logical and quick thinking, self-dependency, and indirectly contribute to development of community infrastructure. Public open space features that may be relevant for children's independent mobility including distribution of equipment, accessibility, aesthetics forming the point of interest, size and quality of the play area, and the presence of green space/greenery within, and near the play area. Children are most often considered as a vulnerable cluster

in a community mostly due to their age and maturity, but most of the traits of a child's social skill comes from the connections, and interactions they have from their childhood. Keeping this point in mind, the planning strategies of outdoor spaces has been observed to be diminishing by the day, imagine the condition of children's play areas in the densely populated areas like metropolitan cities. Hinging to this issue critical thinking needs to be put to our responsibilities towards the needs of children so thattheir interest in outdoor play does not shrink (Shi, 2016).

3. METHODOLOGY

The current expansion has been observed to be quite organic, leading to emergence of un-planned housing and un-organised open spaces. In this setting it is interesting to study children utilising open spaces available, as a space for play.

Figure 1: Site Matrix Showing the Criteria of Selection of Sites

The above matrix demonstrates the current situation in the context of Pune, India. The parameters selected are, a. type of expansion, & b. timeline of construction. These parameters were selected for understanding the condition of play-areas, if any considerations were givenfor a successful play area rom the parameters of the above matrix the sites have been shortlisted for the study relating to the study, following are the sites in discussion: as an example of the selected sites, we are looking at Adinath society under planned, & longevous to understand the consideration in open spaces, and a sprawl at Teen Hatti chowk under the current and organic. To collect qualitative data a sampling strategy was used, where age groups were clubbed to get an overview of their understanding and expectations form an open space.

The sampling for this study is done as follows:

Age 2–5 year

This age group will not be able to answer any of the questions asked by the interviewer, so the idea to collect data from them is by an interactive method which willbe more of qualitative as it would be open to the viewers for independent interpretation. Another approach is to understand the preference of their children when it comes to play areas is approaching their parents. This will lead to an interpretation of the parents and can also be a medium of understanding the Aspect of Safety as per the parents' point of view.

Age 6–9 year

Age 6–9 involve themselves in unstructured active free- play, hence children in these age group have more independent mobility and have a sense of curiosity to explore their surroundings freely. When asked about their preferred choice of play can give subsequent data in form of drawings, of an online form of multiple-choice questionnaire. The children involve themselves actively without the need of any form of adult supervision. Not depending on someone elder, these children form groups within their comfort zone and modify the space.

Age 10–12 year

The children in this age group fall into the category of 'Pre-Adolescent' where they are almost entering the stage of teenagers. Collecting data from this age group will be comparatively easier as I can involve myself in playing with them to understand their requirements, and during their play I can talk to them freely about any recommendations they feel are necessary to be done to their existing space of play.

Overlaying the data retrieved from the samples gave riseto the following factors that affect children through all categories, and developed a base of the study.

- Aspect of Climate
- Sense of Safety
- Aspect of Enclosure
- Level of Independence to travel to their playarea
- Attitude towards active free-play
- Aspect of Elements, Material, & Texture.

While these are the predominant factors that affect a majority, other factors such as the aspect of scale and proportion, specific time of play, limited elements for activities are observed to be an integral factor amongst the younger age groups.

Limitations: The study inclines more towards tangible factors with the help of intangible elements that guide us to understand the parameters necessary for developing an open space with children in mind. Collection and collation of the data has been done focusing more on thequalitative aspect than the quantitative aspect.

4. RESULTS AND ANALYSIS

The study started with the thought of 'How are open spaces for children planned?', while looking into this question another theme emerged altogether 'How are children involved in planning of spaces?'. The presentedquestion makes us think about the current scenario, of spaces 'handed out/tagged' as playground.

This segment unfolds the above-discussed factors to get a better understanding of how each of those factors affect children when it comes to an open play space, andmaking us realise how pertaining are these factors to the field of architecture.

4.1 Attitudes to Active Free-play

The interaction with children states the preference of playing indoor is preferred more that an outdoor play. The statistics hint at the willingness of children to actively participate in activities that take place in two conditions one being outdoor like on an open ground, lawn, playground, etc. or an indoor setting were thespace is more homely, familiar, and recognised as comfortable by the children.

4.2 Level of Independence

The child's ability to move without supervision has one of the most salient effects on their ability to socialise and ability to think in an emergency. Younger children (6–8 years) have less independent mobility as compared to the older children (9–12 years). The mentioned groups have stated their opinion that they are required to be accompanied by an elder most commonly for transport purposes. This dependency may cause an adverse effect on children approaching an open space for play. The different criteria which occur when it comes to the independent mobility of children, the graph states that 57% of children could feel more comfortable if a guardian accompanies them to the place of play which is 600 m or more. This shows that children of all age groups feel safer and would prefer their guardian sometimes accompany them to the playground.

4.3 Aspect of Climate

This aspect refers to the natural elements like shaded areas, the intensity of the sun, what is the climatic setting the children are most comfortable in? Apart from a materialistic approach we also have preferences for the environment we wish to play/work in. From the literature pieces it is observed that children prefer to have a shaded area to play in irrespective of the equipment. If given a choice they would prefer to play under a tree than on an open lawn (if not shaded). In '*Elizabeth Ekadashi*' (Kulkarni, 2014).

Aspect of Elements, Material & Texture: While playing, as different sports have different requirements, so do children have selective preferenceswhile it comes to active free-play. Their preference toplay in a space could also be subjected to change depending on the elements surrounding their area of playing, either natural elements like a tree, or a bushed fence over a metal/concrete fence, or man-made elements like a playing equipment, etc. Children from a smaller age

group might prefer to play or spend moretime in area that have been soft scaped, while olderchildren might find a hard surface more suitable to playon, it depends on the interests of children to where theywant to play and affects the type of unstructured activeplay they prefer.

The presented charts showcase the interests of children w.r.t. the aspect of various textures when it comes to thechoice of texture children prefer in the playground. The textures that were given to choose from were:

a. Grass/lawn, b. Sand, c. Loose Gravel, d. Paver blocks,out of which it is observed that preference to a natural material is given majority of preference which may be due to the softness of the material, whereas the least preference is given to loosen gravel where the texture is isolated and creates a sense of discomfort to the user's experience.

4.4 Aspect of Enclosure

Under this aspect the scale is looked upon, as how different scales impact the decision of children to play in it. Just for example a large open park v/s a narrow street, some children may find the park very comfortable or favourable, whereas some might like to play in an intimate space that is packed. While observing children under this aspect it is important to under the width to height aspect of the site under study. The approach here is to redefine the sense of scale from a child's point of view, and try to understand how even a small change in scale makes a difference to children and their preferenceto engage in unstructured active free play.

With these aspects in mind the 2 selected sites were looked upon for understanding the current scenario:

Adinath Society [(Longevous, and Planned; refer Figure 1)]:

This is a planned housing society that has been a mid- rise building complex. The offsets that have been left as breathing spaces are observed to be used by the children for an unstructured activity.

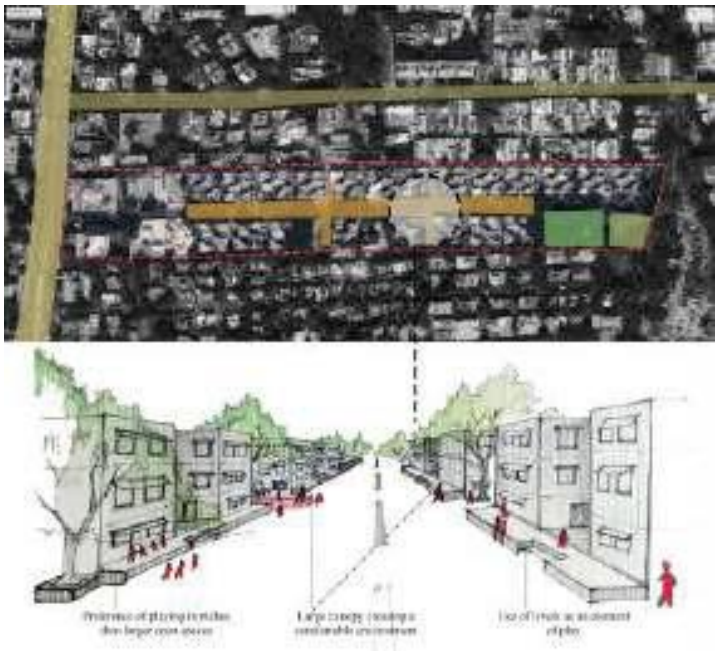

Figure 2(a): Site Analysis of Adinath Society—Pockets ofInformal Play

Sprawl at Teen Hatti Chowk [(Current, and Organic; refer Figure 1)].

The sprawl has gone through various organic growth in terms of volume, space definition, and encroachment. The key method of observation is the difference in the volume of open spaces and the preference made by children with respect to selection of space to play. Since the growth is uneven, so does the availability of open space to play in. Adding to the list of components to be fit in the enclosed area, 'parking' became a main factor. The street that forms the spine of the settlement also houses the parking area for the residents.

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Figure 2(b): Site Analysis of Sprawl at Teen-Hatti Chowk – Hierarchy of Open Spaces

The two presented sites have a potential use and a varied use of play depending on the type of activity. The striking difference that was observed in the above study was that in case of organic settlement the main space of the street had been encroached by the parking for vehicles so the space which was 4m has now become around 2 to 2.5 m., with this happening, there is a significant drop in the preference of play while these vehicles are parked, and the children resort to playing with electronic devices. However, with the area that is available with them for their play has been utilised effectively by the imagination of children. The presented analysis puts light on the preferences and willingness to play indoors, but if asked for, they express to play in an open area than be restricted in a cramped up narrow alley, the inorganic settlement expresses the unseen utilisation of spaces by children, like making use of the extended plinth, making use of the steps, using the walls as support for the basketball net, etc. In the case of the planned society the setbackleft for light and ventilation have formed active niches that children have been playing in, one factor being the limited timings of the provided garden/play area.

5. CONCLUSION

The intent of the paper was to explore and perceive an open space from the point of view of a child, their preference, need, and requirements from an open space. When an open space is linked to a child is most usuallya playground, but from the study it is observed thatthere's more to an open space than just a lawn with equipment like slides and swings. Children from different age groups have different preferences, they may most certainly vary from child to child, but there is a pattern that is consistent in the three age groups. Children aspire more from an open space that we expect, they are affected by details such as texture of theground, the sense of enclosure, presence of natural elements like trees and animals. The survey gave definitive results of what children perceive as an open space and how involved they are in their play area.

While planning an open space for children the followingfactors have to be taken into account:

- **The proportion of Enclosure:** A large ground is to be avoided where the children might feel lost. There has to be a sense of enclosure that can be formed by having structures of ratio 1:2 (1 being the height of the structure, & 2 being the width of the open space) for children to comfortably play in an open space. The volume of the surrounding structures also affects thepreference of children to play.

- **Factor of Climate:** The effect of climate plays a dominant role in children playing in space. Their play area needs to be sensitively designed so as to make themcomfortable to play in. The features that could be added in the play area will withal to the element of interest of children, these features can include different forms of plants, trees, water elements, colourful flora, etc.
- **Access to the Destination:** One of the learnings from the research was that children prefer to be accompanied by someone older to them while approaching a play area. This is primarily because of two reasons, one beingthe distance of the play area from their residence, and the other momentous factor being the journey from their play area and residence. It has been noted in several cases that the dependency has significant degradation in the confidence and development in the child's growth. While designing such spaces specially for children we need to make sure that the access to the play area needs to have as minuscule a confluence of motors as possible so that the children feel safe to travel from their residence to any destination. As discussed earlier this actor of independent mobility has a significant influence in the overall development of the child henceit cannot be neglected.

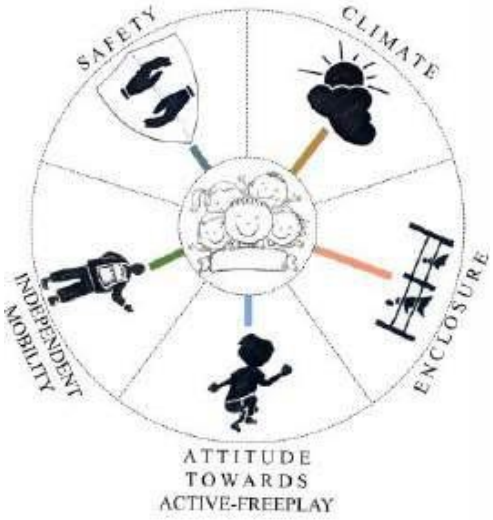

Figure 3: Aspects of Open Space for Children

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Lakshmi Relating Built Environment to Crime and Peace in Alleys of Communities

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ABSTRACT: This research proposal is focused on unwinding the concept of crime and its relation to the built environment, with keeping in mind the psychological factors facilitating it. The scope of study is limited to compact 'alley-ways'—for a preferable visual frame. The methodology is to start by listing spaces with crime already committed. The independent variables are varying, which is to be solidified via survey.

This research will help in understanding the tangible criminal enablers better—that can be avoided in the planning stage itself by listing the components that need a preventive measure to be implemented. Visual surveys are to be the major tool, with a questionnaire targeting unbiased participants residing far from the space in question, to receive observational opinions. The relationship between built environment and status of violent crime committed—if any, is to be revealed as a conclusion to this study.

Keywords: *Crime, Alley, Fear, Built, Proportion, Visual.*

1. INTRODUCTION & BACKGROUND

The concept of an alley can be conceived as one of the oldest forms of land for common public use, and thus one of the richest sites to understand social relationships between people (Rebecca 2019). There have been studies to understand alleys in Japan ('roji') and Shanghai ('lilong') as informal community spaces. (Ima Heidi, 2015; Non-Arkaraprasertkul, 2013). In the city of Covington, Kentucky—honey cart alleys (3 to 5 feet wide), 10 to 15 feet wide service alleys, and 20 to 24 feet center access alleys are omnipresent (Paul Voos, 1993). Hence, passing time always brought with it a new functionality for the typical 'alley-way'.

An alley is usually perceived to be a space with a negative impact—the uncertainty in management and ownership to the said shared spaces, create convenient opportunities for crime (Aiden Sidebottom, 2017). Among the locational typologies of alleys, back alleys—present in high density cities providing services for major urban blocks—are often overlooked by the urban authorities (Bin Jiang, 2017).

Research Questions asked: First of all, why is it that some spaces have more factors contributing to crime than the others? Secondly, what is the relationship of the built environment to the crime committed?

Aim: To state the relationship between built environment and the status of crime committed, considering the factor of fear.

Objective: To let observers share their unbiased opinions, which are to be analyzed to formulate a pattern.

Limitations: The concept of an 'alley' has been put into use majorly in countries outside of the Indian context. Whenever this term is taken up henceforth, the scope of the research paper is to be taken into consideration.

Scope: An 'alley', 'alleyway' or 'alley-way' when mentioned in this research paper, has been defined by its function—which is anything which provides rear access to an urban block.

2. LITERATURE REVIEW

Photograph surveys have been actively contributing in studying the safety of alleys in order to come up with respective preventive measures (Mona Seymour, 2010). The Likert scale can be a means to analyze the safety perceptions of a certain space via imagery—which ranges from "very unsafe (1)," "unsafe (2)," "uncertain (3)," "safe (4)," to "very safe (5)" (Bin Jiang, 2017). The methodology is to list all the visible characteristics of a photograph in order to narrow down to the most

common ones affecting the perceptive fear. Crime can be broadly categorized into—standard violent crime (homicide, criminal sexual assault, robbery, assault); property crime and non-index crimes (Erica N. Morrow, 2000). This paper limits itself to standard violent crime.

A Research Gap: As identified, there is to be a holistic understanding of tangible criminal enablers, suiting locational typologies universally. Which among the previously studied independent variables (Frances E. Kuo, 2001; Thomas D. Stucky, 2009) holds the most importance?

3. MATERIAL AND METHODOLOGY

The sites chosen, depend upon its status of crime. Researchers have always based the criminal mind to recurring patterns of conduct. The source of information ideally needs to be abundant—to be narrowed down to what is required for the study. Hence, unbiased information is to be prioritized. Podcasts, documentaries by third parties, video recordings by bystanders, police documents (Frances E. Kuo, 2001; Thomas D. Stucky, 2009) etc. are to be given a positive consideration. News reports, court statements, self-documentaries are to be avoided.

- ***Sources of Information:*** The notable ones were true crime podcasts (Rotten Mango, Crime Junkie), police websites (Cleveland, Ohio), video recordings by bystanders and documentaries (YouTube).
- ***Selecting the Main Case Study:*** By accessing all the sources as mentioned, 5 crime scenes (alleys) in varied geographical locations—preferably in low-crime areas (Flowchart 1) are to be listed. Rear access alleyways in the cities—New York, Sydney, Ohio, South Korea, and Moscow are chosen—also considering the abundance of Google Street Views. The alleys are all to be constant in their width—4m—always towards the rear of an urban block. This would help in the synthesis of a uniform sampling. Each crime scene is to have a distinct land use adjacent to the alleyway.
- ***Formation of the Sampling*:** Within a geographical radius of 600 m of the 5 previously collected sampling, 3 other scenes for each are to be selected—each of these abiding to the same land use as that of the original 5 scenes. They may or may not be a crime scene (Flowchart 1). It is to be noted again that their width 4 m is to remain constant throughout. The overall sampling hence consists of 5 categories of different locational and land use typologies, each having 4 sub-categories.

Flowchart 1: The Methodology

Source: By the author.

- ***Formation of the Questionnaire:*** Having formed the sampling, the questions need to direct the study to find the relationship between built mass and the status of crime committed. To holistically gain the first impression of the participants, the major questions asked were: first of all, how safe does one think a particular alley is—on a Likert Scale (Bin Jiang, 2017). Why does one think that way—independent variable(s) making up the alley personality (Paul Voos, 1993) need to be selected? Secondly, in which of the alley(s) in the figure (Figure 1–5) do you think is a crime scene?
- ***Dependent Variables:*** Crime (standard violent crime), Safety.
- ***Initial Independent Variables:*** Location, land use.
- ***Final Independent Variables:*** (To be the result of the methodology.)
- ***Constant Variables:*** The width of the alleyway—4 m.
- ***Photographic elements:*** The time of the day showcased on the crime scene is to be according to that of the crime documented. The rest of the sampling does not follow any such rule and are results of Google Street Views.

Figure 1: Commercial and Residential: Kew Gardens, New York

Source: Google Earth street views.

(a) Main case study: Tudor building
(Crime scene—Kitty Genovese murdered).
(b) 125–1231 83rd Drive (Not a crime scene).
(c) 116–17 Grosvenor Lane (Not a crime scene).
(d) 84–17 Abingdon Road (Not a crime scene).

4. RESULTS AND DISCUSSION

***The Questionnaire*:** A sample size of 40 participants, via Google forms. 11 of them were aged 12–18 years. 16 of them were 19–25 years. The remaining 13 fell were 26–55 years. The location of the alleys (Figure 1–5) were not revealed, to maintain unbiased opinions solely on physical characteristics. Each image went under 3 stages. The order of the questionnaire: Stage 1: Figure 1(a). Stage 2: Figure 1(a). Stage 1: Figure 1(b). Stage 2: Figure 1(b). Stage 1: Figure 1(c). Stage 2: Figure 1(c). Stage 1: Figure 1(d). Stage 2: Figure 1(d). Stage 3: Figure 1(a)-(d) so on to Stage 1: Figure 2(a), finally to Stage 3: Figure 5(a)-(d).

Figure 2: Commercial and Commercial: Mosman, Sydney

Source: Google Earth street views.

(a) Main case study: 82 Military Road
(Crime scene—Gwendolin Mitchelhill murdered).
(b) 66 spit Road (Not a crime scene).
(c) 32 Hordern Lane (Not a crime scene).
(d) 126 Kemble Lane (Not a crime scene).

Figure 3: Residential and Residential: Toledo, Ohio

Source: Google Earth street views.

(a) Main case study: 700 Utah Street
(Crime scene—David Fishbein attacked).
(b) 864 Utah Street (Not a crime scene).
(c) 542 Milton Street (Not a crime scene).
(d) 656 State Route (Not a crime scene).

Stage 1: Fear of Crime

The participants were to answer how safe an alley felt on a scale from 0 (Unsafe) to 5 (Feels the safest). Scale rating 2 and 3 are neutral values. This provides the participant with an opportunity to rethink, for an answer closer to the two extremities. The results show the actual crime scene not necessarily making a person feel the most unsafe (Table 1). For e.g., Figure 1(a) & Figure 5(a) one of the most notorious, but 14 participants (accounting to 35% of the total) rated it a 4 out of 5—safer than neutral. But there is a factor keeping the crime scenes from being rated the safest.

Figure 4: Agricultural and Agricultural: Hwaseong-si, South Korea

Source: Google Earth street views.

(a) Main case study: Ridge between paddy fields
(Crime scene—Lee Kyu-sook murdered).
(b) Ridge between paddy fields (Not a crime scene).
(c) Ridge between paddy fields (Not a crime scene).
(d) Ridge between paddy fields (Not a crime scene).

Figure 5: Residential and Open Spaces: Academicheskaya, Moscow

Source: Google Earth street views.

(a) Main case study: Tudor building
(Crime scene—Natalia Pronina murdered).
(b) Same neighborhood (Not a crime scene).
(c) Same neighborhood (Not a crime scene).
(d) Same neighborhood (Not a crime scene).

Table 1: Stage 1, Stage 2: Cells Highlighted in Green Showcase the Most Popular Choice

No. of responses	**Figure 1 (Commercial & Residential)**						
	0 (Feels unsafe)	**1**	**2**	**3**	**4**	**5** (Feels the safest)	**Independent variables affecting Fear of Crime**
a: Actual Crime Scene	1	2	7	8	14	8	Type of adjacent building (50%)
b	0	2	5	11	14	8	Type of adjacent building (47.5%), No. of windows adjacent (35%)
c	1	5	9	16	6	5	Type of adjacent building (52.5%)
d	0	7	6	12	11	4	Width of alley (42.5%), Vegetation present (30%)
No. of responses	**Figure 2 (Commercial & Commercial)**						
	0 (Feels unsafe)	**1**	**2**	**3**	**4**	**5** (Feels the safest)	**Independent variables affecting Fear of Crime**
a: Actual Crime Scene	2	3	4	11	11	9	Type of adjacent building (50%), Width of alley (50%)
b	0	3	4	4	8	21	Width of alley (72.5%)
c	1	14	8	9	5	3	Width of alley (57.5%)
d	3	4	9	12	7	5	Width of alley (62.5%)
No. of responses	**Figure 3 (Residential & Residential)**						
	0 (Feels unsafe)	**1**	**2**	**3**	**4**	**5** (Feels the safest)	**Independent variables affecting Fear of Crime**
a: Actual Crime Scene	5	6	8	10	5	6	Vegetation (87.5%)
b	1	3	2	2	11	21	Type of adjacent building (72.5%)

c	7	10	10	6	5	2	Width of alley (62.5%)
d	5	5	3	8	12	7	Type of adjacent building (55%)
No. of responses	**Figure 4 (Agricultural & Agricultural)**						
	0 (Feels unsafe)	**1**	**2**	**3**	**4**	**5** (Feels the safest)	**Independent variables affecting Fear of Crime**
a: Actual Crime Scene	4	3	7	10	9	7	Destination it leads to (60%)
b	0	5	8	12	10	5	Vegetation (70%)
c	4	14	7	6	9	0	Destination it leads to (55%)
d	6	5	8	7	10	4	Destination it leads to (72.5%)
No. of responses	**Figure 5 (Residential & Open)**						
	0 (Feels unsafe)	**1**	**2**	**3**	**4**	**5** (Feels the safest)	**Independent variables affecting Fear of Crime**
a: Actual Crime Scene	2	4	6	11	14	3	Vegetation (60%)
b	8	8	11	5	5	3	Type of adjacent building (47.5%), Width of alley (47.5%)
c	3	12	9	9	4	3	Vegetation (55%)
d	8	9	6	8	5	4	Vegetation (80%)

Source: By the author.

Stage 2: Independent Variables Affecting Fear.

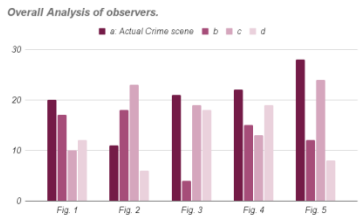
Every important physical variables as proved to be important to the personality of the alley (Paul Voos, 1993) were to be listed. The most appropriate and impulsive option led to them rating the same places either positively or negatively in Stage 1 (Table 1). For example, Figure 1(a) being rated one of the safest places was justified with the presence of commercial buildings adjacently—Figure 4(c) being rated as one of the least safe alleys was because of the destination it led to.

Due to the availability of choosing more than one options, 'width of alley' was chosen 158 times. 'Vegetation'—153 times. 'Type of adjacent building'—150 times. 'Destination it leads to' in case of Figure 4(a)-(d)—75 times. 'No. of windows adjacent'—14 times. These variables make up to more than 50% of the responses, of each image in *Figure 1–5,* and thus are the only ones highlighted.

There was an option to write extra observations. For Figure 1(a) one mentioned how the open space (parking) on the opposite side was uncomfortable. "Only because there are commercial spaces below, the space looks safe; it they weren't there, the heights would be scary", said another. For Figure 4(c) one participant said how the area seemed so dry, and hence added to the discomfort—whereas one person stated how the nets and fencing links the scene to recent human activity, making it seem safe. These were in line with physical attributes, hence hinting a direct link of built environment to the fear of crime.

Stage 3: Crime Scene Predictions

The third stage evaluates the predictions of the different age groups—ranges: 12–18 years; 19–25 years; 26–55 years—where all four images of Figure 1–5 are placed adjacent to each other, and they are asked to guess the crime scene(s).



Flowchart 2: Stage 3: Overall Responses

Source: Author.

Table 2: Stage 3: Cells Highlighted in Red Show which Images Gained the Maximum Votes

Age Group	*No. of Responses*	*Fig. 1*	*Fig. 2*	*Fig. 3*	*Fig. 4*	*Fig. 5*
12–18	**a:** Actual Crime Scene	3	4	5	6	9
	b	8	4	1	4	3
	c	3	7	8	5	6
	d	5	1	6	6	3
19–25	**a:** Actual Crime Scene	9	3	11	13	12
	b	5	10	1	9	7
	c	5	10	6	4	9
	d	5	3	7	7	3
26–55	**a:** Actual Crime Scene	8	4	5	4	6
	b	3	5	1	2	3
	c	2	5	5	4	7
	d	2	2	5	6	3

Source: By the author.

The result (Table 2) reveals a pattern, where participants under the age 18 and those older than 26, have partially succeeded in identifying the crime scenes—only 2 out of 5 crime scenes were chosen by majority. Majority of the participants between 19-25 years have correctly identified most of the crime scenes—4 out of 5. In this age range were 8 architectural students out of the total 16 participants. The rest were students in miscellaneous fields of study.

Looking at the overall responses (Flowchart 2), combining all the age groups, the results state that the majority have guessed the correct alleys with the criminal past—all except one (Figure 2(a)). The one crime scene which was not guessed right, was chosen by a surprisingly low amount of participants.

Expected Outcome

Stage 1 was the first impression of the participant to a certain built environment and thus captured their feelings in a raw form. No crime scene was voted as the safest on the scale by any majority. Stage 2 highlighted 5 independent physical variables in the order of preference are 'width of alley', 'vegetation', 'land use', 'destination it leads to', 'number of windows'. Stage 3: Considering the obliviousness to locations, the crime status and the number of crime scenes (1 out of 4), the pattern of the results achieved on the other four samplings (Figure 1, 3-5) are very close to the ideal result.

Unexpected Outcome:

Stage 1 marked a majority of crime scenes under the safer categories, making the link of the fear and actual crime weaker.

Stage 2: 'Width' was the constant variable of this study—4m.

Stage 3: Figure 2(a) was voted very low as the crime scene, which seems to fade the link to the ideal result expected.

Justification of Findings

Stage 1 being the agent of the first impression—never saw a crime scene rated the safest, and hence justifies how there are still factors existing, preventing it to be perceived as safe. Stage 2 highlighting 'width of alley' as one of the most chosen independent variables—which keeps changing—can only mean that due to the adjacent building heights, the width appears to change image to image making the alley 'congested' or 'open'. Stage 3: Figure 2. can help us understand that the result might have changed due to the adjacent portrayal of all the images of the sampling data—where the alley receiving the most nominations (Figure 2(b)) seems to have a consistent pattern of chosen variables (Table 1) to that of Figure 1(a)—another crime scene—the variable being 'land use'. Hence, it can be safely stated that if there exists an alley which does not have a criminal past, but is deemed unsafe, it automatically holds potential for criminal activities.

5. CONCLUSION

'Width of alley' can be translated to 'proportion of height to width'—due to width being constant throughout. It is the most important physical independent variable and deciding factor of fear of crime. Through a new lens—to find the most probable crime scene within many alleys—the prediction is mostly always right owing to the variables derived while analyzing the fear of crime. Hence, fear of crime is indirectly proportionate to the actual status of crime.

Strengths of the Study: One should note that this study fills the research gap in providing a more holistic view on the variables and factors affecting crime—the study areas are completely different to each other yet provide visibly ideal answers. One can also refer to this study as a model with a strong justification as to why the independent variables are listed as they are—they were chosen after a major analysis of different users.

Weaknesses of the Study: The study is focused on 'alleys', which are only a small part of the urban whole.

Possibilities of Applications: An alley—to be considered as a unit –can be form clusters to make a difference to the urban whole.

Recommendations & Scope for Future Research: From how to make an alley seem less congested than it is—by reducing the building height; to street design interventions on rear alleys, the scope in The Indian context is vast.

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Proportioning Systems of Openings Material and Climatic Response of Houses of Maharashtra

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ABSTRACT: Designing of houses is a collaborative craft of understanding the user needs, balancing the structural requirements and associative space-making; whilst appraising the exterior façade. The openings are an effective tool in achieving personalized user space associative to the set of doings in the space, end-user privacy, climatic considerations, and so on. There is an existing typology of openings in respective areas of a city or a state. There is a scope to understand the core of these proportions and their evolution over the time. The material technology and its limitations, the climate of the particular area and the respective design decisions taken and impact of various styles of architecture can be assessed and comparative analysis of these cases can be overviewed. A comprehensive study of such factors can give a clear perspective of the approach to planning and placement of openings in traditional houses. Evaluation of the traditional window proportions can be undertaken through various lenses of function of the void, material of construction, the belief system of the respective culture, etc. The learning of this tradition of changing proportions would help understand context-specific, time-specific and material-specific designs of openings. At the same time, it would help in understanding closely the 'unconventional housing designs' and what 'breaking out of the barriers of traditional proportions' exactly means; since we would be learning that over the years the designs have changed specific to the context.

Keywords: *Proportions, Materials, Windows, Context-specific, Evolution.*

1. INTRODUCTION

A typical watcher, when takes note of a structure, one is drawn towards noticing its general style without taking a lot of notice of the spatial course of action, portion of openings and envelope and climatic reaction. Other factors like spatial arrangement, development method and offer on openings against the shut envelope can be explored under a design understudy. Along with these essential perspectives, is the quality and character of its interiors. At that point one can attempt to relate this spatial character to the social climate during its occurrence and the detailing in the fenestrations that are the eyes of a building which relate the outside world with the inside, it orchestrates and oversees the light and along these lines sets the climate of the inside (Window as an Element of Architecture, April–June, 2016). In designing of the openings and understanding their sizes and occurrence of those proportions, goes an exhaustive understanding of the traditional approach on designing and climatic considerations. With increasing modernisation, the proportioning systems of openings of houses have undergone considerable transformation. Sometimes this leads to a complete disconnect with the heritage language of the local area. The research would provide an insight to the designers in the form of a pre-study of the traditional houses and various influences on their planning. The selected sites include major cases of Maharashtra, especially Pune. The traditional housing typology of the city mainly includes Wadas, which has a vast range differences in construction technique as well as material use. The selected cases are chosen on the basis of these very differences with a common physical context yet variations in the social climate at different time periods.

The research paper centres around comprehension and dissecting conventional structure fenestrations, which will help in deciding the practicality for its application in contemporary ventures. It investigates instances of fenestration plans receptive to the way of life of the user, prevailing construction methodology and environment. There is inclusion of analysis in the form tables which indicate the ratios of openings to the human statures and the module of construction which comprehensively add importance to those extents and their position in the overall structure.

The inferences are an overall understanding of the proportions through the lens of various building technology aspects and divided into four heads which creates value to the portions of and extents of fenestrations.

2. LITERATURE REVIEW

In order to understand a specific component of a built-form and the parameters of its positioning, sizing and detailing, it is necessary to do a comparative overview. This overview will serve two purposes—evaluate the proportioning systems of the openings and help in understanding the importance of factors such as local skills, culture and beliefs in planning and designing of these distinct openings. Analysing continuity and change to hypothize over the future is an important part of traditional studies. The cycle and parameters administering the change is the major concern of research studies related to evolutions. (Kotharkar, March, 2012)

To move ahead with research, some writing studies were attempted for refining methodology and drawing credible inferences. An overview of Maharashtrian Architecture by D. Narendra, draws an interrelationship between built form and belief system to qualitative heights and stresses upon how traditional architecture acts as a valuable source of inspiration for contemporary designs. Understanding these values in a quantitative measure in terms of modules will help the designers in application of modules in contemporary fashion. The purpose of hypotheses of study is cite connect between components in visual development. With the need to understand the disappearing sensitivity towards the holistic planning approach, the study of transformations in traditional house-forms by R. Kotharkar, attempts to address the social stratification and cultural roots of a specific region and the change that it undergoes with the advancement in technology. This evolution of these forms is inevitable but the earlier changes took place gradually with time and change in the use of the space. With increasing pressures of modernization, certain sudden changes in living as well as planning have occurred. This shift is strongly reflected in the change in built form typology and it's disconnect with the local material, skill sets, cultural beliefs and construction techniques.

Window is a sign of human life, the eye of the building, a source of fresh air and sometimes place of exchange of words and smells but also break in wall's structural continuity and thus a place of vulnerability (Val, 1979). Fenestration is an interface between the outside and inside. The intricacies of elements of fenestrations have expanded over the period of time. Traditional culture, craftsmanship and information find very less spot in today's designs. There is a missing connect between the traditional and contemporary design, of which these openings remain as proof. The explanation of windows and its relativeness to the context with respect to social, cultural, climatic and user interfaces is very rightly put by K. Rewatkar where he stresses that the structure of the window, its composition, image-making quality relies on numerous factors including the climate, society, materials, development methods and cultural convictions.

The size and area of the opening varies with its use (Lotankar Hemal, January 2016). The shift with incoming modern needs has resulted in mass produced urban structures in the region which do not respond to the native climate, ecology, cropping pattern, soil and community needs. It is important to understand the importance of vernacular techniques before it is too late and we completely deteriorate the quality of environment. There is an urgent need to understand the change, by understanding the process of change and the major factors governing it.

3. RESEARCH METHOD AND METHODOLOGY

By and large, the investigation of transformations is conducted through two expansive stages; first looking for the 'traditional core' and later discerning 'continuity and change' of the 'traditional core' (Kotharkar, March, 2012). In the traditional built forms, most of the invariable factors remain unchanged and forms the basis of comparison with variable factors like social setting, user and the use. The research aims at documenting the factors, which decide the proportions of a openings and happening in a particular period; together to develop a holistic approach towards the understanding of proportioning systems and its climate responsiveness, material techniques and function. To understand these factors, some samples of residential built-forms from Pune City were studied and analysis was drawn by studying the elevations and sizes of openings planned for different spaces, different levels and different orientations. These parameters are further dissected through verbal conversations with the users and visual learnings through site visits.

The sampling was done, primarily on the basis of shortlisting residential built-forms of a particular period; which respond to the day-to-day activities and clearly demonstrate the aspects of cultural, social and spatial relevancies. The samples were such selected that they are situated in the temporal context of Pune from 1700s to the 19th century. Locating all the samples in the state of Maharashtra, a typical Maratha house formed the basis for sampling supported by their common location in the Core area of the prime city of Pune.

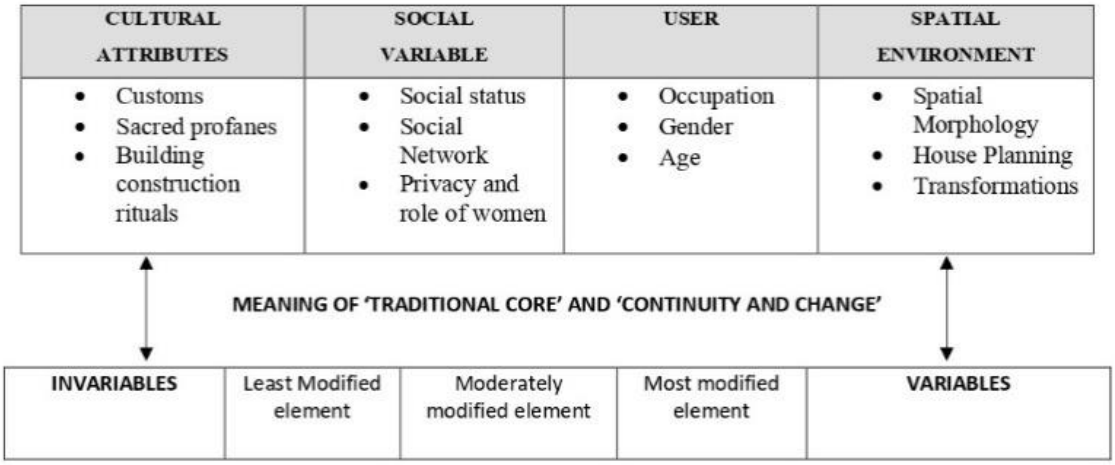

Figure 1: Attributes to Analyse Traditional House-forms

(*Courtesy:* Author)

An attempt to understand the qualitative factors related to the samples; such as customs practised in the earlier times, belief systems, spatial morphology and privacy and social credence; was done through interviews and conversations with current users and understanding the history of the area. The quantitative factors were analysed through observation on site visits and fine study of the proportions through measurements and estimations. For making these estimations two modules are considered, namely, a Human module (X); which denotes the human height of 1200 mm and the human expanse of 600 mm; and the Material module (Y) which is the stone or the brick size. The sizes of openings are related to these modules to get the proportions and further relate them to factors like use, light, privacy, etc.

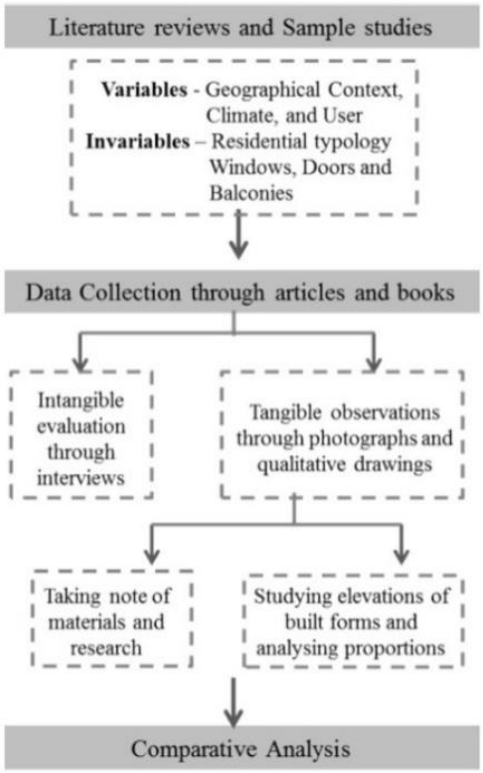

Figure 2: Methodology Chart

(*Courtesy:* Author)

Detailed case studies can help cite various differences in proportions in the same context or vice-versa. The selected case studies are Sathe Sadan (roughly in 1600s), Raste Wada (1784), and Nana Wada (1780). The samples are located in the core area of Pune city, in Kasba Peth, Rasta Peth and Budhwar Peth, respectively. Sathe Sadan is the oldest sample, which is a dry brick masonry load bearing construction, followed by evolving technique of framed wooden construction in Raste Wada and further stone masonry construction in the majestic Nana Wada.

The scope of evaluation extends to learning of intangible influences through interviews. In view of an observation overview and literature reviews, the boundaries for near investigation were planned for the comparative study. Limited data about a particular timeline, restricted movement to certain locations, changing factors in every case may lead to inefficient comparison. Some research questions that are expected to be answered through the paper are the factors affecting a certain proportion of an opening, the scope to understand these proportions visually and reason it considering various factors and what the size of opening does to the interior spaces. Interviewing questions focused upon procuring data related to the late use of the spaces and the use in current times, the age of the structure, the owner at the time it was built and any additions or modifications done.

4. DOCUMENTATION AND DISCUSSION

To understand the proportioning system, case studies of three distinct hous-forms was undertaken. The first case study is of Sathe Wada located in the Kasba area of Pune. The Wada was built around 1600s when its primary use was a residential. It is a house built in dry brick construction as informed by Smt. Aahilyabai—a current resident. The structure is a Ground+1 structure with protruding balcony on the first floor supported on the wooden floor beams typically 100 mm × 100 mm in section placed on the loadbearing wall of 300 mm brick thick. There are living rooms on either side of the entrance with private rooms placed along a 750 mm wide passage which terminates into an open-to-sky courtyard. The doors and windows opening into the courtyard are proportioned such that they are supported on a single horizontal wooden post placed on the bricks and they ventilate and generously lighten the space in the interiors of the room. The openings on the upper floor are such sized that one can sit on the sill plank and have a clear headroom of 600 mm.

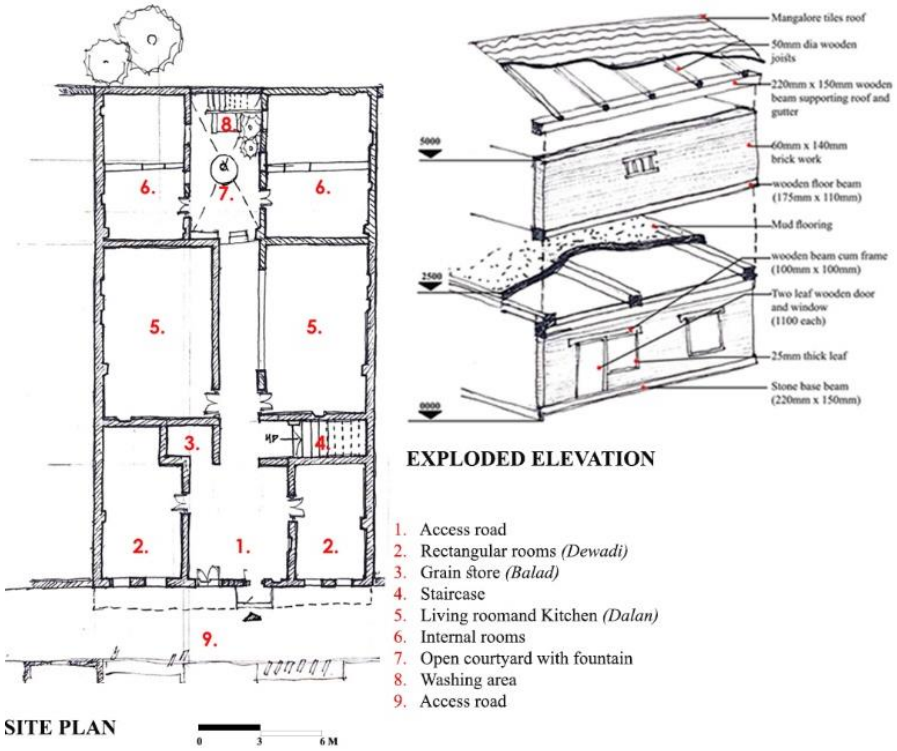

Figure 3: Case Example 1. Sathe Sadan, Kasba Peth:
Plan and Exploded Elevation Showing the Materiality and Construction Details

(*Courtesy:* Author)

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LEVELS	MODULE	CONSTRUCTION MATERIAL	SPANNING MEMBER AND SIZE	F-T-F HT.	OPENING SIZE	OPEINING TYPE	FUNCTION
GROUND FLOOR– RESIDENTIAL INDIVIDUAL ROOMS WITH COMMON HALLS	HUMAN HT (X) - 1500 MM BRICK SIZE (Y) – 140 x 60	LOADBEARING BRICK MASONRY WALLS WITH EXPOSED BRICKS AND INTERMEDIATE WOODEN TIE BEAMS	WOODEN BEAM – 100MM X 100MM DEEP BETWEEN VENTILATOR AND DOOR	2.5 M (1.6 X)	1650MM X 750MM (1.1 X) WITH VENTILATOR OF 350MM X 750MM SPAN – 12 Y HEIGHT – 6 Y	COMMON DOOR AND WINDOW FRAME WITH INTERMEDIATE RODS FOR WINDOWS AND VENTILATORS CONNECTING BOTH STARTING AT FLOOR LEVEL AND LINTEL AT 1650 (1.1 X)	Private rooms. Ventilation purposes and maintaining privacy in the interiors.
FIRST FLOOR - INDIVIDUAL ROOMS	HUMAN HT (X) - 1500 MM BRICK SIZE (Y) – 140 x 60	LOADBEARING BRICK MASONRY WALLS WITH EXPOSED BRICKS AND INTERMEDIATE WOODEN TIE BEAMS	WOODEN LINTEL AND SILL BEAM- 100MM X 100MM WITH OPENINGS SUPPORTED BETWEEN POSTS – 800MM SECTION	2.5 M (1.6 X)	1350MM X 750MM (0.9 X) SPAN – 12 Y HEIGHT – 6 Y	40MM THICK - OPENABLE PANELS STARTING AT 550MM (0.4 X) AND LINTEL AT 1900MM (1.2 X)	Private rooms. Ventilation purposes and maintaining privacy in the interiors.

Figure 4: Case Example 1. Sathe Sadan, Kasba Peth: Analysis Table of and Opening Sizes and Proportions

(*Courtesy:* Author)

Figure 5: *Case Example 1.* Sathe Sadan, Kasba Peth:
Graphical Representation of Proportions with Respect to Human Height as a Module (X) and Opening Sizes

(*Courtesy:* Author)

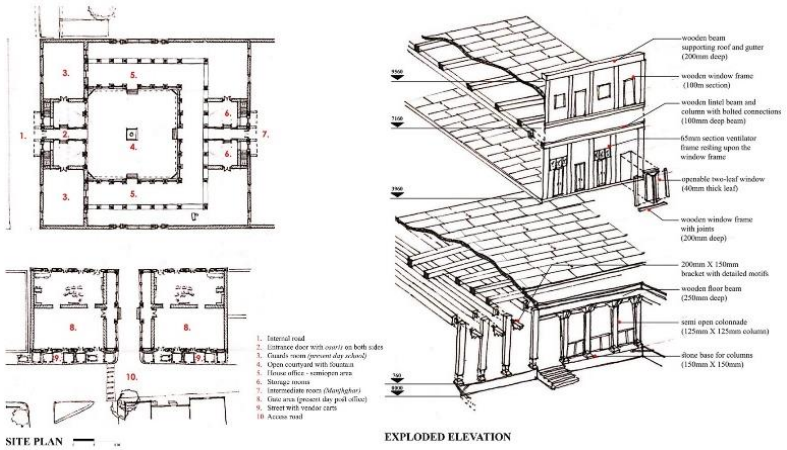

Figure 6: *Case Example 2:* Raste Wada, Rasta Peth: Plan and Exploded Elevation
showing the Materiality and Construction Details

(*Courtesy:* Author)

Another case example is of the Wada which was built in 1779–1784 by Sardar Anand Rao Raste. The Raste Wada is located in Rasta Peth in Pune. There are clear evidences of the walls being made from stone and covered with lime-plaster. The columns typically have a stone base with a 150 mm × 150 mm cross-section wooden post supporting the brackets with decorative motifs. The main framing members are in wood and the flooring is supported by wooden planks. The Wada is a purely residential typology which was built when Sardar Anand Rao Raste was in power. The ground floor consists of a semi-open space lined with columns which was majorly used for gatherings and administrative work by the men. The upper floor has linear arrangement with huge halls of around 40 ft. × 20 ft. used by the women for daily chores and these halls are lined with some rooms for storage and services. The third floor has private rooms used only for sleeping during the 1700s.

LEVELS	MODULE	CONSTRUCTION MATERIAL	SPANNING MEMBER AND SIZE	F-T-F HT.	OPENING SIZE	OPEINING TYPE	FUNCTION
GROUND FLOOR– INTROVERT COURTYARD SPACE (men)	HUMAN HT (X) - 1500 MM BRICK SIZE (Y)	WOODEN FRAME WITH BRICK WALLS AND LIME PLASTER, STONE FLOORING	WOODEN BEAM - 150MM X 200MM DEEP	3.2 M (2.1 X)	1400MM X 3000MM (2 X) WITH RAILING HEIGHT OF 1000MM	COLUMN TO COLUMN OPENINING STARTING AT FLOOR LEVEL AND LINTEL AT 3200MM (2.5 X)	Semi-open colonnade area mainly used by men for administrative work. To maintain the micro-climate on the lower most floor and for better visibility
FIRST FLOOR - COMMON HALLWAYS FOR ACTIVITIES (women and men)	HUMAN HT (X) - 1500 MM BRICK SIZE (Y)	WOODEN FRAME WITH BRICK WALLS AND LIME PLASTER, WOODEN PLANKS WITH MUD BELOW	WOODEN LINTEL – 100MM DEEP BEAM WITH CONTINUOS FRAME	3.2 M (2.1 X)	800MM X 1600MM (1.3 X) WITH VENTILATORS OF SIZE – 800MM X 1400MM	40MM THICK - OPENABLE PANELS WITH VENTILATORS ON ALTERNATE WINDOWS STARTING AT FLOOR LEVEL AND LINTEL AT 1600MM (1.3 X)	Elongated hallways aligned with rooms and windows which are aligned with the main gate-built form. Used by women sitting for household chores and gatherings.
SECOND FLOOR – LIVING ROOMS	HUMAN HT (X) - 1500 MM BRICK SIZE (Y)	WOODEN FRAME WITH BRICK WALLS AND LIME PLASTER, WOODEN PLANKS ON SUPPORTING BEAMS	WOODEN LINTEL – 100MM DEEP BEAM WITH CONTINUOS FRAME	2.4 M (1.6 X)	600MM X 800MM (0.5 X) WITH 75MM c/c BARS	40MM THICK OPENABLE LEAVES WITH FIXED RODS TO THE FRAME. SILL AT 600MM (0.4 X) AND LINTEL AT 1400MM (0.9 X)	Private rooms for the residents Mainly for a peep and ventilation purposes.

Figure 4: *Case Example 2:* Raste Wada, Rasta Peth: Analysis Table of and Opening Sizes and Proportions

(*Courtesy:* Author)

Figure 7: Case Example 2. Raste Wada, Rasta Peth: Graphical Representation of Proportions with Respect to Human Height as a Module (X) and Opening Sizes

(*Courtesy:* Author)

The third case study is of Nana Wada which is one of the very few Wadas of the city, built in ashlar stone with perfectly partitioned elevation with arches. The Wada was built in1800s by Nana Phadanvis who was the then chief officer of the Peshwa dynasty. The load bearing structure has three floors with major administrative activities happening on the first and the second floor. The openings are seen arched with segmental arches with a grilled semi-circular window on the top and rectangular wooden framed opening at the bottom. The windows are majorly of the same height and forms the uniform façade for the Wada. There are huge piers at the junctions of the load bearing walls and the windows offsets of the arch are painted in white forming a distinct character whilst highlighting the beautiful motifs in the ventilator grill.

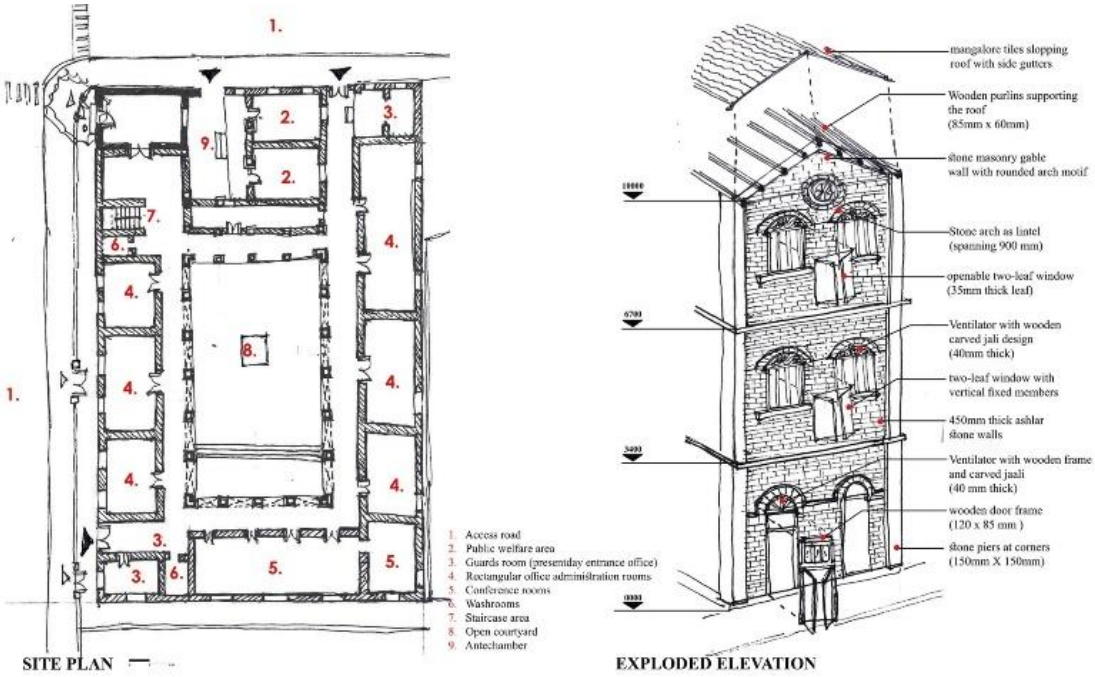

Figure 8: Case Example 3. Nana Wada, Budhwar Peth: Plan and Exploded Elevation Showing the Materiality and Construction Details

(*Courtesy:* Author)

LEVELS	MODULE	CONSTRUCTION MATERIAL	SPANNING MEMBER AND SIZE	F.T.F HT.	OPENING SIZE	OPENING TYPE	FUNCTION
GROUND FLOOR– INTROVERT COURTYARD SPACE	HUMAN HT (X) - 1500 MM BRICK SIZE (Y) – 85mm ht.	STONE ASHLAR MASONRY WITH INTERMEDIATE PIERS AND ARCHED OPENINGS.	SEGMENTAL AND LANCET ARCHES (SPAN - 0.45 Y to 0.6 Y) WITH WOODEN FRAMES	3.3 M (2.2 X)	900MM X 1350MM (0.9 X) WITH VENTILATORS OF SIZE- 900MM X 650MM	40MM THICK - OPENABLE PANELLED WINDOW WITH INT. RODS AND VENTILATORS STARTING AT 600MM (6 Y) AND LINTEL AT 1950MM (9 Y)	Semi-open colonnade area used for administrative work. To maintain the micro-climate on the lower most floor and for better visibility.
FIRST FLOOR – ROOMS WITH LOOPED CIRCULATION TOWARDS THE CENTRAL COURT	HUMAN HT (X) - 1500 MM BRICK SIZE (Y) – 85mm ht.	STONE ASHLAR MASONRY WITH INTERMEDIATE PIERS AND ARCHED OPENINGS.	SEGMENTAL AND LANCET ARCHES (SPAN - 0.45 Y to 0.6 Y) WITH WOODEN FRAMES	3.3 M (2.2 X)	900MM X 1350MM (0.9 X) WITH VENTILATORS OF SIZE- 900MM X 650MM	40MM THICK - OPENABLE PANELLED WINDOW WITH INT. RODS AND VENTILATORS STARTING AT 600MM (6 Y) AND LINTEL AT 1950MM (9 Y)	Rectangular rooms with windows opening in the circulation area. For ventilation and easy visibility for the visitors to the interiors.
SECOND FLOOR – ROOMS WITH LOOPED CIRCULATION TOWARDS THE CENTRAL COURT	HUMAN HT (X) - 1500 MM BRICK SIZE (Y) – 85mm ht.	STONE ASHLAR MASONRY WITH INTERMEDIATE PIERS AND ARCHED OPENINGS.	SEGMENTAL AND LANCET ARCHES (SPAN - 0.45 Y to 0.6 Y) WITH WOODEN FRAMES	3.3 M (2.2 X)	900MM X 1350MM (0.9 X) WITH VENTILATORS OF SIZE- 900MM X 650MM	40MM THICK - OPENABLE PANELLED WINDOW WITH INT. RODS AND VENTILATORS STARTING AT 600MM (6 Y) AND LINTEL AT 1950MM (9 Y)	Rectangular rooms with windows opening in the circulation area. For ventilation and easy visibility for the visitors to the interiors.

Figure 9: Case Example 3. Nana Wada, Budhwar Peth: Analysis Table of and Opening Sizes and Proportions

(*Courtesy:* Author)

Figure 10: *Case Example 3:* Nana Wada, Budhwar Peth: Graphical Representation of Proportions with Respect to Human Height (X) and Stone Size (Y) as a Module and Opening Sizes.

(*Courtesy:* Author)

5. CONCLUSION

It is seen that the proportions majorly depend upon the use than on the material or the construction technology. The level of privacy, orientation and function dictate the proportions. Major social factors decide the motifs and bracket detailing of the openings. Some notions that would have been taken into consideration while deciding the extents of the openings are:

5.1 Proportions of the Central Courtyard

The windows which fall in central court are such proportioned that they allow a sufficient intake of sunlight in the inner spaces. In case of smaller central courts, the height of the sill associatively changes with consideration of the sunlight intake and privacy inside. It can be inferred that the courts are proportioned such that the side is not more than the height of the principal building facing upon it. This decision calls upon another principle of designing along with light penetration, which is the Stack effect. Here the openings on the lower floors have maximum surface area to allow maximum cross-flow of air.

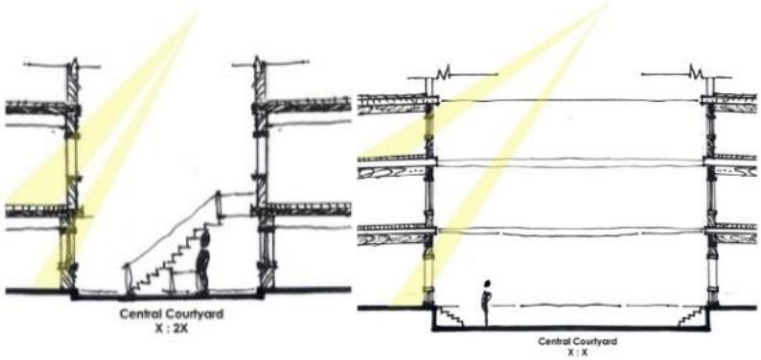

Figure 11: Comparative Graphics Showing Different Proportions of Central Courtyards and Changing Sill Levels of Windows Associative to its Width

(*Courtesy:* Author)

5.2 Sense of Privacy

In Case Example 1 and 2, the windows on the upper floors have a sill at the floor level. The hall on the first floor was utilized by women the space for sitting and viewing the central courtyard. The privacy of this hall is maintained by offsetting the floor ahead of the columns, thus restricting the view for anyone standing in the courtyard, but allowing the women to view the activities taking place in the courtyard. There are openings which start from the base of the floor and go up to a height 1.5 times the human stature, but these openings are very strategically placed on the internal road only and do not fall on the main movement corridor maintaining the privacy of women inside.

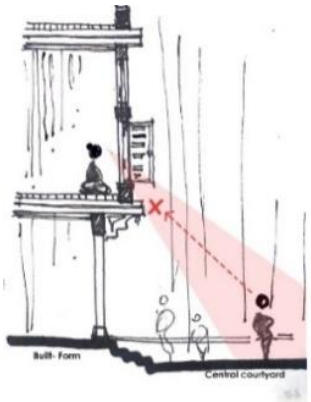

Figure 12: Line of Vision for a Person Standing in the Central Courtyard and the Person Sitting on the First-Floor Level.

(*Courtesy:* Author)

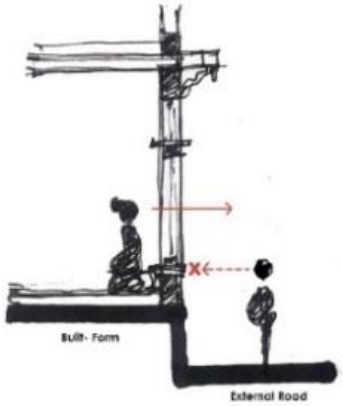

Figure 13: Blocking the Vision from the Main Road and Privacy Inside

(*Courtesy:* Author)

Some fenestrations are designed to form a line of vision ranging from two or more built forms placed in alignment with one another. In Case Example 1, a similar approach is seen where the windows on the third level are seen to be in line with the windows of the gate. This can be related to the way of living of the Peshwa chiefs, where while in their relaxing room at nights, they would be able to sight the entrance gate and the activities happening there. The total height of the opening is 0.4X times a human stature. This height of these windows is designed to allow the continuous vision from two or more structures by stooping and adjusting one's eye-sight through the opening.

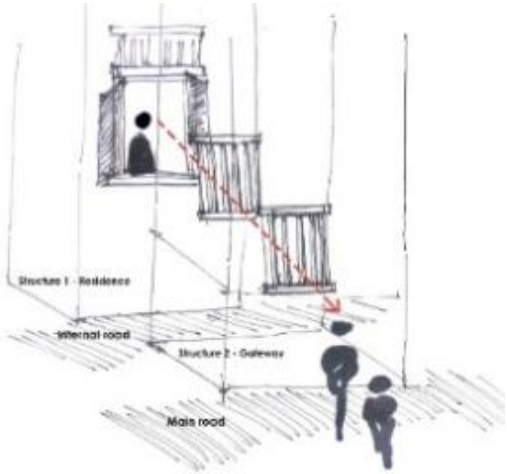

Figure 14: Aligned Windows of Different Structures Creating a Continuous Line of Vision on to the Main Movement Road

(*Courtesy:* Author)

5.3 Materiality of the Structure

The span of the openings is in response to the method of construction and material used. In case of the arched spanning (considering X to be the width of a human expanse), the span goes up to 2X as against stacked type spanning where the span is reduced to around 1.1X. The spanning does not exceed 10 times the cross-section of the spanning member in case of a framed structure.

5.4 Nature of Activities

The type of activities taking place in the space plays a major role in sizing of any opening. The ergonomics related to the respective chore can be related to the level at which the opening starts, its width and the total height of it.

Losing traditional knowledge is losing identity that makes a place unique and thus proper interventions are required to preserve traditional wisdom, sustainability concepts and culture of a particular form of a particular area (Lotankar Hemal, January 2016). It is necessary to understand the thoughtful evolution of certain proportioning systems and their occurrence in history. Along these lines, stands the necessity to undertake appropriate learnings that are needed to safeguard traditional wisdom, sustainability concepts and culture of any place.

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Foremost, I would like to thank Ar. Prasad Gokhale for his sincere help and sparing time with me for site visits. I express my gratitude towards the experts Ar. Minal Sagare and Ar. Kiran Kalamdani Sir for sparing time and contributing to my understanding of the topic. A hearty thanks to all the residents of the city and the workers for the soft co-ordination while site visits and due allowance to visit and photograph the sites. I acknowledge with gratitude the Institution–Our Director Prof. Ar. Prasanna Desai and Mr. Jitendra Pitaliya for their constant support and encouragement. I would like to offer my appreciation to Ar. Niranjan Garde for his overall guidance which helped me in all time of this study and general understanding of the subject. My competition of this paper would not have been possible without my guide Ar. Garima Buragohain. I continue to be indebted to her for persistent support in writing this paper as a part of my curriculum research, for her patience, inspiration, and vast knowledge.

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Tribal Architecture

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ABSTRACT: Adivasi or tribes are the oldest inhabitants of India. In the modern age, these tribes are facing a lot of challenges and issues. Their customs, rituals, and traditions are facing the danger of extinction.

The Gadchiroli district is categorized as a and undeveloped district and most of the land is covered with forest and hills. Forests cover more than 76% of the geographical area of the district. The tribal art, culture, and architecture of the madia gond tribe in Gadchiroli, Maharashtra is studied in this research with current issues and challenges faced by them and transition between new and old.

The Government has started a pucca housing scheme under name of Pradhan Mantri Awas Yojana (PMAY). Houses constructed under this scheme are made out of RCC however; they do not resemble local art, culture, material, and climate. The new genre of construction is completely alienated from the culture and dismisses the traditional knowledge base. This research aims to bring down the housing development to the middle ground where it can utilize modern as well as traditional construction methods.

Keywords: *Tribal Community, Vernacular Architecture, Construction Technique.*

1. INTRODUCTION

1.1 Gonds of Gadchiroli

Madia Gonds or Madia or Maria is one of the endogamous Gond tribes living in Chandrapur District and Gadchiroli District of Maharashtra State. The Gadchiroli district is categorized as Tribal and undeveloped district and most of the land is covered with forest and hills. Forests cover more than 75.96% of the geographical area of the district. This district is famous for Bamboo and Tendu leaves. Paddy is the main agriculture produce in this district. The other Agriculture Produce in the district is Jwar, Linseed, Tur, and Wheat. The Main profession of the people is farming. They speak the Madia dialect of Gondi. The shifting agriculture of madia is known as jhoom. About 91.08 percent of Madia Gond families lived Below Poverty Line.

They have traditional knowledge and skills about utilizing the available resources affectively. They follow principles of sustainability in everyday living. The scheduled tribes of Vidarbha have very less opportunities of income generation and shy of from urban people and urbanized society. The growth of these tribes is affected by Naxalite activities. A need has to be observed to embark on these heritage tribe and their art and cultural traditional activities to sustain with nature.

1.2 Research Question

1. What are the measures that mitigate the upcoming development of pucca houses by pradhan mantri awas yojna on vernacular, sustainable and eco-friendly architecture of Gadchiroli?

1.3 Problems

- Post-Independence, the forest officials have routinely exploited these tribes, denying them any rights and claims to their own forest land.
- In the monsoon some villages are disconnected from world or period of four to five months due to flooding.
- Most of the malnutrition cases in children cases are found in this region.
- Development affected by Naxalite activities in the region.
- 91.08 percent people are below poverty line.
- Lack of sanitation facilities.

1.4 Aim

To study demographics, culture, traditions, local art, craft, history and geographic of madia Gond tribe and implement their outcomes in architectural development of the village.

1.5 Objectives

- To promote local art and craft.
- To study the vernacular and sustainable architecture of gond tribe.
- To study traditional knowledge of construction of gond tribe.

1.6 Scope

- To propose alternative of pucca houses for pradhan mantri awas yojna by integrating culture, heritage, climate, vernacular and sustainably.
- To gather traditional knowledge and skills of madia gond people about utilizing them in architectural development of a region.
- To generate a source of income for local tribes those are skilled with traditional handicrafts from locally available wood and bamboo done by the Gonds.

1.7 Limitation

- Social issues related to Naxalite activities are not part of my study.
- Extent of study is only up to Madia gond tribe living in Gadchiroli district.
- Focus of the study is only on the architectural development of region and not the infrastructure.

2. LITERATURE REVIEW

Article: Environment Friendly Art and Architecture practices by Gond Tribals of Gadchiroli District, Vidarbha

Author: Ms. Aboli S. Hiwarkar, Mrs. Kalpana R. Thakare

Year: 2019

Analysis

- The scheduled tribes of Vidarbha have very less opportunities of income generation and shy of from urban people and urbanized society.
- The growth of these tribes is affected by Naxalite activities.
- They have traditional knowledge and skills about utilizing the available resources affectively.
- They follow principles of sustainability in everyday living.
- The art and architecture of Gond Tribals is endogenous.

Their rituals and practices continued by them follow biodiversity in nature.

- The use of local materials for construction and practices used for daily livelihood are environment friendly.
- Today, these Tribals are in the list of endangered species especially in Gadchiroli due to Naxal activities.
- A need has to be observed to embark on these heritage tribe and their art and cultural traditional activities to sustain with nature.

Article: Reviving the Vernacular Architecture of Gond Tribes Sustainable Case Study in Today's Context

Author: Ar. Seema M. Burele and Dr. Sheeba Valsson.

Year: 2018

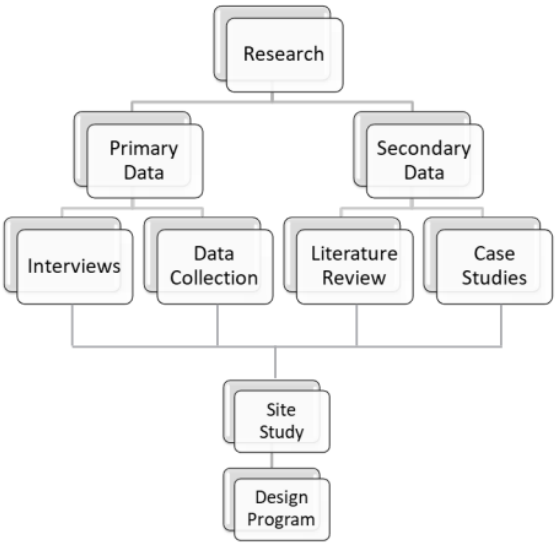
April 2022 | ISBN: 978-93-90951-55-0

Analysis

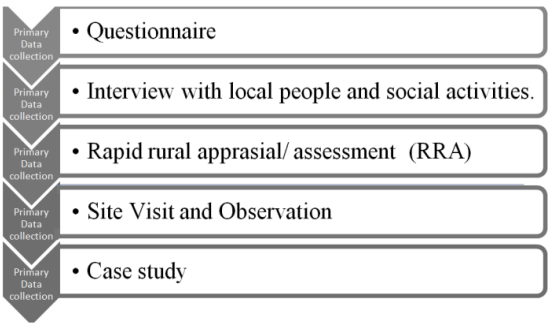
- Architecture is native to the place, build by the local craftsman's, and with local materials in response to the climate, opography and social set up of the community.
- Almost 95% of the houses were made out of mud and were identical in plan and elevation.
- Different earth construction techniques were evolved depending upon the availability of materials, the soil type available and the additives or stabilizer used which comes from agricultural waste.
- The natural resources like soil, agricultural waste.

3. MATERIAL AND METHODOLOGY

3.1 Methodology



Primary Data Collection



Secondary Data Collection

Quantitative: Census, housing, Demographics, Household amenities and other related databases.

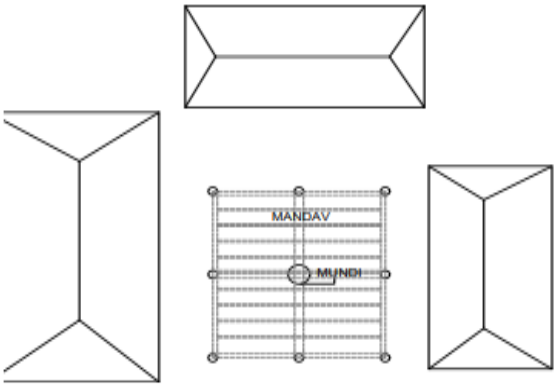
Qualitative: field notes, observation records and other personal, research-related documents.

Data collection is done by survey in seven villages in Gadchiroli Taluka and District. Names of seven villages are potegaon, jaller, marda, jamgaon, karkazora, Rajolli and mavelhati.

Major occupation of villagers is farming. They cultivate rice, Tur and til. In summer they collect tendu pata from tendu tree which is used in making bedi and earn their living. Major source of water for domestic use is from wells and bore wells. Religious deity of people is Mata mauli, Pairsapen, Birsamunda and hanuman. There is one artist in a village named pundlik kumbre who makes miniature model of houses from Bamboo.

Mandav: Every two to three house has a center space called as mandav which has 9 wooden pillars.

Mundi: The central pillar is called as mundi, which is placed at time of marriage in a house. They perform rituals around mundi and perform there religious dance. Mandav is use in summer for sleeping outdoor.



Gothul: Gothul is a Public space in a village where all the religious gathering and meeting of Grampanchayats takes place.

Locally made bricks and mud tile for roof is seen in the village. For foundation for load bearing houses a pit of up to 2 feet is duged and random rubble masonry wall is constructed up to 1 feet above the ground and then mud walls are built on top of that. Roof is made out of bamboo and locally available wood and mud tiles for covering roof.

Construction materials used are mud bricks, timber, cow dung, agricultural waste (Kuda), etc.

Traditional weaving work of bamboo mat is seen in this village. Mud bricks are locally made by digging mud then mixing mud with water and then it is crushed with legs and after crushing it is put into molds and at the last it given fire in the kiln..

4. CONCLUSION

Madia gond one the most primitive tribe inhabiting in the forests of Gadchiroli. The madia culture is unique amongst our Indian traditions and cultures, infrastructure development and exposure to outside world, the tribes have begun to adopt the customs and ways of people living in other more develop regions. Their existence is completely depending upon the forest they lived in.

There is abundance of availability of vernacular building material due to presence of forest. The development of pucca house scheme under pradhan mantri awas yojna has to be mitigating with tribal art, customs, culture and traditions and the environment friendly and modern means of construction method.

ACKNOWLEDGEMENT

I would like to extent my heartfelt and sincere obligation towards all personages who had helped me in this dissertation. With their guidance, help, encouragement an cooperation I was able to headway in this endeavor. I am extremely thankful and pay my at most gratitude to my Design dissertation guide Prof. Anuprita Surve for her valuable guidance and support for completion of this research. I extend my gratitude towards SRPF force in Potegaon sub-station of Gadchiroli for helping me for data collection in naxalite affected areas. I also thank my parents and members of my family, who has always supported me morally as well as economically. At last I extend my gratitude to all of my friends who directly or indirectly helped me to complete my research.

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Inducive Space: Community Hub in the Form of Multifunctional Spaces

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ABSTRACT: Unarguably, in post-pandemic world, humanity has suffered a great imbalance. People have comprehended work-life balance, significance of social connect, presence of peers and sheer joy of physical meet and greet.

Urban construct has reached the saturation point of both horizontal and vertical expansion of land. At present, the 'multi-functionality' of spaces, 're-use' and adaptability, 'hybrid' or flexible built form seems to be fitting as solution. In many cases institutional buildings, corporate offices, commercial outlets go unserviceable post evening or weekends; many markets and similar spaces which are activated for a limited time of the day later turns unusable. Re-thinking and re-assessing such areas in the form of inducive space that gives back to community and nature. It's easy to allocate these in the form of retreats away from the city which adds on to travelling back and forth, it would be intriguing to bring the retreat within the dense set-up.

Keywords: *Post-pandemic World, Community, Stimulative Space, Multifunctionality.*

1. INTRODUCTION AND BACKGROUND

Human behaviour is timelessly evolving, they are highly moved by the surrounding they set in. The post pandemic notion has changed people's perception of life itself; everything was re-looked at entirely from wants to needs. The world with its long-standing eyes and new visions have now started gathering itself together, with a great loss that mankind has suffered, and gauging the future challenges ahead.

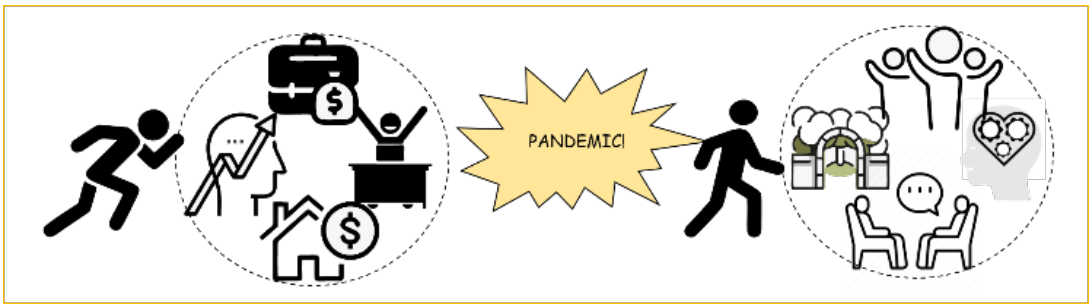

Figure 1: Pre and Post Pandemic Notions

Source: Author.

We are in a transitory phase of human evolution, everything within and around us is changing at the speed of light! The transiting nature of modern human beings requires a space, similar to them, apt to their complex behaviour and city set up they dwell in, the fast-paced urban life, their desire for peace is at peak, a holistic development of the induvial is required which fulfils their social wellbeing, physical well-being and mental well-being.

Through a brief study on environmental psychology, it's quite evident that human behaviour is directly linked with built environment. Since each human is unique in its nature and possess different set of preferences, likings, emotions based on many factors one among them being the built environment, it is no doubt that the present built environment is adversely impacting the humans, an intent to make the process the other way round can be initiated where in the built environment positively impacts the humans and induces positive passive behaviour.

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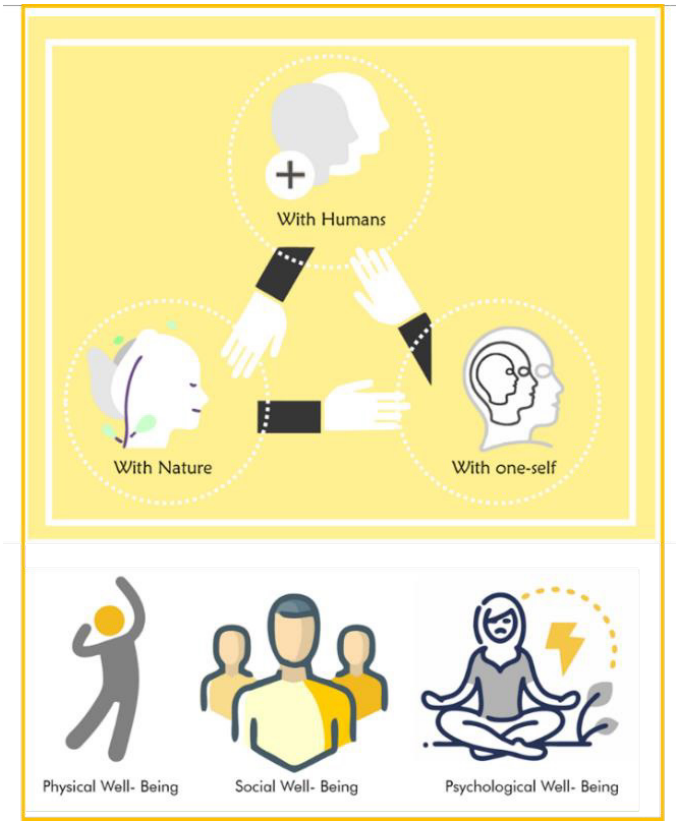

Figure 2: Human Connections Resynced

Source: Author.

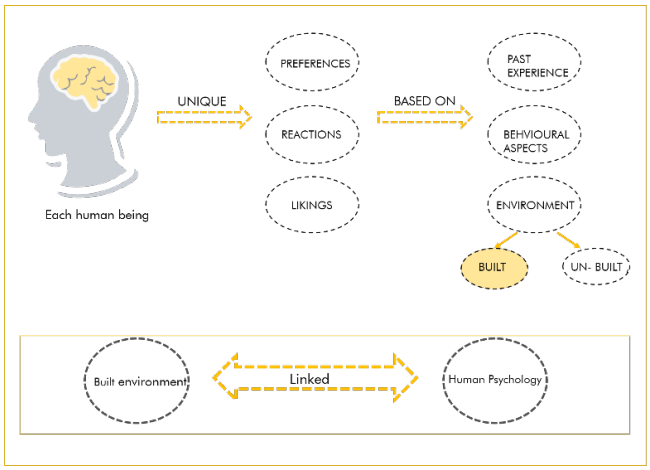

Figure 3: Built Environment Linked to Human Psychology

Source: Author.

A stimulative space that acts as rejuvenation point, a relief abode acting as a respite for the city dwellers in search of joyous, blissful and reflective spaces. An essential vent-out point and break out point was always required by modern human beings, that establishes the long-missed link between positive impact of human behaviour and built environment.

These stimulative spaces can be formulated anywhere, keeping the environmental psychology principles intact such principles are stated below-modern humans must be in close proximation with nature, attention restoration theory through flora and landscape, deriving a sense of stewardship among city inhabitants, developing a sense of community and social bond are few of the many theories mentioned.

Such spaces can be found in the form of retreats, community centers, resorts, rejuvenation and wellness points away from the bustling city having its own set of advantages and disadvantages, the real challenge lies in brining such spaces within the dense urban construct that can be experienced on a daily basis.

The proposed model has many layers to it:

Inducive spaces can be in the form of hybrid structures where in the existing structure is not fully utilized or made apt with the present requirements. Which essentially means one or more functions take place within the same built form & the structure is capable to fit in multiple functions.

It can also be in the form of adaptive reuse, where in existing abandoned buildings can be given a new life and creates activated zones for local community, as there are many abandoned spaces in and around city set ups.

It can be in the form of new built structures where in; it's sensitive towards nature and community, integrating nature within the built form not just in open land patch.

Among these the more suitable seems multifunctional spaces used by different visitors at different times of the day, which can be an ideal solution for institutional or commercial spaces that's goes unserviceable post evening or weekends that can give back to community and nature.

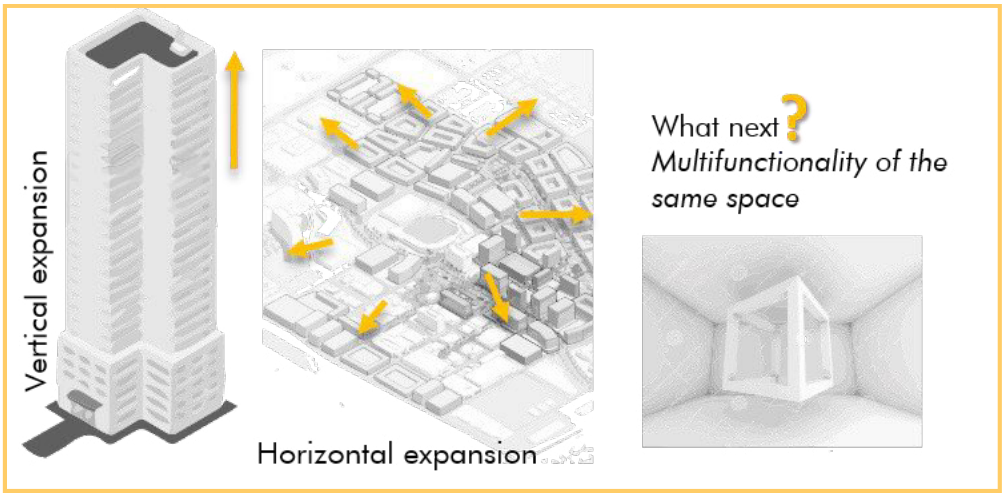

Figure 4: Urban Construct, What's Next in the Built Form?
Source: Author.

Aim

Research aims to understand environmental psychology, varied theories associated with it and idealize a stimulative space through multifunctionality or flexibility in an urban public realm.

Objective

- To understand built environment and its impact on psychology.
- To study varied theories associated with it; healing environment, restorative and beneficial spaces, Zen space design, Biophilia etc.
- To apply the various theories learnt in the design.
- To study various physiological and psychological benefits induced from certain spaces, and apply such similar factors in the design.
- To re-establish the sync with nature in urban fabric.
- To manifest self-reflective spaces promoting mental and physical well-being in dense set up.
- To create a gender-neutral space, catering to all age groups, allowing people from all walks of life for sensory experience and holistic development.
- To explore multifunctionality in spaces leading to social well-being of urban dwellers.

Scope

- The research includes relationship between human behavior and built environment.
- Studying various theories associated with healing environment, Zen space design, etc.
- To study public spaces that boosts mental well- being through sensory activation and such similar aspects.
- Studying hybrid and multifunctional spaces practiced around the globe.

Limitation

- Thesis focuses on public spaces catering only to the urban context, city set up.
- Limitation in documentation since theory-based research.

2. RESEARCH GAP

There has been ample amount of work done in the area of public place-making and multifunctionality in interior space design through furniture, décor etc. but comparatively lesser in the area of multifunctional or hybrid spaces in the built forms; where in the same spaces acts differently at different time of the day catering to the distinct visitors in order to give

back to community and nature at large; since this seems an apt solution for land-crunch dense urban set up already chocking for open spaces, public spaces and social amenities spaces. A research gap thus can be clearly seen in exploration of such areas. An intent is to know if such places already exist through local and old practices or can be formulated in order to give a new direction in architecture through flexibility, hybrid mode and multi-functionality in spaces with an intent to fully use the built forms and give back to community and nature at a larger context.

3. LITERATURE REVIEW

A brief study has been done in the area of environmental psychology, public place making, multifunctional spaces. Through which the following statements can be observed; The clinical research by neuroscientists and psychologists proves that the design of cities can affect our mood and well-being and that certain cells in the hippocampal region of the brain are attuned to the geometry and arrangement of spaces we inhabit in (Chanchalani, Psychological Studies of Urban Environment-city & architecture, 2019).

The urban environment must be designed keeping in mind the people who intend to use them for decades to come. There are factors of social, cultural and political influences that affect the psychological wellbeing. Layout, size and the scale of the space has a significant impact on physical and psychological level, lack of social cohesion and bonding in communities has been found to be a significant contribution to illnesses such as anxiety and depression due to social isolation; such spaces often foster a healthy mental state and wellbeing and create an opportunity for individuals to collide within a space (Chanchalani, Psychological Studies of Urban Environment-city & architecture, 2019).

From the above stated comments, it is quite evident the impact-built environment has on human psychology and with many means it can be restored and made beneficial for the city dwellers. Scoping it down to the public place making from the urban city set up, as it could be experienced by people from all walks of life. Few of the principles for an ideal public placemaking is stated below.

Four Principles of Placemaking Capitalize on Community Assets and Potential are:

- Identity and theme create sense of place,
- Safe access and accommodations for efficient circulation,
- Gateway features and signage define the space,
- User amenities draw people to public places. (West, 2018)

With a brief understanding of the link between built environment and human behavior, its effects and impacts on an urban level, and the principles of public place-making mentioned. The third aspect is multifunctional spaces; since it seems a fitting solution for the urban set up already choking for public and social amenities spaces and open areas. The following statements gives an outline of multifunctional spaces.

A multi-functional space can be described as a true integration of different functions in time and space. This is different from mixed-use development that compartmentalizes the various uses within a community or a landscape. For example, implementing multi-functionality within communities creates spaces that have multiple purposes. Due to their access to diverse uses in one place, these spaces can contribute to a community's vitality. (Brandt, 2013)

With all the aspects intact, now focusing on the examples or concepts in which it's been practiced one such is the concept of 'pocket neighborhoods' practiced in the European context.

Pocket neighbourhoods are clustered groups of neighbouring houses or apartments gathered around some sort of shared open space a garden courtyard, a pedestrian street, joined backyard or a reclaimed alley. They can be in urban, sub urban or rural areas. (Chapin, 2014)

These areas essentially provide a platform not only for recreational and physical activities but also social gathering spaces, outdoor community rooms & multipurpose halls, common corridors, galleries, foyers & passageways within a close proximation to nature or natural elements, providing stimulant and activated spaces that leads to communication, cohesion and tolerance at large.

The below mentioned table gives a concise data of the various theories and principles learnt while in search of design principles leading to mental, physical and social well-being. Prevalent and popular environment psychological theories has been mentioned with its application in tangible-built form.

Table 1: Application of Various Environmental Psychology and Design Philosophies

	THEORIES	INFERENCES & APPLICATION FROM THE DESIGN PRINCIPLES
1	A.R.T. Theory	• Attention can be restored & regained when we are in close proximation with nature. • Involving natural elements & species of plants that are easy to maintain soothing to eyes, not only allocating natural elements in the built form, but integrating the nature within the built form itself. • Introducing elements that engages nature & humans together in the form of street furniture, sitting place, indulging in any activity related to nature & natural phenomenon, it also emphasis that to include natural elements it shouldn't have an open space necessarily, but nature can be integrated within the building itself, so the built form itself becomes a natural habitat.
2	Barker's Ecological theory	• Theory states -change of behaviour due to change of environment & the people there. So placing the elements in the built form that either induces more social interaction or more privacy E.g. Placing the seating facing each other induces more interaction, and back to back seat gives more space for privacy & private task & activities. • Design elements that insists for provoking communication & social interaction through change in levels, change in sitting orientation, space navigation.
3	Zen Philosophy	• Zen philosophy is an intangible aspect fostering spirituality in spaces • Following the principles of 'simple & unadorned' i.e. Principles of minimalism & decluttered in the space arrangement & within it in the form of furniture, etc. • Use of uncladded natural building material in its original form existence of shadow as much as light, so as to create an interplay between the two spatial connection & visual sense, use of tints & colours, use of elements of design, pattern; in an harmonious order, voluminous effect through space allocation & height.
4	Bio-philia	• Not just allocating natural elements in the building, but following a gradual pattern so that there can be a link established between nature & man. • E.g. Including living walls or green walls, sky light or any source of natural day light, presence of water in the form of fountain, pond or water flow, including biomorphic forms & patterns, in sync with nature through materiality, natural sounds like water flow, bird's chirping etc.

Source: Various.

4. MATERIAL AND METHODOLOGY

The methodology applied here is areas in which the design principles and flexible nature of the spaces can be applied in the urban areas in order to derive maximum output from the built form and giving it back to community and nature, below mentioned are few of the arenas in which multifunctional spaces can be incorporated.

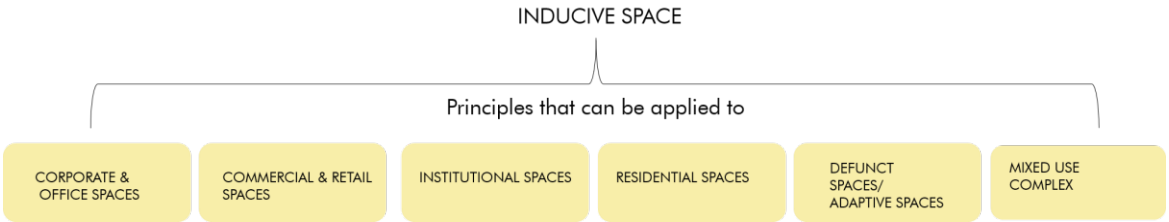

Chart 1: Various area Potent for Inducive Space

Source: Author.

After identifying the area that can be transformed into an inducive space, a sensitive approach is required in order to allocate the functions and their relation with one-another, its placement, accessibility and to determine at which level it has to be located, for this; understanding the background- built environment and its connection to human behaviour, pre and post pandemic notions of human beings, various principles and theories learnt through the course and study from the practices done elsewhere of the similar kind, with an intent to ultimately form a stimulative space. As mentioned in the chart below:

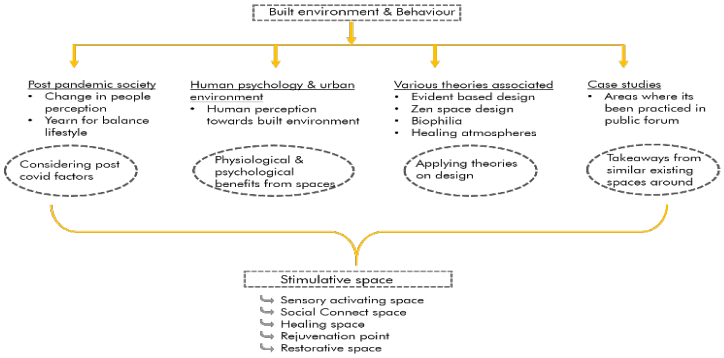

Chart 2: Methodology Applied to Form an Inducive Space

Source: Author.

We observe that conventionally the built form consists mainly of horizontal and vertical planes in the form of structural elements such as floors, walls, roofs and openings. Multifunctionality can be largely seen within these elements. The most common example would be of a retractable roof turning the space into an enclosed one or semi-open space when unfolded. A compilation of such examples can be seen below majorly bifurcating in the form of elements of a building.

The table mentioned below states the flexibility in space designing with examples across the globe with their distinct features and location.

Table 2: Varied Application of Multifunctional and Flexible Spaces—An Overview of Practices

	MULIFUNTIONALITY, FLEXBILITY IN	EXAMPLES	PECULIARITY	LOCATION & ARCHITECT
1	Vertical plane: Walls, partitions, dividers, hedges, parapets, etc. Movable, rotational systems both automated & manual	1. Daita2019 Reconfigurable house 2. 8-23-VI, Pavilion	1. Scaffold of steel pipes & platforms that can be adapted to the needs 2. Discarded red metal panels form pivoting walls	1. Suzuko Yamada, Japan 2. Gldani (local residents), Georgia
2	Horizontal plane: Roof- retractable roof, movable roof, folded roof, plated roof, rotational pavilion etc. Floor- Buoyant floors, rotating or pivoting floor through electrical mechanism., pivoted-decked & rotational floor through track & large hinge through drivers system operated by both mechanical & automated	1. Quadrant house 2. Visitor center	1. Movable terrace 2. Operable interactive village hut opens & closes depending on the temperature	1. Robert Konieczny, Poland 2. College students-Tsinghua School of Arch. China
3	Material: Reused polymers, Carbon fibers, waste product of steel industry as a reusable by-product for construction industry	1. Carbon fiber (material) The Cube (structure)	1. Five times stronger than steel & weighing less, flexible in nature can be molded fabricated & twisted	1. Architecture firm-Henn, Germany
4	Other elements, openings-door & windows, Furniture, interior & street furniture, mobile sculptures etc. Circulation pattern & arrangement of programs, functions	1. A kit of parts-Mobile classroom	1. Through renewable material & local assemble technique classroom can be assembled anywhere	1. Studio Jantzen, USA
5	Adaptive reuse of defunct structures or abandoned areas in the local neighbourhood	1. Kalam Udyaan	1. a garbage dump converted into recreational area & forest park	1. Undertaken by BMC, India

Source: Various.

5. CONCLUSION

With the increase in land use and exploding population in urban areas, public place making and multifunctional spaces can be merged in order to aid the urban dwellers with the stressful fast-paced city life, a conventional notion of public place making can be observed within the urban dwellers, where-in an attempt is made to introduce distinctness or newness in the programs and functions which can be translated through multifunctional spaces that are flexible in nature.

Since allocation of public amenity areas, land open spaces are often considered as less advantageous in monetary terms due to various political and other uncountable aspects, a mild retaliation to it can be seen in the urban set ups initiated by local and cognizant citizens, urban designers and architects, many youth initiatives, etc.

Hence a gradual pattern can be seen of neglected or abandoned spaces getting transformed into public leisure area, activities and gathering space; few of the examples are stated below—in the western sub urban areas of metropolitan city Mumbai, makeover of such abandoned spaces can be observed in Malad and Bandra; Brihanmumbai Municipal Corporation (BMC) has transformed a vast land used to dump trash in the yard and had human encroachment. The area was transformed into an urban park named Kalam Udyaan, covers an area of 2.75 lac square feet and is home to more than 4,000 saplings, similar example in Bandra, the area has its own wonderland. It was built within 1.5 km of the Bandra Reclamation and is officially known as the Bandra Wonderland. It has something to offer for everyone from toddlers to the elderly each can enjoy their own space, with mere play of lights, street furniture etc. a space that is warmth in nature arousing a sense of playfulness and community; sharing a social bond can be observed, which in turn increased the footfall of the area which is ever increasing.

Flexibility could be achieved through materiality, form of the structure i.e., grid pattern, circulation pattern, arrangement and allocation of functions, interior arrangement and street furniture, etc. with an intent to give back to community and nature at large.

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Revival of Mumbai's Rivers: The Man-made Edge of River Dahisar

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ABSTRACT: Rivers have been significant for all the civilizations in the world. In India, rivers were considered sacred and a symbiosis existed between the river and the people, who held themselves responsible for its preservation. Over time, rivers were exploited and encroached upon, intervening their natural flow. Especially urban rivers, such as those of Mumbai, have been narrowed and channelled artificially affecting their flow and aquatic life, degrading them into disconnected parasitic edges and reducing human involvement. One of these is the River Dahisar. The aim of this paper is to understand the ways to retrieve and revive the river's edge and transform it from a parasitic environment to a symbiotic one. The methodology helped understand factors leading to a disconnected edge and understand its sectional condition, involvement of the people and contextual activities. Successful cases were studied to suggest applicable strategies for revival of the edge of R. Dahisar.

Keywords: *Urban Rivers, River Environment, Natural River Edge, Revival of River, River Activities, River Edge Land Use.*

1. INTRODUCTION

Rivers have always been a significant factor in the origin of civilizations as they provide the required food, water and resources for sustaining civilization. Rivers also provide for spaces for community engagement and socio-cultural activities. In India too, rivers have contributed to the origin and evolution of settlements and cities and are considered sacred. One such example is the Indus Valley civilization along the Indus River who used its water to drink, wash and irrigate the fields and for religious ceremonies [i].

Unfortunately, rivers today are not looked upon similarly and are not treated well. Especially in urban contexts, due to the increasing population and infrastructure, they are used to dump domestic and industrial waste. One of the most affected cities is Mumbai which has four major rivers flowing through it: R. Mithi, R. Poisar, R. Oshiwara and the R. Dahisar. Once significant contributors of the natural watershed and biodiversity, today these rivers are heavily polluted and have been reduced to mere streams with a disconnected river edge [ii].

Out of these, the R. Dahisar originates at the spillway of the Tulsi Lake located inside the Sanjay Gandhi National Park (SGNP), Borivali in the northern suburbs of Mumbai [iii]. After about 8 km, the river exits SGNP and enters the urban context with settlements around it and flows for another 4 km until it reaches Manori Creek to meet the Arabian Sea. In these 4 km, the river is contravened and encroached upon, disturbing its ecosystem. These encroachments on dry parts of the riverbed and on its banks had choked and pinched the watercourse and subsequently contributed to water pollution. The river currently is highly polluted with dumping of industrial effluents from workshops and sewage from slums and stormwater drains [iv]. This ingress of encroachments and pollutants from the banks as well as modification of river-course have compounded the risk of flooding [v].

In order to curb flooding by the river water, the municipal authorities have built high concrete retaining walls around it, leading to the absence of a natural water edge depleting the rivers of rich soil, vegetation and aquatic life. This also discourages the growth of vegetation and sustenance of flora and fauna around the bank. This disconnection signifies the lack of a healthy river ecosystem, ground water table, an urban recreational waterfront. Apart from the tangible aspects, a disconnected river edge lacks observation of socio-cultural activities and prohibits spaces for community engagement with the river.

In order to maintain the ecological balance and a healthy living environment, it is essential to have an open public space accessible to all which allows citizens to be in proximity to the water body, without disturbing the river. It is thus

imperative to revive R. Dahisar and bring back its natural river edge. The aim of the paper is to understand the methods and solutions to revive R. Dahisar's edge and transform it from a parasitic environment to a symbiotic one.

The objectives of the research are as follows:

1. To study the existing fabric, demographics and sectional condition of the R. Dahisar.
2. To observe the involvement and activities of the surrounding people and neighbourhood settlements with the R. Dahisar.
3. To identify the factors and reasons leading to a disconnected river edge of the R. Dahisar.
4. To study the various methods and interventions at the design and policy level involved in the process of reviving R. Dahisar's natural edge.
5. To suggest architectural and policy level solutions which can be implemented to revive river edges in a similar context.

The above objectives would aid to revive river edges with similar contextual background.

2. LITERATURE REVIEW

Several reports and studies have been examined to understand the various methods and techniques which can help in restoration and revival of river edges.

A report by the European Centre for River Restoration [vi] suggested direct techniques and measures to restore rivers and improve the environment. These depend upon the type and characteristics of the water body. Removal of hard bank protection and repro-filing of banks, removal of hard bank protection and replacement with a soft engineering technique, planting of suitable native species and creation of aquatic ledges, backwaters and online wetlands are some of the techniques.

Components and Guidance Note, a report curated by the National Institute of Urban Affairs, New Delhi [vii] suggests policies and guidelines for the Urban River Management Plan. They include removal of encroachments and land acquisition for riverbank beautification and related development works, restriction/banning of certain activities such as open defecation, disposal of solid waste, washing of clothes and several others. They further suggest construction and restoration of ghats, provision of public baths and toilets, walkways, parks and other public spaces. Measures to prevent future pollution of the river are emphasized.

Planting of native vegetation along a disconnected or degraded river edge is a significant step recommended by Nijhawan [viii] and Lalwani [ix] for its revival, who suggest the suitable species for this purpose.

The above measures are all important in understanding the process of revival of a river ecosystem. Small scale interventions used, act as catalysts to let the river and the natural ecosystem revive itself.

3. MATERIAL AND METHODOLOGY

In order to achieve the above mentioned objectives, a combination of research methodologies were used. Primary research methodologies were undertaken to understand the behaviour and activities around the River Dahisar. Secondary research methodologies helped understand case studies of successfully revived river edges. The river channel, behaviour of the water flow and the sectional condition were analysed to understand the existing fabric of R. Dahisar; demographics and lifestyle were observed to understand the contextual response of human activities to the river-edge. Factors causing a disconnect in the river-edge were identified and those spots documented.

Online resources were used to study architectural and landscaping design elements and policies of revived water-edges and to understand proposed land use, sectional treatment and river front design.

All these helped to identify the issues at the ground level that are at the root of degradation of the river-edge and the methods which can transform it from its degraded parasitic state to a symbiotic one.

4. RESULTS & DISCUSSION

4.1 Problems Identified along the Edge of the R. Dahisar

As a result of the urbanisation in the Mumbai's suburb of Dahisar, the major water source, R. Dahisar, has been badly polluted due to dense population that has grown along the river's banks. In recent times, the river-bed has narrowed and become shallower due to the accumulation of silt, debris and plastic bags [iv].

(a) ***Encroachments:*** Encroachments on the river-bed as well as on its banks have choked and pinched the watercourse and aggravated risk of flooding. Disruption of the natural flow and subsequent contribution to water pollution is caused and aggravated by the dumping of industrial effluents from workshops and sewage from slums and storm-water drains [iv]. Though, these encroachments had initially settled along the river to avail the resource of water, they have now degenerated to letting their waste into the river.

(b) ***Water Pollution:*** Thoughtless dumping of cow dung which comes from the tabelas (cow-shelters) along the river adds to the pollution, according to Pankaj Trivedi, a river activist and resident of Dahisar, which damages the water but also has a very offensive smell [x]. A water quality test conducted recently by a BMC corporator at the behest of ex-Mayor Dr Shubha Raul shows that the water contains sewage, has a high acidic, nitrite and chloride levels and almost zero levels of oxygen [xi]. The ingress of pollutants from the construction activity, industries and slums, as well as modification of river-course and local diversion of streams have compounded the risk of flooding.

(c) ***Flooding:*** Flood water inevitably enters at the ground floor level of the houses, causing damage and inherent financial losses. This has often been reported by newspaper articles. Ghosalkar [v] gives the example of water from the R. Dahisar crossing the concrete compound wall and entering the buildings at Shrikrishna Nagar, Shanti Nagar and Daulat Nagar buildings upto a depth of 1.5 m. This also takes place at other nearby places like Pragati Nagar, Shanti Nagar and Prabodhan Thackeray Nagar. In spite of such articles, Ghosalkar states that "The residents living in these areas constantly face threat of deluge." Interviews conducted by the author show that little has been done to mitigate this problem except for rehabilitating informal settlements and constructing concrete retaining walls. However, this has been of little use as the informal settlements have sprung up again at their original sites. Most of the bungalow-type of homes were completely submerged. As of March 2016, most of the original residents have either sold off their property or are staying in rented accommodation awaiting redevelopment of their property.

(d) ***Disconnected River Edge:*** To curb the flooding, the local governing authorities have built concrete retaining walls all along the edge of the river which blocks any and all engagement activity between the river and the people.

In order to revive the river's natural edge, it is important to cater to the root causes that have led to the disconnected river edge.

4.2 Case Studies of Revived Water Edges and Ecosystems

In order to understand the methods to revive disconnected and degraded river edges at both, design and policy levels, several cases of restored ecological and revived water edges were studied.

Figure 1: Nala Edged with Stones

(Source: Garden Department, 2015)

Nala Park in Pune: This project aiming at purifying waste water to let into the rivers was launched in 1998 by the governing authority of Pune city [xii]. The nala (Figure 1) was edged with stones and planted with native grasses. Allied programmes that were introduced to induce and sustain the revival process were an art gallery, a musical fountain, a park for children, jogging track and lawns. This ensured a healthy maintenance of the spaces along the river.

Osho Teerth Park at Pune: This case reported by [xiii] was directed at restoring the nallah and the surrounding area by treated the water and opening it for public use. The chronological steps involved are seen in Figure 2a. Setting up the primary filtration system guided through a steel railing and an iron gate to separate the garbage and sludge, creation of wetland zones to hold and manage flooding, creation of level drops for facilitating aeration of the water and eventually using this treated water for irrigation. To increase oxygenation, the edge was planted with water hyacinth and stocked with fish such as gambusia and silver carp which eat pollutants and mosquito larvae. Finally, passing it through a sand filter rendered the water fit for irrigation and fishing. Thus the design measures undertaken could be summarised as stone toe protection, imbricated edge, in-pond fountains, step pools, shallow wetlands, cleansing filters and serpentine ponds (Figure 2b).

Figure 2a: Meanders Created to Reduce the Water Flow

(*Source:* [xiii])

Figure 2b: Meanders Created to Reduce the Water Flow

(*Source:* [xiv])

(c) ***Minghu Wetland Park in China:*** This ecological project by Turenscape [xv] (2015) uses the strategy of slowing the waterflow down hill slopes and create a water-based ecological infrastructure to retain storm-water to regenerate the ecosystem and to provide natural and cultural services that transformed this industrial city into a liveable human habitat. Strategies used were retention ponds and landscaped wetlands (Figures 3a and 3b) created to reduce peak water flow and regulate seasonal rainwater and planting of native vegetation to re-establish the original water and soil conditions.

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Figure 3a: Retention Ponds to Reduce Water Flow

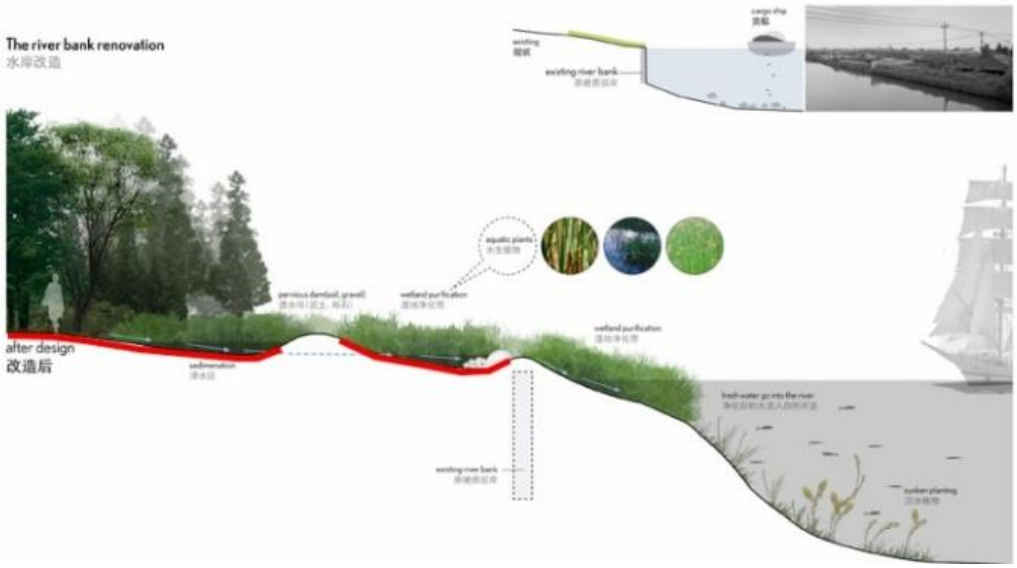

Figure 3b: Pathways along the Terraced Wetlands

(Source: [xvi] Turenscape, 2015)

(d) ***Quingpu Wetlands, Shanghai:*** This revived wetland ecosystem park [xvii]. (2010) first developed the ecosystem, plants, water and land which is seen in (Figure 4). It allows visitors and local residents along the Path of Experience around the park. Land was levelled to create low-lying areas protected from the frequent river floods by the surrounding hills, without the need for external landfills. This creates a rich diversity of natural habitats for flora and fauna. In addition, the park acts as an informative, interactive space which revives the historical lifeline of the Dian Pu River with a floating amphitheatre for cultural performances and a harbour promenade, where old ships are turned into bars and restaurants.

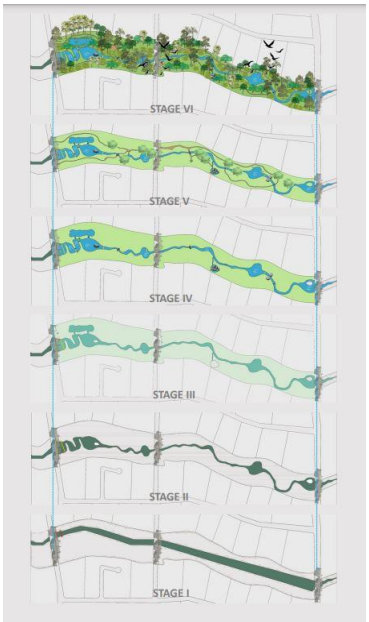

Figure 4: Water Edge Sections of Quingpu Wetlands Showing the Low Lying Areas

(*Source:* [xviii])

Looking at the above cases of revived river-edges, it is observed that the interventions primarily deal with edging them with natural materials to create an environmental buffer and then facilitating and promoting sensitive involvement of people with the river.

4.3 Design Strategies to Revive a River's Natural Edge

The techniques listed by the European Centre for River Restoration [vi] suggest that improvements to the water's edge and habitats on the bank benefit plants, invertebrates, birds and animals which live on the banks and the riparian zone. Some of these specifically are:

1. In-channel habitats for aquatic plants, fish and invertebrates
2. Physical habitat conditions of the watercourse
3. Creation of a more natural bank profile
4. More varied habitat niches
5. Restoration of natural processes which include erosion and deposition
6. Aesthetic value of the watercourse
7. Recreational value

From the above findings, it is understood that any environmental intervention caters not only to a specific element of the environment but also the entire ecosystem and hence it is important to look at design strategies and techniques as an integrated intervention.

4.4 Beneficial Vegetation

Species of vegetation native to a certain region show adaptation to the environmental and biological condition of that particular place. They increase the biodiversity which helps to clean the water, purify the air, maintain healthy soil, regulate the climate and provide us with food and resources. Thus planting of native vegetation helps to revive a degraded and polluted ecosystem. Table 1 shows the trees and shrubs suitable for a river's edge in an urban context in a warm and humid climate, as is found in and around Mumbai with varied benefits [viii, ix, xvii and xviii] which can withstand humidity and rainfall and hence require less or no maintenance. Thus, landscape design and river edge design can be derived from the above list of vegetation species.

Table 1: Trees and Shrubs Native to the Warm and Humid Region of Mumbai

Benefit	*Common Name/Scientific Name*
1. *Large trees that reduce the heat gain by providing shade, and provide more oxygen*	Neem/Azadirachta indica Pipal/Ficus religiosa Arjuna/Terminalia arjuna Sal tree/*Shorea Robusta*
2. *Trees used in Landscape design*	Ashoka tree/Saraca asoca Gulmohar tree/*Delonix Regia*
3. *Trees that are suitable to be grown in warm and humid climate with heavy rainfall*	Kadamba/Neolamarkia cadamba Karanj/Pongamia pinnata Child life tree/Putranjiva roxburghii Jamun/Sygyzm cumini
4. *Trees that improve quality and quantity of groundwater table, improve reduce soil erosion and increase soil fertility.*	Kanel/Cascabela thevetia Acacia/Acacia auriculiformis Mango/Mangifera indica Lemon/Citrus limon Shisham/Dalbergia sissoo
5. *Shrubs that can be sustained in Mumbai's humid climate and monsoons*	Baringtonia/Barringtonia lecythidaceae Lagerstromia/Lagerstroemia indica Henna/Ingadulsis mendhi Bouganvellia/Bouganvellia thema Plumeria alba/Plumeria apocynaceae

(*Source:* Compiled by Author from [viii, ix, xvii and xviii])

4.5 Guidelines and Policies to Revive a River's Natural Edge

In order to reduce the ill effects of a degraded river' edge and revive it, the benefits and outcomes of proposed policies that help to achieve the above aim are studied. The guidelines of the Urban River Management Plan (URMP) framework curated by the National Institute of Urban Affairs, New Delhi [vii] enlist environmental, economic and social benefits detailed in Table 2.

Table 2: Benefits, Vision and Objectives of the URMP Framework

Aspect	*Environmental*	*Economic*	*Social*
a. *Vision*	To support a habitat for biodiversity to thrive	To provide opportunities for economic development	Celebration of the river by the citizens
b. Objectives	1. To ensure effective regulation of activities. 2. To keep the river free from pollution. 3. To rejuvenate waterbodies and wetlands in the city. 4. To enhance the riparian buffer along river banks. 5. To adopt increased reuse of treated wastewater. 6. To ensure maximum good quality return flow from the city into the river	7. To develop eco-friendly riverfront projects 8. To leverage on the economic potential of the river.	9. To inculcate river-sensitive behaviour among citizens. 10. To engage citizens in river management activities.
c. Benefits	Rich biodiversity, clean air, water and improved groundwater levels.	Improved livelihood, tourism growth and attractive investment.	Vibrant places for religious, cultural and recreational events.

Source: Compiled by Author from [vii].

Thus, the guidelines for designing of such river management projects cater to not only the environment but also to the economy and the society making it a practical and viable intervention.

4.6 Identification of Factors of Disconnection of the Edge of R. Dahisar

In view of the factors seen above, the most significant one leading to a disconnected river edge of the R. Dahisar is the artificially channelised river which is edged by concrete retaining walls. Other factors are informal settlements, commercial and manufacturing units which block the river's edge and dumping of waste which make it inaccessible and unusable for the residents. Figure 6 shows the land use map of the region around R. Dahisar. It has been divided into eight nodes in order to identify the spots at which the factors of disconnection are seen.

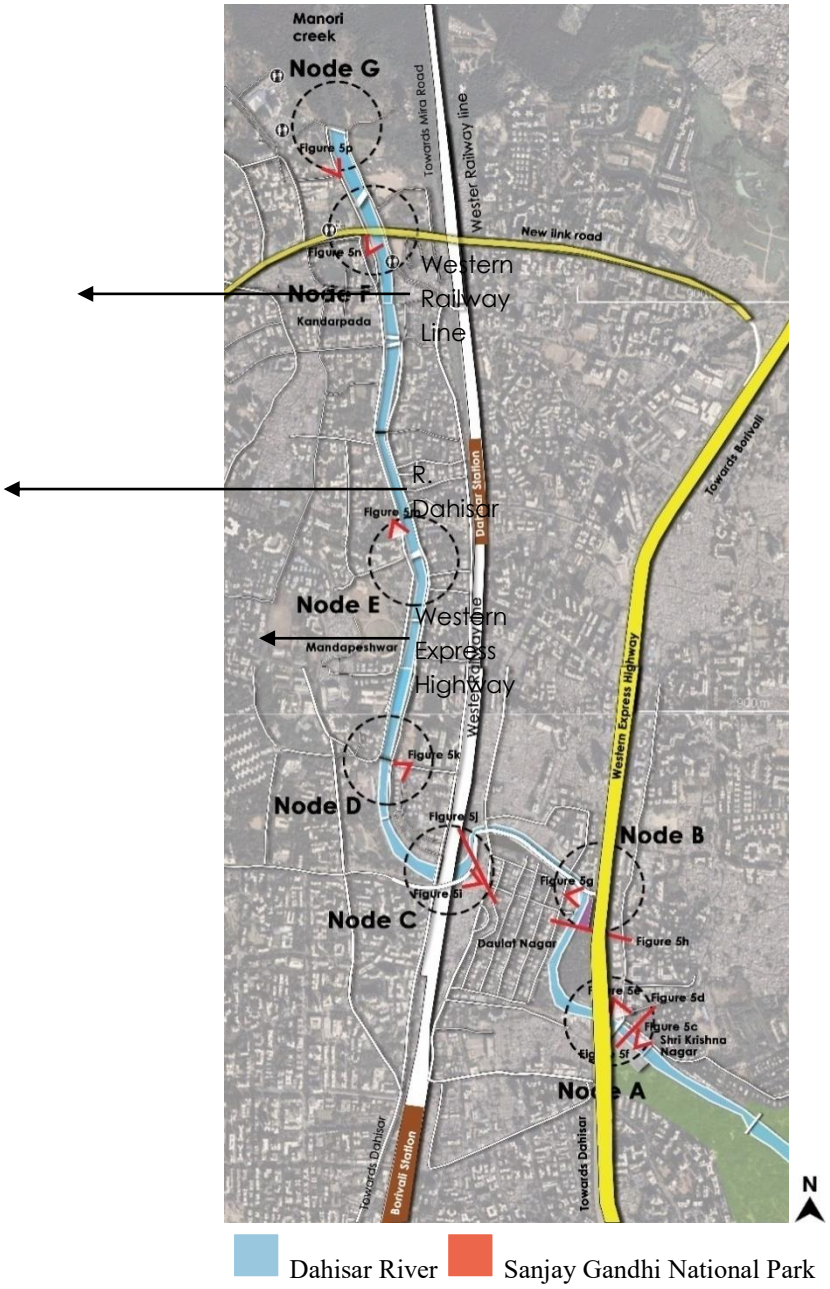

Figure 5a: Land Use around R. Dahisar

(*Source:* Adapted by Author from Google maps and through site visits)

Table 3: Identification of Factors of Disconnection of the Edge of R. Dahisar

Node	*Zone Delineation*	*Existing Land Use and Elements*	*Factors Leading to Disconnection of River Edge*
A	Junction at the Western Express Highway Landmark: Sanjay Gandhi National Park Entrance	Dhobi ghat community	Lined along the river blocking the edge (Figure 5b, 5c)
		Bridge over the river	Potential site for dumping waste (Figure 5d, 5e)
B	Intersection with the Sudhir Phadke flyover Landmark: Sheth D.M. High school	Open space	Concrete retaining walls along the open space blocking it and making it inaccessible and under-utilized. (Figure 5f, 5g)
C	Intersection of the river with the Western railway line Landmark: Hindu Smashan Bhumi	Infrastructure development	Construction destroying the river ecosystem (Figure 5h, 5i)
D	Parallel to the Western railway line through residential neighbourhoods: Landmark: near Shri Harilal Bhagwati Municipal Hospital	Residential development	Construction activity and waste dumped disturbs the river bed and ecosystem. (Figure 5k)
E	Parallel to the Western railway line through residential neighbourhoods Landmark: near St. George Church	Vehicular roads	Car parking along the river edge leading a visual disconnect (also added risk to cars being flooded). (Figure 5l)
F	Intersection of the river with the new link road Landmark: Dahisar bridge	Infrastructure: New Link road	Visual disconnect. (Figure 5m)
G	River joining the Manori creek Landmark: Kolhapur Bhairavnath Mahadev Temple	Open space acquired by informal settlements	Dumping of vehicle scrap and junk. (Figure 5n)

Source: Adapted by Author from Google maps and site visits.

The junction of the Western Express Highway with the river labelled as node A, seen in Figure 5a, marks the first point of contact of the river in the urban context. There exists a Dhobi ghat community as seen in Figure 5b and 5c, have lined up along the river creating an inaccessible edge.

Sant Dnyaneshwar road which is the first vehicular bridge over the R. Dahisar in the urban context, connecting the Western Express Highway and the localities to the east of it, act as potential sites for dumping waste in the river as seen in figure 5d and 5e, which eventually contribute to the disconnected river edge.

Figure 5b: Informal Settlements Cropping along the Retaining Wall

Figure 5c: Informal Settlements along the R. Dahisar

Figure 5d: Bridge Over the River Facilitating Dumping of Waste into the River

Figure 5e: Bridge Over the River Facilitating Dumping of Waste into the River

Node B

After passing through node A and flowing through the locality of Krishna Nagar, the river then meanders and intercepts the Sudhir Phadke flyover at the junction marked as node B. As seen in figure 5a, there lies an inaccessible and underutilised open space, as seen in figure 5f and 5g. It is thus observed that there exists open spaces along the river but are blocked by the concrete retaining walls and are thus inaccessible.

Figure 5f: Under-utilised Open Space: Environmental Disconnect

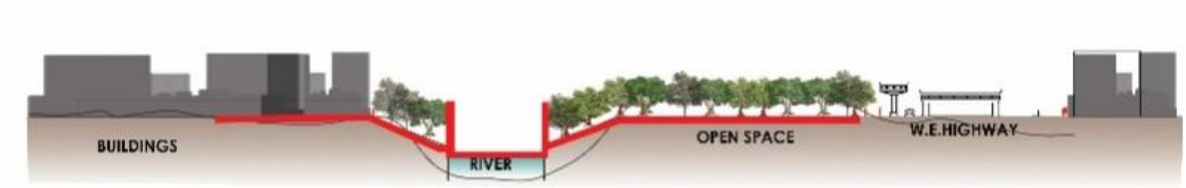

Figure 5g: Environmental disconnect with the R. Dahisar

Node C

The R. Dahisar flows under the Sudhir Phadke flyover and intercepts the Western railway line creating a high traffic junction which is marked as node C, seen in Figure 5a. Under spaces of the Flyover, as seen in Figure 5h and 5j are used as dumping sites and create a physical disconnect.

Figure 5h: Garbage Dumped under the Sudhir Phadke Flyover

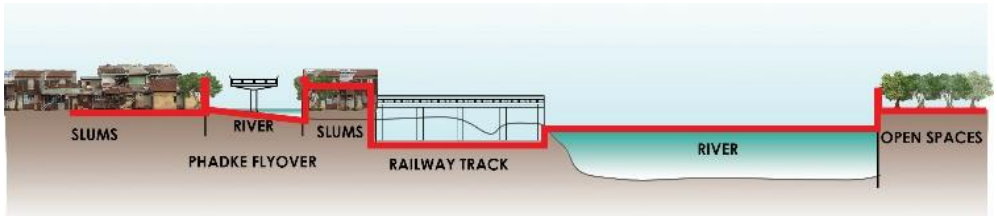

Figure 5j: Physical Disconnect Due to the Infrastructure and Informal Settlements

Node D

After passing through node C, the river meanders and flows parallel to Western railway line through residential neighbourhoods which is marked as node D, seen in Figure 5a. In this neighbourhood, building construction works have cropped up along the river as seen in figure 5k. It is observed that this hazardous construction waste is dumped along and in the river, blocking and disconnecting the river's edge from the land.

Figure 5k: Construction Waste Blocking the River Edge

Node E

The river further flows linearly through the residential neighbourhoods as seen in figure 5a, and is intercepted by a number of vehicular and pedestrian bridges connecting the two edges of the river. One such interception created by a vehicular bridge is observed to be a high traffic junction marked as node E in figure 5a. At this junction, vehicular parking (Figure 5l) have blocks the visual connect with the river.

Figure 5l: Car Parked Along the Edge Blocking Visual Access to the River

Node F

Further along, the river is intersected by the New link road, delineated as Node F, seen in Figure 5a. The new link road flyover (figure 5m) adds to the physical and visual disconnection of the river.

Figure 5m: New Link Road: Dahisar Bridge Blocking the Access to the River Visually and Physically

*Node G*Towards the end, the river drains into the Manori creek, delineated as Node G, seen in Figure 5a. Abundant unsupervised open spaces, have led to dumping of vehicle scrap, junk and garbage, as seen in figure 5n, degrading the water and disconnecting the edge.

Figure 5n: Vehicle Scrap and Industrial Waste Dumped along the River

Figure 5: Factors Leading to a Disconnected River Edge

(*Source:* Author)

5. CONCLUSION

In order to understand the methods and solutions to revive R. Dahisar's edge and transform it from a parasitic environment to a symbiotic one, this paper has studied the issues that have caused the artificial channelising of R. Dahisar. These are summarised as follows:

Encroachments and river pollution are the main causes leading to flooding of R. Dahisar due to the concrete retaining walls built by the local authorities all along the edge of the river, artificially channelizing. This is seen to block any engagement opportunity between the river and the people. Mapping the context and the involvement of people with the R. Dahisar, activities like walking, jogging, cycling, playing sports, performing music, dancing, sitting, gathering, etc. are observed to be carried along the river. Unfortunately, these activities are disconnected from the river due to the concretisation and high retaining walls. In order to revive these activities, it is imperative to revive the river's natural edge by addressing the root causes that have led to the disconnection.

It is observed that the majority of factors contributing to a disconnected river edge, seen in Table 3, consist of settlements encroaching, scrap and waste dumping and poor quality of infrastructure along the river.

The techniques and methods executed to revive a river's edge broadly deal with removal of hard banks, creating a buffer zone along the river and planting vegetation and creating an ecosystem. Some of the policies and guidelines proposed in order to revive a river's natural edge advocate removal of encroachments, restriction of activities that disturb the ecosystem of the river, restoration of the river and its buffer areas, prevention of discharge of untreated sewage and sludge, treatment and reuse of sewage water and sludge. These solutions and policies cater to the root causes which will prevent and avoid contamination and disconnection of the river's natural edge.

Analysing and implementing the above executed solutions, methods and guidelines, some of the factors leading to the disconnection of R. Dahisar's natural edge can be dealt with similarly. In relevance to the revival of R. Dahisar's natural edge, primary solutions could include removal of the existing concrete retaining walls which would open up the river and connect the environment around it. Creation of an environmental strip along the river to reverse the adverse effects of the polluted water and to revive the river's ecosystem. Reservation of a zone of land along this strip to restrict any ill activities that can disturb the river which will in turn curb the flooding of the river. Secondary solutions specific and relevant to the case of R. Dahisar have been proposed, as seen in Table 4, which aim to overcome the respective identified factors that lead to a disconnected river edge.

Table 4: Suggesting Solutions (column 2) to Overcome Identified Factors Causing Disconnection of River Edge

Factors Leading to Disconnection of River Edge	***Solutions to Overcome the Factors***
Dhobi Ghat community lined along the river blocking the edge (Figure 5b, 5c)	Rehabilitation of the community and opening up the river's access.
Bridge over the river as potential site for dumping waste (Figure 5d, 5e)	Banning of waste dumping and any ill activities, surveillance of such strategic spots.
Concrete retaining walls along the open space blocking it and making it inaccessible and under-utilized. (Figure 5f, 5g)	Opening of the river and integrating the open space into the river.
Infrastructure development's construction destroying the river ecosystem. (Figure 5h, 5j)	Proposing policies regulating the extent of construction, use of materials, management of construction waste.
Construction activity and waste dumped disturbs the river bed and ecosystem. (Figure 5k)	Policies should be proposed to limit the degree of construction activity and policy to manage the waste generated.
Car parking along the river edge leading a visual disconnect (also added risk to cars being flooded) (Figure 5l)	Proposing policy/regulation to reserve certain width of road along the edge as buffer zones.
Visual disconnect due to the New link road (Figure 5m)	Redesigning the under spaces of the flyover.
Dumping of vehicle scrap and junk on open spaces. (Figure 5n)	Banning of certain scrap processing industries along the river, Proposing policies to manage the waste generated.

(*Source:* Adapted by Author from Google maps and site visits)

The primary solutions aim to tackle the root causes helping the broader objective of reviving the river's edge. The above listed solutions aim to cater to the specific observed factors which hinder any physical and visual engagement with the river.

The existing concrete retaining walls restrict the environmental connect of the river with the soil, landscape and ecosystem around it creating a parasitic environment. Removal of such hard banks, creation of an environmental buffer and buffer zone with restriction of certain ill activities all along the river aim to cater to the root causes such as encroachments, pollution, flooding. Once the river is opened up and environmental connect is established, the river's natural edge could be revived. Further by specific interventions and proposing policies restricting certain activities could maintain this natural state of the edge by establishing visual and physical connect with the surrounding and enhancing engagement of the people with the river. Such an environmental, visual and physical connection leads to creation of a symbiotic environment. Thus the solutions suggested through this research paper hope to transform R. Dahisar's parasitic edge to a healthy symbiotic one. The success of the same could be applied to other rivers flowing through a similar context, scale and region.

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The Effects of Slums on Cityscape in Metropolitan City

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ABSTRACT: India is a fast-developing country with many of its metropolitan cities growing at a higher pace in terms of their population. During last two decades, migration from villages and small towns to urban areas has increased tremendously in India. This had led to the degradation of urban environment by growth of slums, especially in the metropolitan cities. Pune is one of the many metropolitan cities in India where urbanisation has a great boost. Slums cause many adverse effects not only to the surrounding but also the architecture of that place, its identity, and its skyline as well. This paper articulates the consequences of rapid increase in slums, on the surrounding and the overall cityscape in Pune. The research will be carried out by identifying slums in Pune, analysing with respect to living conditions, socio-economic factors, selecting a study area and interviewing people within it. The paper concludes with recommending ideas to glorify the cityscape.

Keywords: *Slums, Cityscape, Population, Internal Environment, Urbanisation, Introduction & Background of Study.*

1. INTRODUCTION

In India, the rapid growth of slums in urbanized areas, especially in metropolitan areas, has become a major problem due to urbanization. The surge in slums is primarily due to the outflow of people from rural areas and the tensions over unused, unprotected, inappropriate public and private land. This includes poverty, unemployment, lack of access to clean water, lack of permanent housing/increase in temporary housing, traffic congestion, pollution, poor and unhealthy living conditions, poor sanitation, and lack of land. It leads to many serious problems, such as improper use of land, destruction of cityscape, etc.

Pune is the second-largest city in the state of Maharashtra and one of the eight-mega cities in India regarding population, with a population growth of 7.8% during 2001–11. Pune attracts thousands of immigrants because of a couple of variants of monetary sports and most of them falling in the class of lower strata forming low-income groups, who are compelled to stay in slum due to poor affordability. These immigrants begin encroaching areas may it be a public land, private land, land besides heritage sites, riverbanks, and many other, which ultimately destroys the cityscape and cultural price of the metropolis. To study the effects of rising slums in Pune and finding an appropriate solution to retain the identity of the place and adding value to the skyline is main lineup of this research. The study bars to the cityscape & living conditions of slums in Pune.

The concept of slums has both physical as well as social aspects, and thus its definition varies according to different countries, places, housing situations, and governing authorities. A compact area of at least 300 populations or about 60–70 households of poorly built congested tenements, in unhygienic environment usually with inadequate infrastructure and lacking in proper sanitary and drinking water facilities (Census of India, 2001 and National Slum Policy). In simpler terms, slums are densely populated regions within an urban area, which are informally inhabited by individuals of the low-income group or by the people below poverty line (BPL). They are a set of various colonies having colloquial names as vasati, etc. The acute problem of slum formation is found not only in the big cities but, also in medium and small cities/towns in India due to rapid urbanization, poor housing planning and increasing migration of people from rural to urban areas (Jitendra Kumar, 2014).

Reasons for generation of slums:

- Unemployment.
- Literacy.
- Socio-economic status.
- Growth in population.
- Unaffordability of modern housing.
- Pandemic.
- Natural disasters.

India is expected to reach its peak population of 1.65 billion people by 2060, after which it will begin to decrease. Out of the total population 42,578,150 people live in slums (Census Commissioner, India, 2021). In Pune City there are total 564 slums. Out of the total 564, 353 slums are being notified by the government whereas remaining 211 are not notified slums. Out of the total declared slums in Pune only 60 slums occupy Central, State Government & PMC (Pune Municipal Corporation) land. 70 slums are undeclared but still are on the Central, State Government & PMC lands. Remaining 434 slums are on private lands.

Table 1: Shows the Total Number of Slums in Pune along with the Number of Slums that are Declared and Undeclared

Total slums in Pune City	564
Slums notified by Government	**353**
Slums not notified	**211**

Source: Pune Municipal Corporation.

Table 2: Breakup of Landownership

Declared slums on Govt. land	60
Undeclared slums on Govt. land	70
Private land	434

Source: Pune Municipal Corporation.

However, by various report, it has been revealed that not only 353 slums have a better provision of the basic services by PMC, but also the rest non-declared slums are being served by the corporation. Hence, notified or not the PMC holds all the rights for betterment or redevelopment of these areas.

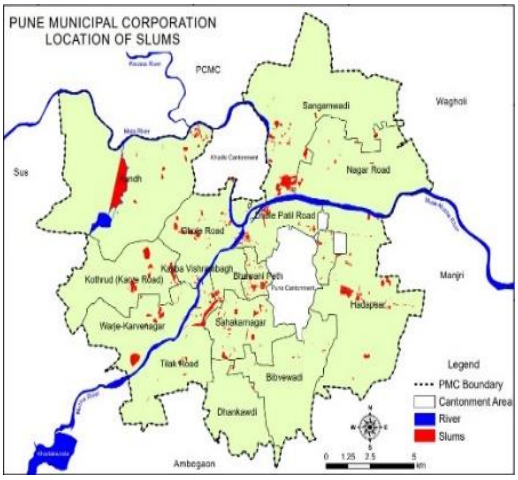


Figure 2: Shows Location of Slums in Pune Marked in Red

(*Source:* Pune Municipal Corporation)

Impacts of Slums

The growth of slums is expected to have major consequences on both humans and the environment which are inextricably linked. The conditions that exist in slums like living under physical threat from natural/manmade disasters and improper housing have direct impacts on residents. The main motive of the slum dwellers is to get an adequate water source in proximity within their living areas. This not only fulfils their need for water but the slum itself becomes a prominent source of polluting it. The overall beauty of the water body is spoiled not only due to pollution but also the lack of infrastructure and living conditions of the slum. Hence, the corporation needs to look after the redevelopment, renovation, or rehabilitation of such areas.

2. LITERATURE REVIEW

N. Mundhe, 2019 examines the growth trend of slums in Pune, its location and classification. It describes in detail the density of tenements in the slum areas and states the areas which are privately owned or are under Government lands. It helps in understanding the larger picture of the city with a detailed mapping with GIS techniques.

Shubhshree Nath, 2020 deals with the physical, social as well as the living conditions in Pune. It helps to understand the various attributes like proximity and access to transportation, amenities like health care, education, etc. The slum dwellers settle near areas were water; the most important resource for living is located. This in turn also effects the neighborhood and is a reason for environmental pollution.

Raunak Prasad & Niruti Gupta, 2016 Slums are those elements of a city which aren't noted by the authorities and where housing and residing situations are missed out appallingly. Slums are small density tenements which apparently form larger settlements and sprawl illegally at the threshold of a city. It focuses mainly on the rights and legality and not on the affects that it has on the city.

3. METHOD METOLOGY

The method included attempts to find how slums affect the cityscape by identify the underlaying factors. Various factors that are responsible for the growth of slums in Pune were identified. These factors include- socio-economic conditions of the community/people below poverty line. It also includes the need for education, better work opportunities & various disasters. Covid-19 pandemic also played an important role in the drastic growth of the slum areas.

Pune being one of the metropolitan cities, large number of migrants settle in different regions of Pune forming slums/informal housing. These slums were identified and analyzed with respect to the location, as location of slum is an important parameter that affects the skyline of the city. It was also analyzed based on the neighborhood, surrounding, and living conditions.

Further, an appropriate study area was selected which had more predominant factors. A semi-structured questionnaire was designed to interview the residents of the slums. The target population to be interviewed was 100 people. Whereas only 40 people got interviewed as many denied answering or had lingual problems. These interviews were analyzed, and results/solutions were made on the same basis

4. STUDY AREA

Pune attracts thousands of migrants from various rural as well as urban places in the country. The migration is due to varying economic activities and most of the lying under below poverty line. These people are forced to live in slum like conditions due to the unaffordability of housing in urban areas. This results in the formation of slums. Janta Vasahat is the largest slum in Pune located near the Mutha Bank Canal at the foots of Parvati Hills.

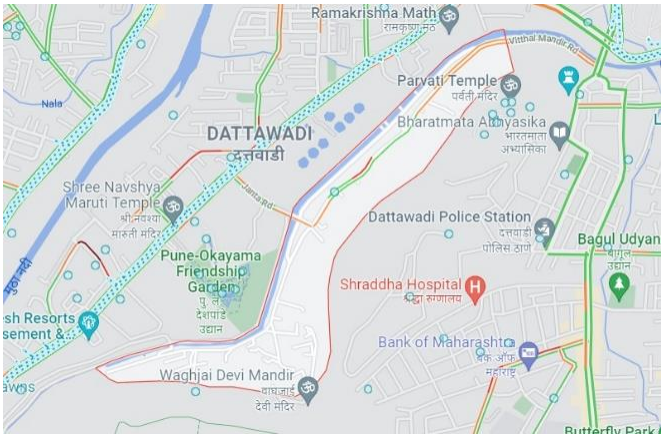
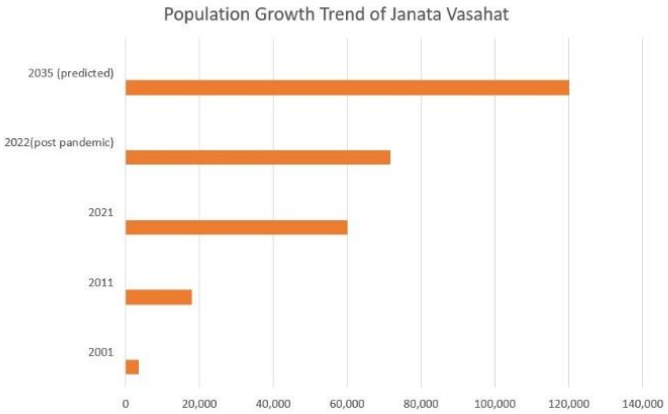


Figure 3: Shows the Aerial View of Janata Vasahat Marked in Red

(*Source:* Goggle maps)

Janata Vasahat being the largest slum in Pune stands at the foothills of Parvati Hills, since 1974. Due to the great drought in 1970's many migrants having low income from different parts on the country like Bihar, Madhya Pradesh, Jharkhand as well as some parts of Maharashtra arrived at Pune in search of refuge and livelihood opportunities. In today's date, the slum dwellers are encroaching the historic Parvati Hill that housed the pride of Peshwa Dynasty. Not only the encroachment/growth of slum towards the hill but also the pollution of the Mutha Bank Canal has become the note of major concern. Hence, Janta Vasahat has been selected as the study are as it is not only increasing its area day-by-day but all destroying the overall historical background and cityscape of Pune.

5. RESULTS & DISCUSSION

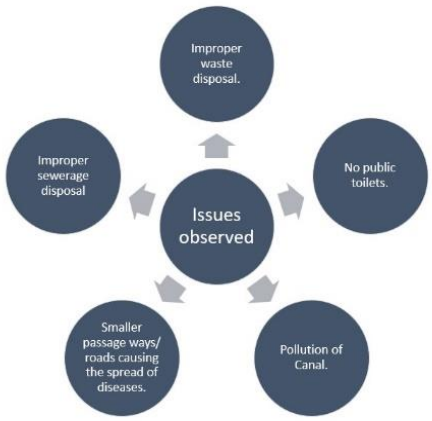


Anata Vasahat is a set of many smaller slums with a total population of 60,000.

Figure 4: Shows the Growth in Population of Janata Vasahat

(*Source:* Pune Municipal Corporation)

The people residing in the slums are migrants who are daily-wage workers, small scale businessmen, maids, local artisans from various parts of the country as well as some IT workers. Janata Vasahat was considered as an unauthorized and undeclared settlement. It remains as a legally disputed area. This has also affected the development of the region. The area has been provided with water and electricity supply by the municipal corporation. This has led to the problem of improper waste disposal as well as sanitation. Taking the opportunity of developing the area, many private landowners were attracted to the land to develop the area. They proposed the development in terms of low-income housing, building kachcha makaan, some flats and residential spaces for rental profit.



Under the development programme led by Municipal Corporation the entire land of Janata Vasahat is reserved as "Green Park". Under this act any construction activity in the area is prohibited. This becomes a dominant reason for the underdeveloped Janata Vasahat.

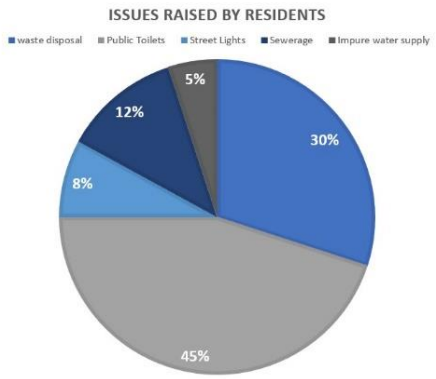


Figure 5: Shows the Issues Raised by the Residents

Issues observed during the survey.

5.1 Living Conditions

Since 1974 till date the area of Janta Vasahat has kept increasing due to various reasons. They are:

1. Migration in search of Job
2. Education
3. Natural disasters
4. Covid-19 pandemic.

As the slum has not been declared by the Govt. and even some part of the slum stands on private land. Due to these reasons, the only basic services that are provided by the local authorities is water and electricity. Other development of the area doesn't come to reality as there are many political interventions.

Being the largest slum in Pune, the informal housing has a quite congested dwellings as well as overall planning. This is due to the randomness and informal approach of the people how start settling in the area. It becomes a dominant reason for spreading of disease and unhygienic living conditions. Covid-19 pandemic had a greater impact on the slum due to the reason mentioned above. Waste disposal is another factor the makes the region unhealthy for living. Disposal of waste is also seen along the roadsides. The same canal water is also used for domestic purpose. This adds into the livability of the place. Thus, Janata Vasahat has worse living conditions and needs development subject to basic services like sanitation, waste disposal and timely cleaning of the canal.

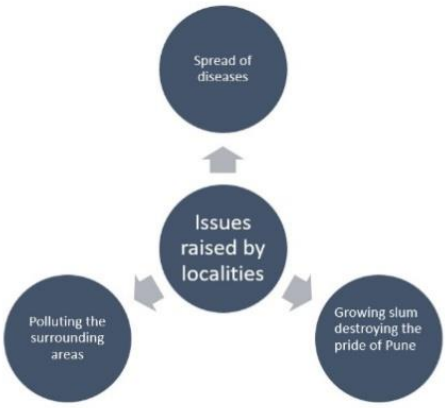
5.2 Socio-Economic Aspect

The history of Janata Vasahat dates to the drought in 1970's. Many families who experienced larger/greater impacts of the drought arrived in Pune. These families were in a search of a refuge and hospitable environment. The barren land at the foothills of Parvati Hills suited best with a canal running alongside. Many families started settling on this land as affordability was a prime factor which influenced the initiation of slum.

The individuals living in the slum are majorly daily wage workers, housemaids and artisans who sell their artifacts in the city. People living in the area are below poverty line. Children go to the nearby govt. school. The slum holds small retail shops whereas, the marketplace is located at 1 km.

5.3 Neighbourhood

Localities living in the proximity of the slum says that the increase in the slum is very drastic and needs an urgent action. They further say that the encroachment of such an historic site and reserved area is not at all expectable. The unhealthy living conditions not only affects the individuals staying nearby the slum but also the people who visit Parvati and Taljai Hills. The slum not only disturbs the social conditions of the neighbourhood but is also responsible for the disturbed skyline of Pune.



Issues Raised by Localities

5.4 Canal

Janata Vasahat has settled at the banks of Mula-Mutha Nadi Bank Canal. This canal is prominent source of domestic water supply to the slum. Slum Dwellers not only use the canal water but also pollute them. As the Vasahat has a major problem related to waste disposal, most of the waste is being disposed at the canal bank. Not only wet & dry but sanitary waste, old/scrap vehicles and various plastic products are being disposed near the canal. This in turn pollutes the canal. No waste disposal bins are seen in the slum area. Thus, it has become a garbage dumping and has become a major source of outspread of diseases. Once a beautiful canal has now turned out into a place for dumping waste and has effects like spreading of diseases in the area.

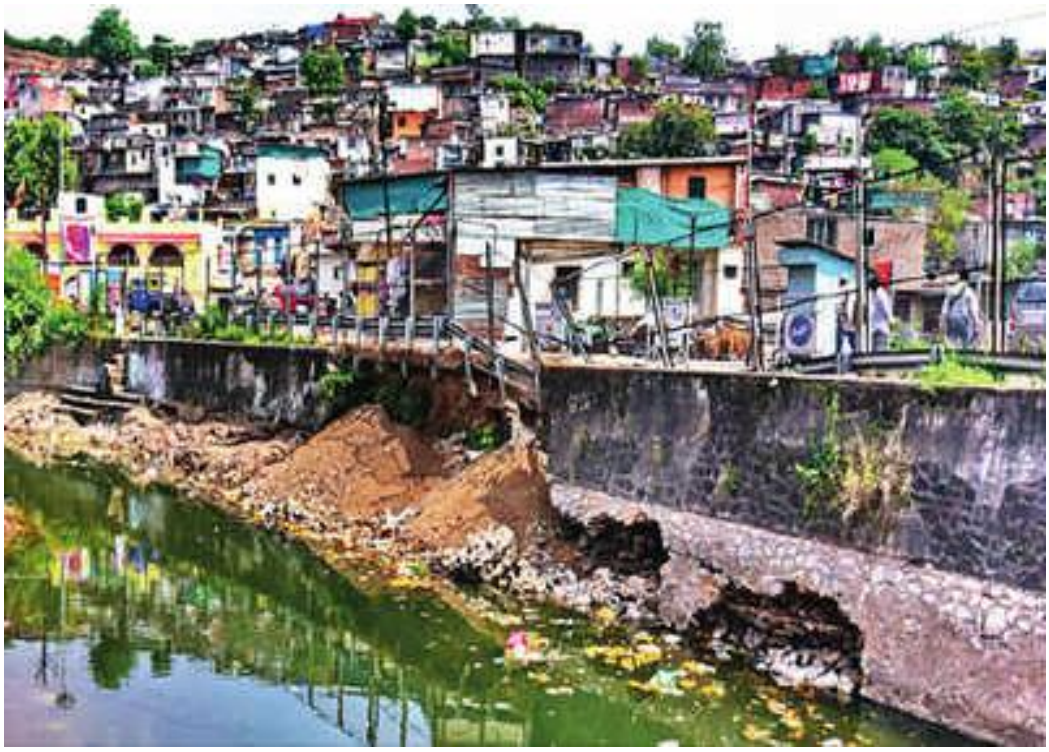


Figure 6: Shows Waste Disposal and Polluted Areas of Canal

In the year 2016, PMC had signed a loan agreement with Japan International Cooperation Agency (JICA) for pollution abatement of Mula-Mutha and its subsidiary canal areas. Despite the project deadline been 31st Jan. 2022, the project has not even started due to various political interventions and court orders. This has led to the delay in the process of cleaner and beautifying the city.

Rehabilitation: Pune Municipal Corporation had made attempts since 1974 to demolish the slum but the efforts ever all vain due to various political interventions. In the preceding years some part of the slum also got notified. The govt. made several attempts which included:

- Land acquisition project with Housing and Urban Development Corporation (HUDCO).
- Housing loans and new accommodation with exchange of rehabilitation.
- Pune municipal Corporation slum removal department offered surplus land at the rate of 1 Re/sq. ft. Every family was given a plot of land to move out and eventually a park would be proposed.

All the efforts made by the Local Authorities were to vain because more than 50% of the population of Janata Vasahat denied for it. Many times, Political Interventions were also the reason for failing of schemes. The people demand for 500 sq. ft. of area to the authorities whereas the authority provides them with only 300 sq. ft. Many people having larger families demand for a greater area for rehabilitation. Thus, the rehabilitation of the area is a matter of dispute. Janata Vasahat is in proximity to the work area of residents, marketplaces, and the city Centre. This is also a reason most residents deny for rehabilitation.

Solutions

Waste disposal and polluted canal was the major issue seen in Janata Vasahat. Educating the residents about waste disposal, sanitary health issues and diseases by conducting campaigns by various governmental and non-governmental organizations can help in reducing the problem.

Waste disposal bins should be kept at intervals within the slums, along the street and canal areas. This may reduce the dumping of waste along the canal bank and result into a cleaner surrounding.

Vehicles such as bell trucks which collect waste from various areas of the city should also provide services in these areas. PMC in collaboration with Adar Poonawalla Clean City Mission has taken initiative for cleaner & healthier Pune. This mission focuses mainly on organic waste management. Such initiatives from various private organizations would help in solving issues of waste disposal especially in slum area. This would also focus on solid waste management, scrap collection and recycling.

The government had made several attempts for rehabilitation of the area. Denial of residents makes the failure. Educating the residents about the various rehabilitation schemes, pros and cons of rehabilitation could help in rehabilitation. Education the residents by personally connecting with them could also emerge a sense of trust in the residents. The authorities should ensure that this may not affect the work and transportation issue the resident might face. This could be done by running campaign and spreading awareness and importance of rehabilitation as well the historic pride of Pune.

Every year many families migrate to Janata Vasahat due to various reasons. This leads to the drastic growth of the region. Encroachment of the Parvati/Taljai Hills is a subject of concern. Authorities must set a boundary for the existing slum. Settlement beyond the boundary should not be allowed. This would keep the area of Parvati reserved and stop further encroachment.

6. CONCLUSION

The study helped to understand the on-going situation of slums in Pune, Janata Vasahat in specific. Lack of services is major factor contributing to the consequences that are faced with respect to living conditions, health, cleanliness, external and internal environment. Waste disposal and sanitation has found to be the missing elements in the slum. It also has effects on the neighborhood, cityscape, and the over-all image of the city. The research helps us understand the effects of slums on the neighborhood and adversely the slum itself. Solutions recommended could be an attempt to enhance the skyline and make the slum area a better place to live. Understanding the rules and regulations by the local authority and making the solutions work would be the future scope of the research.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. Rasika Medhekar for her valuable guidance, inspiration, and encouragement. Her keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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How Alternating Balcony Affect the User Experience

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ABSTRACT: The balcony is an essential part of Architecture. The Role of it has been changing according to the time. But from a few decades it was losing its importance, it was taken for granted and also as an element for earning. But now due to Covid-19 pandemic people are knowing its importance again. This was one of the mediums where the user came and connected with their neighbour. But as we are seeing most of the typology practicing is that on one floor, we have a balcony and another one a window. So, the research tries to understand why this typology is practiced to great extent and what is the user experience while using it.

What the user feels about the space does they use as interaction space with their neighbour or as a private space for enjoying.

The Methodology would be collecting the data from the users who are living there for quite some time. Finding out the reason behind why most architects are performing this type of typology. It will help to understand the user's needs and how they use It or its effect due to that.

Keywords: *Balcony, Alternating, User Experience, Private Space, Interaction Space.*

1. INTRODUCTION & BACKGROUND OF STUDY

In today's Scenario most of the housing schemes which are practicing are having the same type of typology. Nowadays the balcony is provided on an alternate floor, because of that the upper floor to the floor having a balcony gets a window over there. It is practiced everywhere now but they don't think about the impact or experience of the user to it. The user's needs are not considered. So here the research tries to understand what is the user's need and how they use it for different purposes or if they don't like it, what are the different solutions they prefer and what all side effects are seen.

The main intention would be to understand how the user living in that typology feels about it.

Do they feel there should be a private space for them and is it leading to people covering and enclosing their balcony or they use it as a space where they get connected with their neighbour.

The one of the reasons behind this type of typology which is practice is due to the FSI (Floor space index). As by providing alternating the total height of the balcony increases and after some height it is not considered under the area and the FSI of it can be used somewhere else. The main aim for this research would be how this alternating place balcony will differ or change the purpose or experience of a person.

Understanding the user's uses and what they needed, so studying some of the case studies where the architect has understood, analysed and then proposed his design for such spaces.

2. LITERATURE REVIEW

As nowadays in the current scenario the balcony is provided on an alternate floor, to analyze the purpose of the balcony the first thing comes in mind is why where the balcony meant?

Where they use it as a private space, where the user comes to enjoy his time and relax in that space or as a space from where an interaction can be done with our neighbour. It can be interaction with the beside ones or else it can also be vertical ones. These two were the initial thoughts about the space. The main aim would be how this alternating place balcony will differ or change the purpose or experience of a person.

So, for understanding some article which will related to topic was reviewed, the first one was "Opportunities and Benefits of Green Balconies and Terraces in Urban Condition".

In this article the author explains about the cities how they are growing wider and wider in the current scenario. For the Cities the most important thing is they should have urban green space, as it has many advantages. The cities need this space but still the cities which are rapidly growing need it eagerly. As there is climate change the need for some results should be thought off. As the space such as balcony and terrace are for interaction can they be the space where some third dimension of urban green space can be created. so, they try to create that and how it will accept the user is also being studied.

His main aim of research was as the green space is decreasing in the cities which are rapidly expanding. Can the element in the building such as balcony and terrace can become a green space which will help the ecosystem and also the user of the residence can enjoy.

So, for this many different sizes, shapes and different orientation of the balconies are selected and studied.

- Total 10 terrace and 10 balconies were selected.
- Each of them having different size, shape and orientation.
- The user responses were collected. From different age group of 20-70 years of age

Opinion on making balconies and terrace into green space

The study has a conclusion that as green spaces are important in current rapidly expanding cities. The balcony and terrace can easily be converted into the urban green space. These have a potential for growing various kinds of greenery. This solution has a wide range of benefits and it will help each and every one. The user of the residence and also the ecosystem and it will have a positive effect on climate changes and the urban heat island effect.

The next article was “The Impact of Private and Shared Open Space on Liveability in Subtropical Apartment Buildings”

The study was how the resident used the private and shared open space and what are their perceptions about it. For this the liveability of apartment buildings in subtropical urban context are studied. According to the research the resident has highly valued the private balconies. The other interaction space is also being studied.

Around the world in most cities the number of high-rise apartment buildings are increasing, because of that the resident lifestyle quality gets affected and also sustainability for the community becomes a major concern. So, to explore more they gave a thought: can they have positive and negative perceptions on private as well as on shared open space, for liveability of apartment building in such cities.

The aim of this research by the author was to solve the problem through the resident’s point of view or perspective. The concern was in apartment building what is the role of the outdoor spaces, in a subtropical climate. They try to explore whether occupants consider interaction with the external environment. Does this space contribute by any means in positive or negative point of view to the liveability of residents in apartment buildings in such city of subtropical climate.

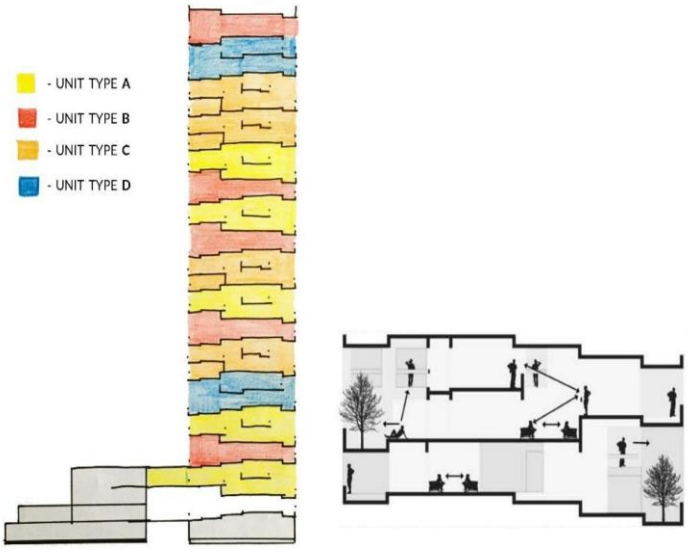


Figure 1: Overall Section and Section Showing Interaction between Each Other of Kanchanjunga Apartment

Methodology they use for research,

- Open and closed survey questions were taken
- Survey Sample—respondents from residents were considered from different age groups.
- Some of the examples were considered for studied

In their study they have found that in apartment buildings in especially subtropical climate cities, the balcony is one of the important desirable features still being a private space too. Residents feel that such spaces are necessary because they give an alternative space to the dwelling unit and they have flexibility and feeling of spaciousness, from the indoor dwelling unit. By having privacy as well as a climate responsive unit the resident would be more satisfied.

This will enhance the contribution in open space to apartment liveability.

Book Case study was done to understand if we planned the spaces properly how it will work accordingly for that:

Kanchanjunga Apartments, Mumbai by Charles Correa.

The case study helps to understand the space where they have created it where both can happen interaction as well as privacy is also maintained.

The Plan and section show how different sizes are arranged giving proper each unit a privacy also an opportunity for interaction.

Figure 2: Plan and Section of Unit A and B

Figure 3: Plan and Section of Unit C and D

3. METHODOLOGY

To understand the use of the balcony, its user experience related to it needs to be seen.

For that the user will be the most important in this research. They will help how they wanted and how architects can apply it while designing the housing scheme.

Firstly, is balcony a useful element that needs to be understood from people's point of view.

So, the first thing is that a society or community in Pune city is founded, where they have alternating balconies.

Where the user lives in the society for quite some time, and where people are easily available and they are contributing by providing information and helping in this research.

Which will help the other architect to think about this issue in more of a user point of it.

For this the collection of data has been another step, for collecting the data from the users which are living there, for more need-based analysis the user was divided into different age groups, because each age group people are associated differently with the balcony for its use.

The age group were 1) Under 16 years, 2) 16–26 Years, 3) 26–50 Years, 4) Above 50 Years.

The gender also played an important role in how they get associated with the balcony.

Questionnaire for the people is prepared and it is circulated to the residents. From that their perception is found how they feel about it.

Taking an expert review on this is quite helpful, interviewing some of the architects why they are making such a design, with the help of a questionnaire.

Comparative Analysis is done through Plan, Sections, some photos, and Video of people how they use their space for their different activities & does the orientation of the space make any changes in what activities are performed by different age groups of people.

How the user can be connected is shown in the analysis. People between 2 balconies and one user in the window and another in the balcony is also analyzed.

The case studies of master architect work we understood how they try to make space in which the interaction can be done between neighbours, with proper analysis and understanding of space.

4. RESULTS & ANALYSIS

The site selected for the analysis of the balcony were Rohan Kritika, Treasure Park

This is the Site plan is of a Rohan Kritika project

Figure 4: Site Plan of Rohan Kritika

In Overall Site, the Configuration of building shows that they are designed in such a way that the middle centre space will be open for garden, and the parents can keep an eye on them.

This is a typical floor plan of a building block, in this the yellow colour mark space is a vertical movement corridor. The green colour spaces are balconies, and the pink colour is that there is no provision of balconies there.

Figure 5: First and Second Floor Plan

As seen the colour is getting created on alternating sides.

In the section, the main intention was to understand how the double height balconies volumes create good or bad effects.

The yellow once is one unit and below blue one is another unit, the section shows that the architect has tried to create some space where the people come to relax, and they can still have interaction with their neighbours. Here the interaction is not only with the beside once or immediate above once, but they have tried to achieve that the interaction is with the beside once, the neighbour above & the neighbours below also.

This typology will help the increase in interaction within the building.

The idea for providing the double height space has come due to the F.S.I.

If the balcony is provided on every floor one above another then the clear floor to floor height will be 10ft so its area is considered in F.S.I use.

But if it is provided on alternating floors the area would be not be considered in F.S.I

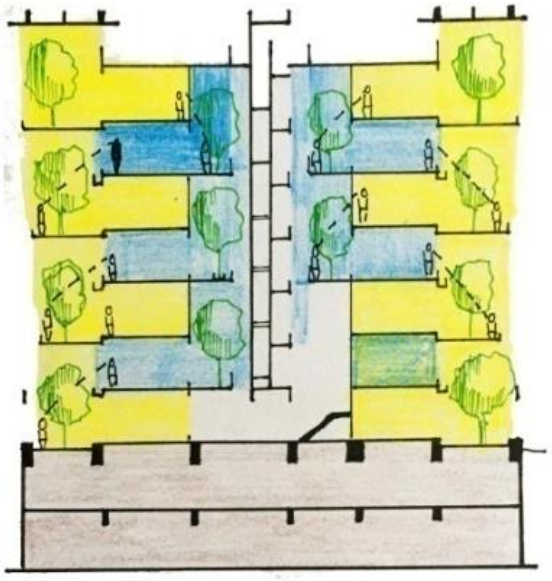


Figure 6: Section of Rohan Kritika

Figure 7: View 1 of a Site Showing Interaction

Figure 8: View 2 of a Site Showing Interaction

Red line marked is trying to show the interaction which takes through the balcony. How one user from the balcony tries to connect with the other one. And the yellow dash is trying to show the interaction which happens from window to the below or beside one balcony space.

Figure 9: View from the Balcony Shows How Many such Balconies and Windows the Interaction can Take Place

Another site is Treasure Park Society which is located near Sahakar Nagar, Pune. This society is also having the same typology of having balconies on alternate floors. This is a site plan view of the society.

Figure 10: Site Plan of Treasure Park

Figure 11: Elevation View 1 of Treasure Park

As seen in this image they have also used the same typology, balcony on alternate floors.

In this I have tried to mark how the interaction is taking place. The red line means interaction between people from each other balcony & yellow line means interaction between people, one from balcony and other from a window.

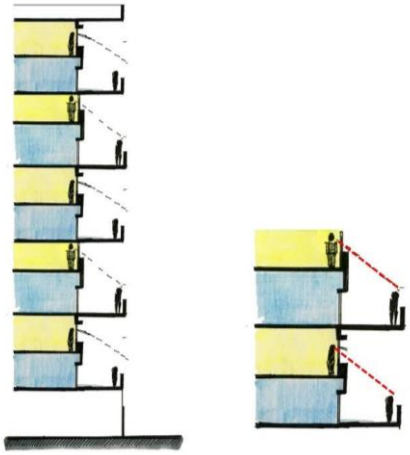


Figure 13: The Section of Treasure Park Society

By drawing the section, the proportion between the window and balcony is understood.

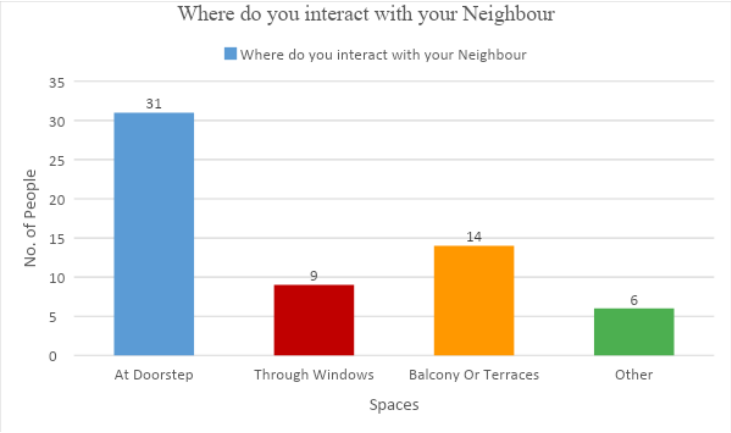
If the length of the balcony is increased, Firstly the user will use it for the different types of activities and also the area will be used for some relaxing or for free time, simultaneously the conversation between the user can happen in that space. If we see in another way the builder or some architect thinks that by providing such an alternating balcony, they are saving their F.S.I on the structure & also with double height space- Ventilation is good or let say it is proper and it is helpful for both the users of the flat.

To understand the people perspective on such space, an enquiry was conducted to understand how the people perceived about this space.

Majority of people responding for the survey were people between the 16-26 year age group.

All the age group people were considered for the survey because each different age group is differently associated or connected with the balcony. Each has its own different way for using the balcony.

Table 3: Chart Explaining where Neighbour Interact



As balcony is important or not, its location also plays an important role whether it will be used or where most offend, they prefer having it.

Most of them were having it in Living room, where it will act as a spillover space to it.

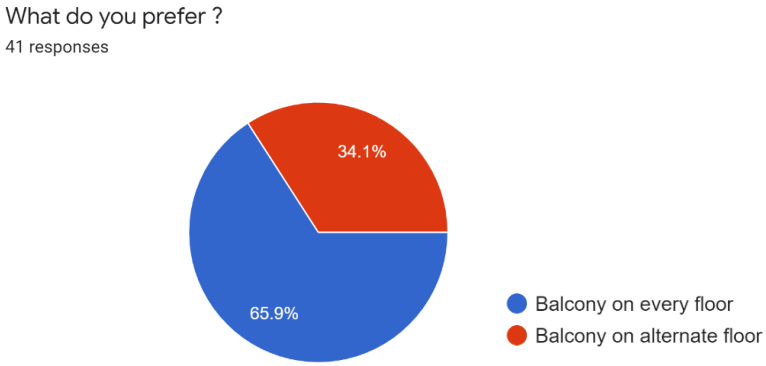
Another one where it is preferred is the Master Bedroom, where it will act as spillover space but still it will act as some private space for the user.

If the different people from different age groups didn't get the point of building typology with respect to the balcony.

For them the question was where do you like to stay? So, the majority of them were willing to stay in Image 2 of the balcony.

Around 70% prefer balcony on every floor & around 30% people prefer balcony on alternate floor.

Table 9: Chart Explaining what People would Prefer



6. CONCLUSION

The conclusion of this research is that, by conducting a survey of the people many different perspectives on the balcony was understood. What different age groups have their own different ways or they are associated with them. As per most of the people feel that the balcony is an important element and it should be provided. But its size, or the way it is put, also play a different role if there is interaction between the people.

Since most of them they prefer talking or interacting with neighbour at their doorstep, other spaces are also there but majority is at doorstep, which is some because of different activity, happening all the day

As mentioned, the majority feel a balcony is important to their lifestyle, but still only half of them have a clear idea that it should not be covered or enclosed. Other were confuse & some were willing to do that.

The balcony can only be use or it will be useful when the length of the balcony is minimum equal to the width of it. Lesser the length the chances of interaction with there neighbour is decrease. Greater if then there are advantage in term of interaction or some recreational space they need, or some other activity can also be perform easily or held.

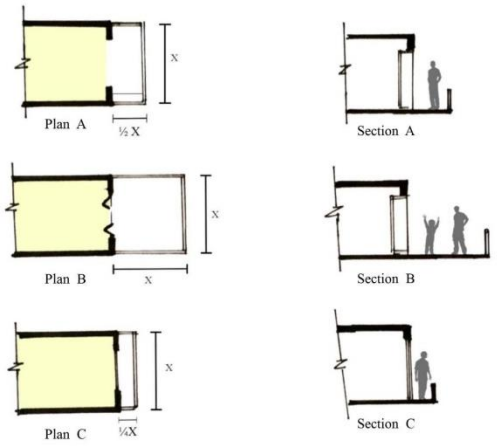


Figure 16: Different Size of Balcony and it Proportions

Through this Image different sizes and its proportion with other units is able to be seen. The plan A defines if the width of the balcony is half of the width of the room then, the user is able to interact with others beside one but it can for a longer period. The A plan gives both the privacy is also maintained so he is able to interact with others.

The another plan B is having a balcony with a same width as of room, in this situation the user are always can interact with other, while performing different activities also as the space is larger. As found in a survey many users want balconies as multi functional space, some of them feel like gardening, household activities, drying cloths etc can happen. Children have a different feeling they think of using for playing games, playing with pets and also can be used for study.

The elder once thinks about working, reading the newspaper etc.

This larger type of balcony is useful and different age groups have their different fond of activities.

The Plan C type is having a balcony but due to its smaller size, it cannot be used as frequently.

It is ¼ of the room width

In this image the plan and section showing the difference between a normal window and a box window, how it changes the user experience.

The floor with a normal window the user can view the person in the balcony on the floor below, where they can interact with each other when needed. But due to this type there is lack of privacy also, because of the angle which is getting created. But in another situation where there is a box window they still have an opportunity where they can interact whenever needed. But due to the projection of the box window the angle with respect to earlier once have decreased, so by increasing the privacy level in that situation.

As seen the balcony is an important element in architecture, if it is designed properly by giving the user a space where multifunction activities can happen, not only that the experience of the user is also enhanced by that. So proper uses and user requirements would be more helpful.

Figure 17: Plan & Section having Balcony and its Above Floor with Normal Window and a Box Window

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I am sincerely thankful to all the Faculty members involved in this Research in Architecture subject, by helping me to write a research paper on "How Alternating Balcony Affects the User Experience".

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I am thankful to our VIT'S PVP College of Architecture Director, Prof. Ar. Prasanna Desai he is always there to help whenever needed.

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Comparative Analysis of Architecture and Landscape as an Integration for Designing a Spiritual Center

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ABSTRACT: Spirituality involves recognizing that there is something greater than myself, something greater to be human beyond the sensory experiences, and that the whole of which we are part of is cosmic or divine in nature. This paper sets out to define the landscape character required for spiritual centers for enhancing the spiritual aspect of the individual. It explains the relation between the built and unbuilt form in a spiritual campus and how the softscape and hardscape plays an important role in encouraging an individual to relax, rejuvenate and think deeply within towards the purpose of life. The aim is to study the characters of landscape as an integration with the builtform which would promote the spiritual well-being of an individual.

Keywords: *Spirituality, Landscape and Architecture, Meditation Center and Nature, Landscape Elements.*

1. INTRODUCTION

Recently in the pandemic times many people have realised the importance of good mental health. Yoga and meditation helps a lot in keeping the mind and body healthy further leading to a productive and stress-free life. In the field of landscape design and architecture, one of the primary goals is the creation of spaces and places that connect in a meaningful way to the user. To study the qualities of landscape architecture as a integration with built form which will enhance human spiritual well-being towards establishing architectural guidelines that will facilitate spiritual practice is the main objective of this paper.

2. LITERATURE REVIEW

The concept of landscape involved the creation of the different forests (van), which have a cultural and religious significance in Hindu mythology and Indian culture (iii). Visual colour pattern along pathway, is achieved through different layers of planting (iii).

3. MATERIAL AND METHODOLOGY

Case studies and findings/observations and interpretations from them:

3.1 Art of Living International Center, Bengaluru:

It is the spiritual center campus built in 1986 founded by H.H. Sri Sri Ravishankar at 21km SW of Bengaluru on Kanakpura Rd.

Observed elements of landscape stimulating sensory aspect of human being spiritually:

- **Vishalakshi Mantap**: Green pockets surround this meditation center. Has a pathway with a water body pointing towards the mediation center.
- **Nakshtra Vanam:** Based on astrological and medicinal aspects, Nakshatra Vanam has many rare plants with medicinal values. This Vanam helps astrologically while sitting and meditating under the tree based on one's Nakshatra.
- **Guru Paduka Vanam**: Inspired by Guru Paduka this is an open to sky amphitheatre catering satsangs. It has a central water body and green belts of steps for sitting. This gives a sense of suttleness.

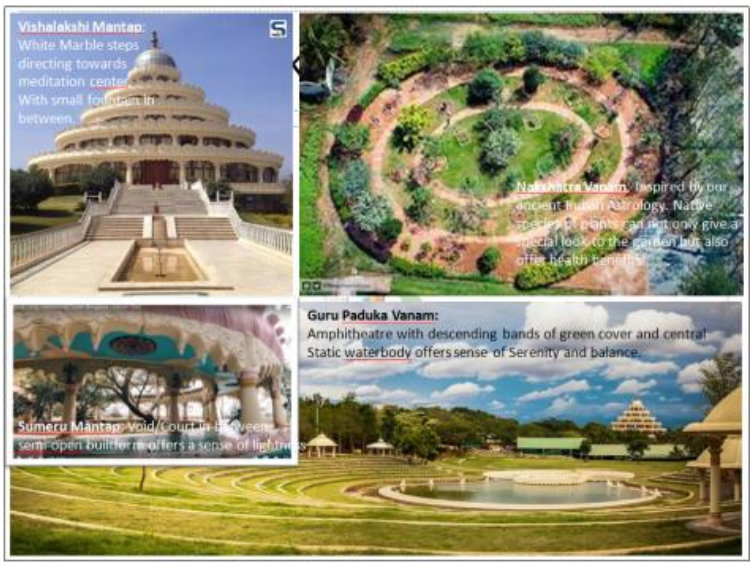

Figure 1: Clockwise: Vishalakshi Mantap, Nakshatra Vanam, Guru Paduka Vanam, Sumeru Mantap
(*Source:* https://www.youtube.com/watch?v=jQjk_Cr-vBU)

Figure 2: Art of Living Bengaluru Site

(*Source:* https://www.google.com/url?sa=i&url=https%3A%2F%2Fashramsofindia.com%2Fmaps%2F&psig=AOvVaw3NpvjJt9PBX8Guukjcsbjj&ust=1646156880962000&source=images&cd=vfe&ved=2ahUKEwiDhqyy-qL2AhUtxDgGHagkASwQr4kDegUIARDCAQ)

- **Sumeru Mantap**: It has a beautiful water pond at the center, twelve pairs of pillars, representing the twelve signs of the zodiac around it and encircled by ornate Lotus petals. It has an open court between. This visually acts as void in which one transits from semi-open to open to sky space within.
- Whole campus is designed in its natural precinct.
- Softscape and hardscape used is indigenous.

3.2 Matri Mandir Gardens, Auroville

Its construction was completed in year 2008 founded by Mirra Alfassa (Mother) and Sri Aurobindo. It is designed homogenously with its meditation center "Matri Mandir". It has 12 gardens namely *Existence, Consciousness, Bliss, Light, Life, Power, Wealth, Utility, Progress, Youth, Harmony, Perfection (i).*

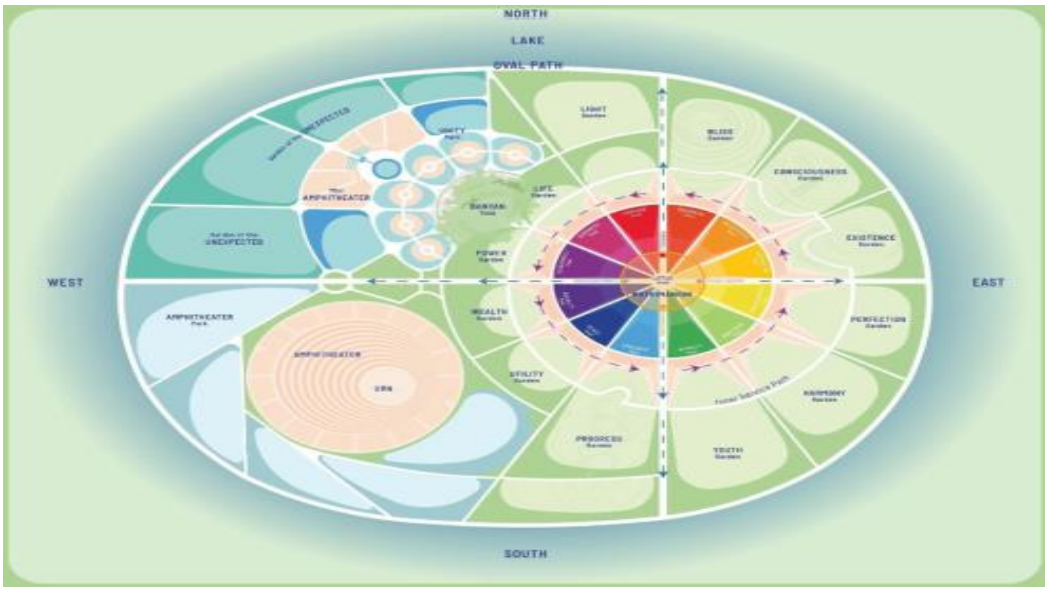

Figure 3: Matri Mandir Gardens

(*Source:* https://www.google.com/url?sa=i&url=https%3A%2F%2Fmatrimandir.org%2Fgardens&psig=AOvVaw34u08bYAShk6NQdB-ABDqL&ust=1646156934807000&source=images&cd=vfe&ved=2ahUKEwjLwYLM-qL2AhV7_DgGHckhDocQr4kDegUIARC8AQ)

Observed elements of landscape stimulating sensory aspect of human being spiritually:

- *Sat*, *Chit* and *Ananda* are the Sanskrit words for Gardens 1, 2 and 3 respectively. *Life* and *Light* are the names of Gardens 4 and 5. *Love* is represented here by the Matrimandir itself. Water will be represented by the Lake surrounding Matrimandir and its gardens.
- The gardens are inspired by the flower petals.
- The meditation center form resembles as if it is rising from the ground.
- Radial planning pattern used focusing the meditation center.
- Indigenous softscape and hardscape used.

3.3 Pyramid Valley International, Bengaluru

This spiritual campus located at Kanakpura near Bengaluru was found by Sri Patriji. It has world's largest mediation pyramid.

Observed elements of landscape stimulating sensory aspect of human being spiritually:

- The campus is designed in its natural precinct.
- It has a rain-water fed lake in its central part and this valley creates a sense of calmness and also contributes evaporative cooling.
- Indigenious softscape and hardscape used which provides more earthy feeling.
- The campus has a zen garden which gives a suttle effect.

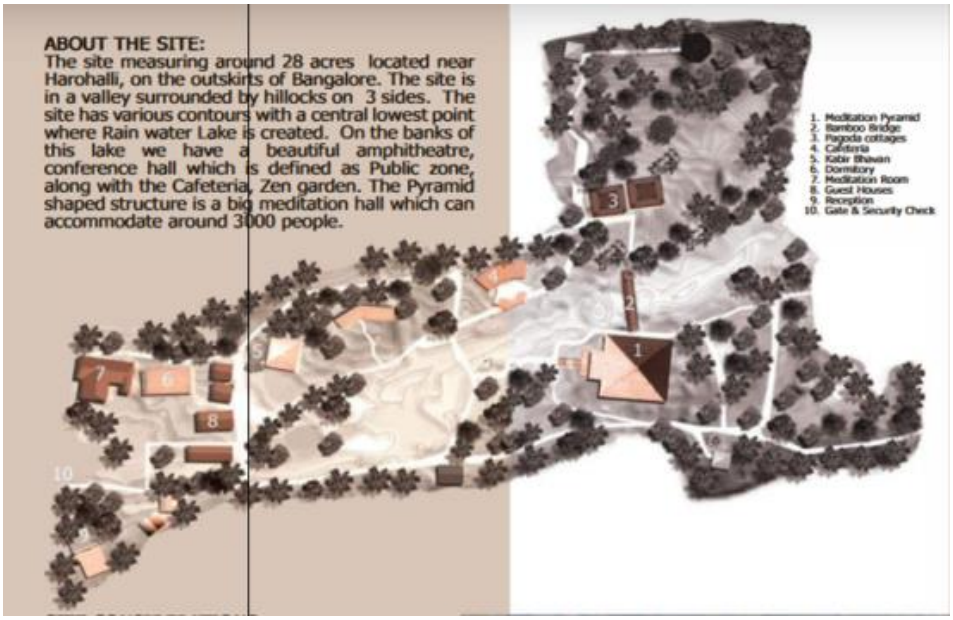

Figure 4: Pyramid Valley International

(*Source:* https://issuu.com/bharathiprem/docs/copy_of_pyramid_valley_portfolio)

Figure 5 Landscape Elements in Pyramid Valley International

(*Source:* https://issuu.com/bharathiprem/docs/copy_of_pyramid_valley_portfolio)

3.4 CHINMAY VIBHOOTI ASHRAM AT KOLVAN, PUNE

Completed in year 2010 founded by Chinmaya Mission Trust this spiritual center is located amidst the Sahyadri ranges near Pune(iv).

Figure 6: Site Plan of Chinmaya Vibhuti Ashram

(*Source:* https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj_qZfn_aL2AhUEyosBHeiABc0QFnoECEkQAQ&url=http%3A%2F%2Fwww.g7architects.in%2Fv3s%2Fcsc_chinmaya.php&usg=AOvVaw33tULEL9xMhnLsXZ1uXqCd)

Figure 7: Swanubhooti Vatika

(*Source:* https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwj_qZfn_aL2AhUEyosBHeiABc0QFnoECEkQAQ&url=http%3A%2F%2Fwww.g7architects.in%2Fv3s%2Fcsc_chinmaya.php&usg=AOvVaw33tULEL9xMhnLsXZ1uXqCd)

Observed elements of landscape stimulating sensory aspect of human being spiritually:

- The landscape planning for the park Swanubhooti Vatika was to connect humans to nature and ones consciousness..
- Indigenous hardscape and softscape is used.
- **Prashnapath**: A path by which we enter the garden stimulates the visitors to think within.

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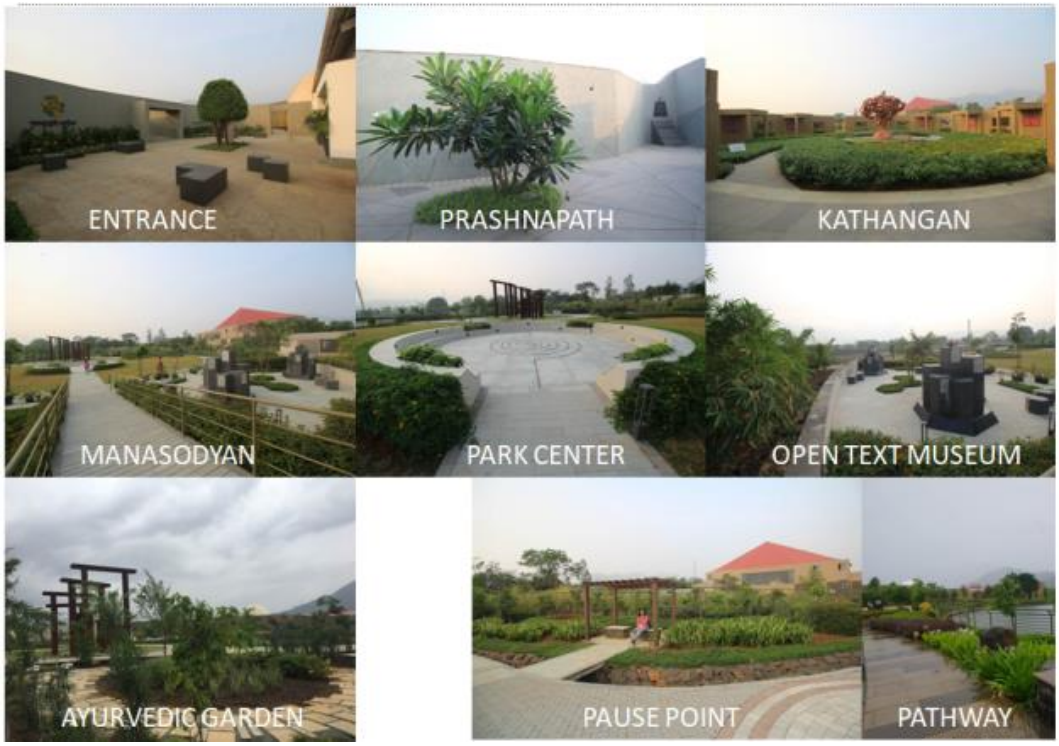

Figure 8: Swanubhooti Vatika: Landscape Spaces

(*Source:* https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjAnbzY-6L2AhWqyosBHfvxDYwQFnoECAQQAQ&url=https%3A%2F%2Fworldlandscapearchitect.com%2Fswanubhooti-vatika-pune-india%2F&usg=AOvVaw2VA9eUqn3m8kLJy2_bzQP0)

- **Gurusthali**
- **Kathangan**: An exhibition space succeeding the Prashnapath which shares incidences from our ancient wisdom in a semi-covered passage with open to sky court inbetween.
- **Anand Sarovar**: A lake at Swanubooti Vatika having a statue of Lord Hanuman provides a sense of suttleness.
- **Manosodyan**
- **Open-text museum**: Wisdom thoughts displayed on hexagonal forms around 1.5 m height.
- **Vijay yantra amphitheatre**
- **Nakshatra Van**: Garden inspired by nakshatra
- **Ayurved garden**: Has frames in ascending or descending manner and its related concept.,etc.

4. RESULTS AND DISCUSSION

Table 1: Analysis of the Case Studies from Observation

	AOL, Bengaluru	***Matri Mandir***	***Pyramid Valley, Bengaluru***	***Chinmaya Vibhuti, Pune***
Landscape integrated with builtform	No	Yes	No	No
Landscape forms/concepts inspired by ancient history	Yes	No	No	Yes
Indigenous softscape and hardscape	Yes	Yes	Yes	Yes

From the above data analysed and results obtained it is seen that,

(a) Only Matri Mandir has the integration of the landscape with its builtform. So, the landscapes for other campuses are seen in patches.

(b) Art of Living and Chinmay Vibhuti Ashrams have a part of landscape inspired by ancient Indian literature while Matri Mandir's gardens are inspired by petals and of Pyramid Valley are in their natural precinct.
(c) Indigenous hardscape and softscape has been used in all the studied campuses.

5. CONCLUSIONS

From the results obtained we can conclude that a successful landscape design for spiritual campus requires:

(a) Integration of the built-form with landscape,
(b) Landscape inspired by ancient spiritual concepts,
(c) Use of indigenous softscape and hardscape materials.

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Cultural Expressions in Architecture

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ABSTRACT: Vernacular Architecture reflects and influences culture. Cultural practices and design undistinguishable endeavors of mankind. [2] Architecture is supposed to create spaces for shelter against weather conditions and these conditions directed civilizations on various levels.[2] Settlements got built, individuals migrated from their hometown to some another area and developed a dwelling in that region and thus the culture got formed. With culture, there came beliefs, tradition, living, geographical relief, food, customs and architecture. Architecture of place is defined by the context and surrounding of the region.

Keywords: *Culture, Civilizations, Settlements, Context, Vernacular.*

1. INTRODUCTION

Time has been a witness to the changing climate, culture, moreover the social and economic aspects of people and the environments.[1] Vernacular Architecture has always been a way of building locally in adaptation to cultural, social and the micro-climate of a particular region.[1] It has evolved with time with the help of better equipment's and skilled workmanship. Vernacular architecture constantly adapts to its surroundings, with change in culture and tradition

The culture of each society is identified through its manifestations such as language, art, and architecture.[2] Architecture and culture are pleasant and indistinct standards that constitute the identity of the society. The grandeur of structure can outline any civilization and introduce itself as an iconic and cultural idea for spotting the cultural values of the society. Architecture as an element of human lifestyles displays the tradition in each society interacting with structural, historical, economic, and social capabilities of society. People in every country try to comply with their norms and hold their values in making of architecture by making use of the material and things changing the cultural and social attitudes in clique have strong influence on architecture. Therefore the role of culture in promoting architecture is essential.[2]

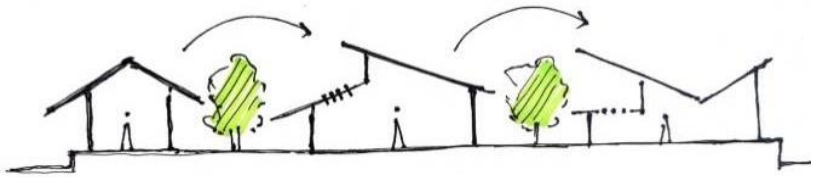

Figure 1: Evolution of Vernacular Architecture

Aim: To study the importance of culture in architecture.

Objectives

(a) to understand the cultural significance of a region.
(b) To understand the merging of cultural expressions in the design process along with vernacular architecture.

Scope and limitations: Study has been carried out to understand the influence of culture on a region. Different case studies and research paper will be analysed in this process.

This research paper studies the tribal communities' culture and their cultural influence on the region where the settlement has been flourished.

2. LITERATURE REVIEW

Culture is everything that people have, think, perceive, know, feel, and do as members of society.[9] "Culture is the material and non-material works of arts and science, plus the knowledge; manners; education, made of thought; behavior

and attitude accumulated by people through their history.[9] The very essence of any built form or built environment is the manifestation of culture hidden behind its layers of abstraction. The manifestation can be regal and imposing like that of mighty empires, or it can be simple but powerful in creating an identity for them who hold onto it. Creating the expression of culture in built form is often the unconscious effort of every designer.[10] In fact, culture plays a dominant role in every design process from the very beginning.[10] This is because any design, designed to perform a desired function is directly or indirectly derived from or synchronized with the user's cultural identity. It adds our thought processes. Architecture is art that combines the expression, technology and satisfaction of human needs.[2] The purpose is to make places where people are more humane, more lively and happier". Society is the product of culture and people are the inhabitants of society. Therefore, people always express it socially and culturally. Architecture is an aesthetic art of creating vital living space for people. "Architecture is a profession rooted in culture". Architecture is a manifestation and expression of culture. Therefore, architecture and culture are interdependent and inextricably linked.

3. CASE STUDIES

3.1 Case of Manapad in the Coastal Stretch of Tuticorin

Manapad is about 58 kms south of Tuticorin, a port town in South India. Manapad's coastline stretches approximately 3145 m and has a total area of 260 hectares.[5] It is a Christian populated area with a total population of around 6000 inhabitants.[5]

Culture of manapad: Manapad has a distinct culture as it has gone through many changes in its religion, profession, etc. It has a cultural mix of India, Portugal and Ceylon. This resulted in a cultural mix which is also reflected in their outward appearances such as dress style, food, language (Tamil accent) etc. It had an extroverted layout with many open and semi-open spaces towards the streets and the sea to provide good views.

Religious context: Manapad is said to have practiced Hinduism from the beginning. It is famous for its coral reefs and pearl oysters and hence the Muslim rulers came to this place. This caused unrest in the place and they also tortured the natives by imposing heavy taxes and penalties on them**.** This is one of the reasons why Muslim religion is still devoid in this place.[v] The advent of Christianity was attributable to the arrival of the Dutch sailors and that since Francis Xavier. Thus the village is inhabited predominantly by Christians.

Figure 2: Maps Showing the Growth of the Village [5]

Social background, custom, lifestyle & family structure: Satisfaction based on the socioeconomic classification and the community/caste is to be seen between of the village. The village has a Ceylon-Portuguese cluster, Nadar cluster and Paravas cluster. Each of these clusters has a different culture which is reflected in their architecture too. These clusters contains of the people belonging to the identical family. Their common workplace like public sale yards, fishing net sewing sheds etc. are all located contrary to their living areas and close to the sea. The spaces in between the clusters and the surrounding open spaces are vibrant and used for multi activities like social gathering spaces, play areas etc.[8]

The first settlement grew in a natural manner alongside the coastal line, in which fishing turned into the primary occupation.

The second settlement grew in clusters with the occupations being supported by fishing activities like boat building, etc.

The third settlement is a planned settlement. It's planned in grid pattern with churches on the one side and the back waters on the other. This settlement has high class people staying in.

Street Pattern: The main streets are the traditional streets which facilitate chariot movement during church festivals. The next category of roads is slightly lesser in width and connects the clusters with the primary roads. The final category of

roads are very small and segregates various clusters from one another.[5] All the road intersections have a small shrine/grotto, that is constructed and maintained by the citizens of that road itself.

Analysis of the Case Example

The sample selected for study is 120 years old and is situated in the properly planned grid iron settlement area of Ceylon-Portuguese cluster. It is located at the intersection of two streets, adjoining a grotto and a small shrine.[5] This house is situated on the banks of the backwater.[1] It has two different cultural influences (Sri Lanka, Indo-Portuguese) in its architecture. These houses have an extroverted planning with lot of open and semi-open spaces like Balcoes, verandas, and Balconies etc. which faces the street and sea.

Figure 3: Map Showing Location of Case Example [5]

Culture and Architecture: The village is a Christian ruled city. Different church buildings had been constructed in extraordinary clusters. This created a department many of the population with appreciate to the church they had been entitled to. There also are Grottos on the intersection of each street. There is separate worshiping vicinity in the house. This indicates their closeness of their religion. The humans additionally rejoice diverse church feasts all through the year. Marriage and different rituals take vicinity consistent with the Indo- Portuguese custom.

Conclusion: Culture and climate performs a crucial function in Vernacular architecture. This is found out through the evaluation of vernacular structure of Manapad. Its architecture displays the sensitivity to its particular subculture from the agreement stage to a man or woman constructed shape stage. They also are touchy to the socio desires of the customers thru the supply of open and semi-open areas (verandas, balcoes and balconies). The homes display its flexible nature by adapting to Tamil culture in Ceylon Portuguese homes. Thus the architecture of Manapad is solely the end result in their cultural expression.

4. STUDY OF TRIBAL COMMUNITY OF MADHYA PRADESH

Madhya Pradesh is a state located in the Central India. It is known for its tribal culture and habitat. Each tribe has a unique settlement due to climate, topography and availability of materials. The culture and architecture are closely knitted.

Culture and Architecture of Madhya Pradesh

The state is well-known for tribal culture and folks traditions.[5] Patterns of textiles also are pondered withinside the vernacular architecture. Dancing and singing are part of their everyday life. It is a community hobby performed every day after the work. Therefore, those sports have developed the need of a network area like courtyard and chapel within side the agreement sample. Each tribe has its very own manner of agreement sample on the idea in their culture and way of life like Sahara has circular, Bhil has scattered and Koru has linear. The indoors walls of homes are depicted with the figures of birds, animals, timber and god-goddess through comfort work.

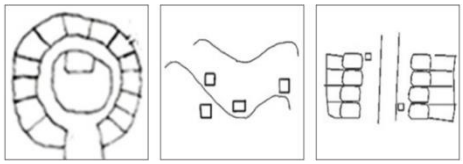

Figure 4: Plan Showing Different Types of Settlements [5]

Moderen District has been chosen for the case study of Saharia tribe located on the north west of Madhya Pradesh.

Ecological aspect: Ecological isolation influenced the Saharia to stay as cultural isolates. They have got rituals and ideals related to trees, maximum villages have mystery areas under the trees. In Khariyapura village the settlement is on a plateau surrounded by the hills, cultivated land and forest. These sorts of settlements are evolved from the ecological setting and enable them to maintain a vigil and shield their crops. Due to the undulating plateau, it isn't clean for a stranger to discover a Saharia village.[6] The Saharia maintained ecological equilibrium with their surroundings for ages, despite the low level of technology.

Architectural Aspect

The settlement is hooked up through the pedestrian pathway to the primary road. The houses are orientated closer to east, north, and west forming a round pattern. The front of the settlement is from the south. The front facade of all of the homes is closer to the center. They have a way of life of joint family. The joint families have a larger cluster at the same time as nuclear have smaller ones. There is a place of worship within side the centre of the settlement and adjoining to it is a community area known as Choupal.

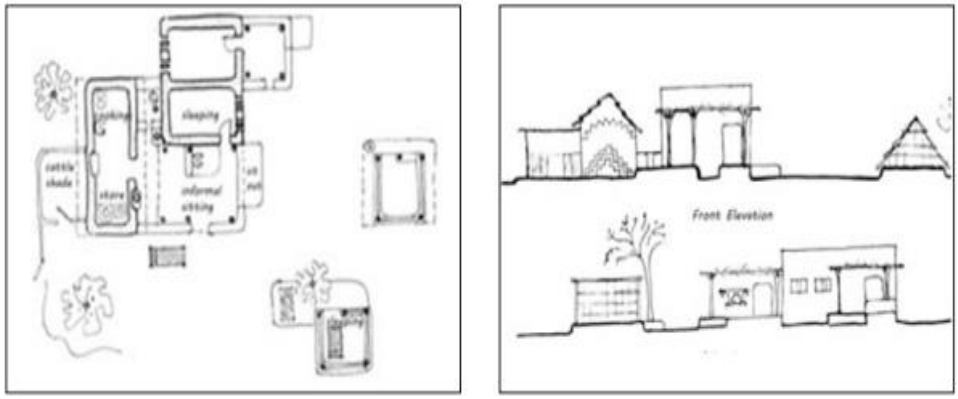

Figure 5: Plan of Saharia Dwelling at Kahariya Village [v]

Construction Method and Techniques: The materials used for the production of homes depend on locally available materials. Houses are load-bearing the shape of random rubble masonry and dust mortar. They move for a shallow basis due to tough strata. The partitions are made from stones, plastered with mud; cow-dung is used as a finishing material. The partitions are painted with lime, minerals, and natural colours. In order to save your clay surfaces from cracking and crumbling a fresh coat of clay and cow dung is implemented from time to time.

Conclusion: The range of the local lifestyle is eloquent in the manner they deal with and manipulate their surroundings. The constructed surroundings are fashioned with the aid of using the values and cultural believes of the community. The vernacular form of structure is rapidly being changed with new industrial materials consisting of metallic and concrete. It has been located that after constructing fail to meet the fundamental necessities of cutting-edge standards, conflicts arises and often results in overcrowding. To increase physical sustainability, restore the buildings, cultural individual with community partnership and their way of life knowledge. Upgradation and adaptive use of locally available material need to be encouraged.

5. VERNACULAR ARCHITECTURE AND SETTLEMENT OF DIASPORIC 'MANIPURI' COMMUNITY

For 1000 years, Bangladesh has been home to many ethnic groups with numerous races, languages, and cultures.[11] This ethnic range of vicinity and tradition has additionally been meditated in the different vernacular architecture of the Bengal delta. The Manipuri are one of Bangladesh's foremost ethnic races, who migrated within side the 17th century from the Indian kingdom of Manipur. Over the years considering the fact that migration, they maintained their vital identification through their cultural practice. Their distinct characteristics, while adapting to the nearby context, are remarkably meditated by their language, dressing, cultural practices, ritual practices, and structure. As Rapport stated, the vernacular structure is a direct expression of society and tradition.

Analysis of Manipuri settlement and architecture settlement planning system:

The surveys effects display that Bangladeshi Manipuri's opt to stay in small clans contain 10–20 houses.[11] This linear outside area offers a completely unique man or woman to Manipuri Para, as this isn't very standard in common villages.[11] This linear area features as a network area and offers a feel of territory within the network. Besides, this slim area features as a buffer among public features, services, and personal residences. Overall zoning precept of a Manipuri Para indicates a logical connection of various useful spaces, in which character families are tied up with network features.

Interpretation of Manipuri vernacular practice:

After studying the patterns, responses, the elements that give Manipuri dwelling a unique character are found out.[11] Vernacular architecture for the Bangladeshi Manipuri community is a good example of how traditions continue to modernity and social values reflect through form and space. The authors seek to further interpret the dwelling culture of Manipuri by defining socio-cultural, socio religious, environmental facets.

Cultural aspects of Manipuri dwellings:

The indigenous traditional knowledge system is an important cultural aspect possessed by every ethnic community.[11] Over the years, ethnic communities have maintained their understanding and anchored their cultural practices through cultural expressions. Vernacular architecture is a repository of the traditional knowledge of specific ethnic communities, where cultural values are preserved in their vernacular technology, material culture, and aesthetic expression. Through the years, the Manipuri preserve their home culture through a manuscript (yum = house, sha = build, rol = method) written by Yumsarol.[11] The mandapa holds great importance as it gives the Manipuri community a unique cultural identity. Year-round, Mandapa is a learning and practice ground for various performing arts such as dancing, singing and community theatre. This also serves the purpose of community education for religious instruction and craft training. Manipuri house forms are an excellent source of both tangible and intangible cultural values.

Aspects	***Madhya Pradesh***	***Manipur***
Family structure	Nuclear family	Joint family system
Fairs and festivals	Mixed culture like holi, Christmas	Holi, Christmas,lui nagai ni
Beliefs and rituals	Believed in nature	believed in deity
Common place	Centre of the settlement served as gathering spaces	Verandah used as multi-functional space for private and public festivals

6. CONCLUSION

As it is observed the modifications in lifestyle and structure are reciprocal. The effect of one is meditated at the other. India's rich cultural history is vanishing because of the effect of urbanization and globalization. In order to guard and preserve our wealthy cultural and architectural history the factors of vernacular must be integrated with inside the present day making plans and structure. The provision must be made to include vernacular structure and conventional expertise within side the policies. The paper concludes with the aid of using mastering and appreciating the concepts of vernacular structure and integrating them with present day expertise and technology. Custom and traditions make an influence at the location and with preserving the fundamental, cultural, and artistic elements within side the constructing, a completely easy construction without spirit turn into a great construction. More importantly, the characteristic of the construction can evolve the expression of the architect and it's far simultaneous with the emergence of the message of structure, towns, and areas. Following the sample and numerous traditions has created a numerous structures and vernacular language.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. Tejaswini Marode for her valuable guidance, inspiration and encouragement. Her keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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Cymatics a Visionary Architecture

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ABSTRACT: Music is everywhere, even our heartbeat is a piece of music. Every matter that exists in the universe is vibrating on its frequency, resonating with each other with rhythm. Architecture appeals to the eye, whereas music appeals to the ear, both music and architecture require an artistic mind to create. The study of sound visualisation is known as Cymatics. Geometry can be found in sound. A sound at a certain level of frequency can help a human body to heal by listening to sound and by feeling it An interactive process between a human and a structure in which the musical sound plays a major role. There will be a sense of connection between living and non-living things.

Keywords*: Cymatics, Sacred Geometry, Intricate Patterns, Soundscape, Acoustics.*

1. INTRODUCTION

All artists are concerned with the concepts of space and time. Music and architecture have both evolved through tangible and intangible stages. As abstract art forms built on rhythm, proportion, and harmony, architecture and music have a clear cultural connection. This is how music and architecture interact in order for them to be physically felt and spiritually comprehended.

2. RESEARCH QUESTIONS

- What does music look like?
- What if sound is visible through 3-dimensional volume and lights?
- How can a cymatics approach assist in the creation of complicated patterns?
- What is the relationship between architecture and cymatics?
- What role does sound play in the healing of the human body and mind?

Aim: The goal was to comprehend cymatics through the lens of architectural form and how architecture and sound helps a human to heal.

Objective: To see sound as a physical pattern and to investigate the patterns formed by vibrating bodies.

Scope: The scope is to develop a sensitive approach to building the structure by analysing sound. We may interpret our surrounding sounds using acoustics and cymatics, which will establish a sense of understanding between person and architecture and create the structure according to it.

By using architectural form and sound therapy we can enhances the user experiences by combing structural form and sounds.

2. LITERATURE REVIEW

2.1 What is Cymatics?

When a sound is carried over water or sand, it tries to imitate the natural pattern. It's an exploration into the vibrations of visual sound. The visualisation of Cymatics is visible in two dimensions, but it may be turned to three dimensions utilising audio mapping and 3D software. In the digital age, we can understand sound and see patterns.

The sounds can be observed in a visual format, according to Ernst Chladni, a German scientist and musician. His demonstrations entail using a flat plate with sand to demonstrate the patterns that sound creates at various frequencies. On the metal plate where the sand forms a mandala pattern, multiple frequencies are blasted.

2.2 Human and Cymatics

Humans are largely made up of water. Furthermore, water makes about 99 percent of the molecules in our system. There is a link between the creation of a human-machine interface that uses water as the medium and sound waves as the medium.

When a certain song or piece of music is played, it produces frequencies that modify brain waves, resulting in emotional changes. It has a big impact on a person's health and happiness.

The human ear can hear sound frequencies ranging from 20 Hz to 20 kHz at varied amplitudes. Because of the sound of the cave walls, our words are heard louder in the cave.

A fifty-year experiment on the human senses was conducted by Alfred Tomatis, a French doctor. Because the auditory nerve is related to all of the body's muscles, sound has an impact on the body's balance and flexibility, as well as the sense of sight. Because the inner ear is related to all areas of the body, including the heart, lungs, liver, stomach, and intestines, sound frequencies have an impact on the entire body. (Victor Christianto, January 2020)

Dr. Masaru Emoto, a Japanese author, researcher, photographer, and entrepreneur, claims that human awareness affects water's molecular structure.

Sound waves, for example, alter a liquid surface into a certain pattern based on the wave's frequency. The patterns generated on the water surface resemble a QR code in appearance. Many of these pictures are reminiscent of the traditional mandalas or yantras seen in temples all around the world. These mandalas and yantras have a profound scientific meaning. (CHRONICLE., 22 October 2017)

2.3 Human Chakras and Cymatics

In Sanskrit, the term 'chakra' implies wheel or circle. Each of the seven centres is a receptor that vitalizes the body with prana, or life force energy, by connecting subtle energies with the physical body. All chakras must be operating properly and in harmony with one another in order to preserve emotional, mental, physical, and spiritual health.A system of chakra sounds was created by famous sound healer Jonathan Goldman, in which the imaged on the CymaScope can be used as a meditation aid. Surprisingly, when he visualised the heart chakra, it took the shape of a heart. (Merrick, 26 May 2015)

2.4 Architecture and Cymatics

We find diverse patterns and textures throughout Nature, whether alive or inanimate, that might be symmetrical or asymmetrical.

At both the largest and smallest sizes, serial components, or recurrent patterns, may be detected. The events don't happen in a linear or continuous sequence, but rather in a constant state of vibration, oscillation, undulation, and pulsation.

The resulting circular, geometric forms can be considered mandalas in and of themselves. These structures may be found all over nature, from the sunflower head to the nautilus Shell to the pinecone. (Tuzzio, 29 November 2014)

When architecture and sound meet, we may call it sonic architecture, which is a field concerned with the building and reconstruction of architectural environments from a listening viewpoint, as well as the other way around.

Sound is different from practically any other environmental data that can be collected, according to Ar. Alican Inal's paper *"Sonice architecture: examining the link between places and sound."*

As architects, that degree of understanding is invaluable. However, in order to truly comprehend the advantages of sound as a design tool, we must first visualise it. The first step is to create a spectrogram, which is a computer-generated picture.

It is feasible to generate more detailed, site-specific 3D models of the sound environment by merging the data from several spectrograms together. Soundscapes are the name for these sorts of models. It's possible to build constructions whose entire form is governed by sound, which may lead to some really intriguing effects. (INAL, 12 May 2020)

3. MATERIAL AND METHODOLOGY

The goal of the research was to learn how sound may be used in architecture and other industries. Sound, cymatics, natural elements, fractals, the human body, and architectural spaces were linked using various approaches. In terms of form and energy, the factors mentioned above are intimately connected.

We can create attractive acoustical architectural environments by learning about each element and connecting on a common ground.

4. RESULTS AND DISCUSSION

"If you want to learn the secrets of the universe, think in terms of energy, frequency and vibration."

—Nikola Tesla

Musical therapy, often known as sound therapy, is a type of treatment in which music is used as a means of communication between the therapist and the patients. The patient uses musical instruments to communicate their feelings, which leads to interaction with other participants of the treatment session.

The cymatics technique can enhance both soundscapes and sacred geometry. The two disciplines of sacred geometry and cymatics are interwoven.

It is evident that the complicated pattern that exists around us is moulded consciously or subconsciously by the environment's sound, with cymatics playing a significant part.

4.1 Sacred Geometry

Sacred Geometry is often referred to as the "architecture of the universe", it is found throughout the natural world. It is all around us and is one of the very few subjects that satisfy both the left brain and right brain hemispheres simultaneously. It satisfies the left brains desire for logical, sequential and objective data.

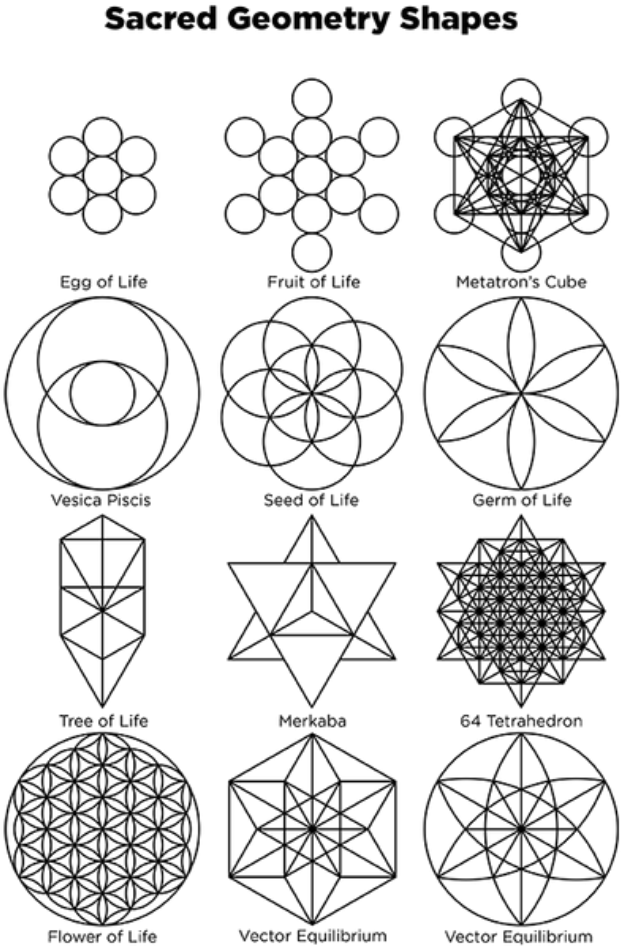

Figure 1: Sacred Geometry Shapes

As we can see from the above image sacred geometry and cymatics have similarities between them in terms of shapes and patterns. (Morgan, 4 September 2019)

The molecules of our DNA, the cornea of our eye, snowflakes, flower petals, crystals, a shell, the stars, the galaxy we spiral within, the air we breathe, and all life forms are created out of geometric codes.

The main finding that will blow our mind is in the Chladni plate experiment. In his experiment using metal plate and sand the patterns that emerged with the help of frequency and vibrations. Various sound patterns based on frequencies were generated during this experiment.

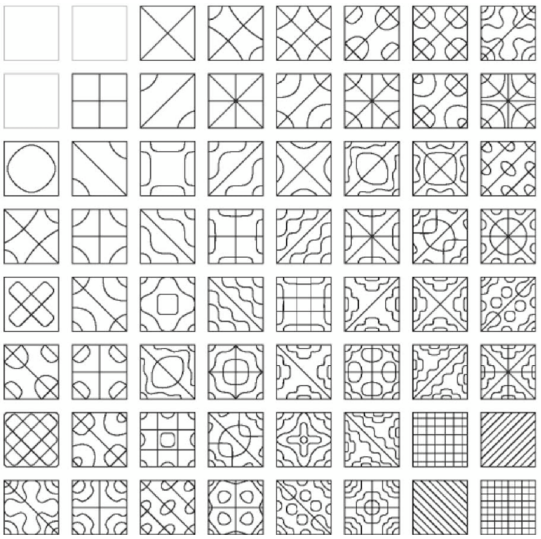

Figure 2: Patterns Generated during Chladni Experiment

Ernst Chladni's scientific experiment can be connected to our old devotional songs and sound patterns can be visualized.

Example can be seen in the sound OM and Sri yantra (The Sri Yantra also called Sri Chakra is a beautiful and complex sacred geometry used for worship, devotion and meditation.)

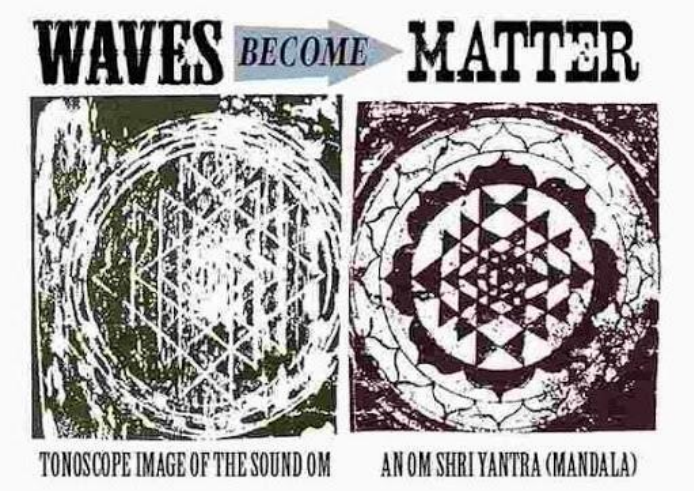

Figure 3: Tonoscope Image of the Sound OM and Sri yantra

5. CONCLUSION

After mentioned the advancements in this study, its clear that everything in this universe are connected to each other and vibrating in its own frequency. The matter shaped through the sound and vibration.

By utilizing the sound data, 3d software, technology and different types of materials we can make beautiful sustain environment and architecture in our surrounding.

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The Impact of Green Architecture on the Environment of the Neighborhood

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ABSTRACT: Today in the 21st century, the world is developing faster, resulting in serious problems of environmental and human health. Buildings becoming a huge consumer of energy and land which leads to serious topics such as global warming, heat island effect, etc. Green building design is becoming widely adopted and is being promoted for sustainable health. It improves the environment as well as heals human health through various methods. They must not be only eco-friendly but should also be functional to provide a comfortable, workable, living, and calm environment for human activities. It is realized that green buildings as a universal response to spread awareness and knowledge of the role of human activity in global climate changes, environmental degradation with maximum expression in LEED Certification and other assessing methods. This paper aims at highlighting the impact on the building environment which encompasses the scope of the positive environment by studying the materials, benefits, and techniques of green building globally.

Keywords: *Maximum, Global-Warming, Green Building, Sustainable, Environment, Certification.*

1. INTRODUCTION AND BACKGROUND STUDY

India is a developing country which leads to an increase in population and rapid development. The robust increase in technological advancement and the growth of GDP has brought in huge demand for residential buildings. Development has led to focal changes in world development, which mainly includes natural, social, economic, and Environments on the green land become a problem to the world's environmental condition. Buildings interact with the environment in numerous ways as the traditional construction methods and materials are damaging the ecosystem because they release greenhouse gases, dust and consume resources in form of water, energy, materials, etc. The construction industry is one of the largest sectors for environmental degradation. A large quantity of carbon dioxide gas is emitted throughout construction. It is calculable that 40 percent of energy consumption and one-third of all greenhouse gases emissions worldwide (United Nations Environment Programme, 2009) is caused by the sector. Nearby 40-50 percent of electricity is consumed domestically for air conditioning (the National Climate Change Secretariat, 2012).

Hence, buildings are major pollutants that affect the ground coverage, air quality and are accountable for climate change. To resolve these issues, it is necessary to change the construction techniques & to consider green building design. It also ensures that the human standard of living can be constant and not scarce. The three effective factors are environmental, economic, and social. Environmentally, A green design decreases the use of energy, water, waste, prevents environmental degradation, and promotes the use of natural resources. Economically, the total operation and maintenance cost is reduced which is usually spent on productivity. And socially, it has a positive impact on the ground coverage and neighboring infrastructure. Green buildings are meant to be beautiful and we live, play, and work in that ecosystem, it has a mental and physical connection to our health and environment in numerous ways.

1.1 Topic

The impact of green architecture on the environment of the neighborhood.

1.2 Research Question

Can green buildings principles and materials help achieve an impact on the building environment?

1.3 Aim

Design green buildings by blending spaces between nature and humans using modern technology.

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1.5 Objectives

- To study different green/eco-friendly material and their benefits.
- To study the techniques used in the construction of green buildings.

1.6 Scope

- Reducing energy consumption and adverse environmental impact.
- Thermal insulation due to cooler temperatures of the external facade itself.
- Sustainable construction practice.
- Higher property value
- Overall health improvements

1.7 Limitations:

- Difficult renovations
- Misaligned incentives
- The initial building cost is high

2. LITERATURE REVIEW

2.1 Green Architecture and Design

Green Architecture is the integration of structures by using resource-efficient methods that are sustainable at each stage from design to construction to operation. The aim is to accomplish the minimum possible effect on the environment by choosing green/eco-friendly building materials.

Ventilation systems designed for efficient heating and cooling, Energy-efficient lighting and appliances, Water-saving plumbing fixtures, Landscapes planned to maximize passive solar energy, less harm to the natural habitat, Alternate power sources such as solar power or wind power, non-synthetic, non-toxic materials, Locally-obtained woods and stone, Responsibly-harvested woods, Adaptive reuse of older buildings, Use of recycled architectural salvage, Efficient use of space

2.2 Need of Green Building

Among the production and manufacturing sectors, the building and construction sectors occupy the uppermost place as the largest contributor to pollution and natural resource consumption (Levine *et al.*, 2007; Plank, 2008). It is to be noted that, buildings are one of the major consumers of natural resources and account for a major portion of the greenhouse gas emissions

It is said that buildings are one of the main consumers of natural resources and a part of greenhouse gas emissions. Apart from using resources such as energy and raw materials buildings also produce waste and potentially harmful atmospheric emissions (Alnaser *et al.*, 2008). Buildings around the globe are estimated to consume 40% of natural resources, 25% of water, 35% of energy, and generate 40% waste and 35% of Green House Gases (United Nations Environment Program, 2009). Thus, it is essential to design green buildings to save energy, decrease wastage and stop the environment from degrading.

Title of paper—Green Architecture: A Concept of Sustainability
Author—Amany Ragheb, Hisham El-Shimy, Ghada Ragheb
Year of publication—2016

The increase in the number of green buildings revolutionized the architecture field. Continue to satisfy mother earth by building more and more green buildings. The energy performance index determined by the total energy consumed upon total built-up area should be understood in the right context and is not the only determinant of a green building. Operation and maintenance are critical for maintaining “greenness”. Buildings undergoing green rating should be monitored through construction and operation. All green parameters should be checked and performance should be judged based on holistic performance. Large construction projects undergoing environmental clearance are required to incorporate most of the green/sustainability parameters as required by green building rating systems. Green materials and passive cooling and heating technology

should be analyzed and implemented appropriately. Green building and sustainability are one of the most trending subjects globally, which has been spread to decrease the negative impacts of the construction industry. (Amany Ragheb, October 2015)

Title of paper—A Review Paper on Green Building Research
Author—Mr. Apoorva V.Kotkar, Prof. Hemant Salunkhe
Year of publication - 2017

This paper study reported all the technical and also economic aspects related to green buildings globally. Also, through this live case study of a small residential bungalow in a small town of India, it is expected to attract at least researchers all over the world, especially in India, and also to all the readers towards the planning of their new homes or modifying old ones by simple modifications and converting it into a green or a sustainable building for future long-term savings. (Mr. Apoorva V.Kotkar, July 2017)

Research gap: We analyzed various studies performed and practiced in the construction of green buildings. Agreeing with the advantages of construction techniques, material, and green building benefits, the literature also concludes that there are some gaps in it. Construction of a green building can be difficult and also meet every rating system. There are limitations in the material industry from finding the right material and getting it in an affordable and large quantity. Even though the return is high and environmental degradation is reduced but the initial building cost is high. The initial cost depends on eco-friendly technologies, skilled labor, and resources that are supposed to be implemented in the design. We identify possible areas for future research and suggest recommendations in the conclusion to fill these gaps.

3. METHODOLOGY

This research paper is aimed at the study of the development and construction of the green building. together. The primary objective of the research study was to find out the green/eco-friendly buildings materials and techniques/technologies used in the construction. Also, it aims to find the impact of green architecture on the people by blending modern and green structures making people aware of the environment and its advantages.

This study is conducted through a complete review of the literature published in various national and international papers and literature. The methodology adopted to complete the research includes literature reviews, case studies, documentaries, and a few other qualitative methods.

The systematic approach followed during the paper consist of below steps

Introduction

Collection of preliminary information through literature study.

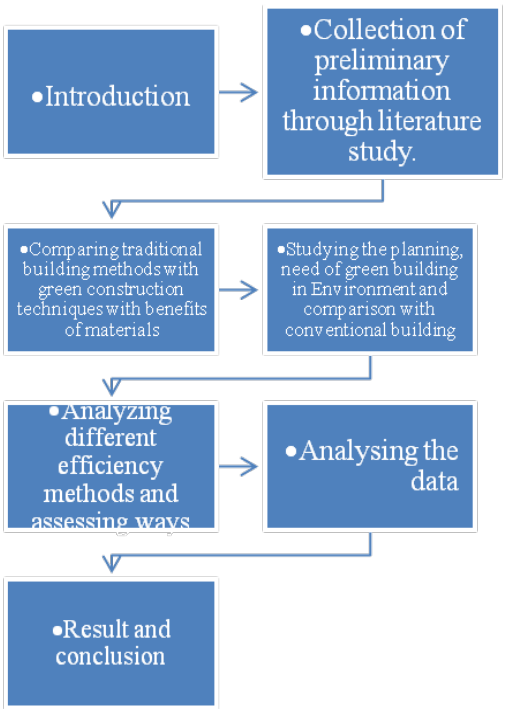
Comparing traditional building methods with green construction techniques with benefits of materials

Studying the planning, need of green building in Environment and comparison with conventional building

Analyzing different efficiency methods and assessing ways

Analysing the data

Result and conclusion



Flow Chart

4. RESULT AND DISCUSSION

4.1 Benefits of Green Buildings

Newly built green buildings can have tremendous benefits. The benefits include the reduction in water savings ranging from 30% to 50% and energy consumption savings may range from 20% to 30%. Enhanced air quality, excellent daylighting, health & well-being of the occupants, safety benefits, and conservation of scarce national resources.

Decreased wastage of water:

- Reserve natural resources
- Improve indoor and outdoor air and water quality
- Protect biodiversity and ecosystems
- Improve occupant productivity
- Reduce operating costs
- Reduction and optimization of energy consumption
- Health, comfort, and safety of all occupants
- (Dr. Bidyut Jyoti Gogoi, 2017,)

4.2 Material Efficiency in Buildings

Material that has a high state of efficiency or recyclable content should be more implemented. The materials which are least processed, available locally, and are renewable should be considered which construction. Plant wood/materials like bamboo, straw, stone, metal, glass, steel, etc. reusable, renewable, and recycled material should be more executed. The EPA (Environmental Protection Agency) also recommends using recycled industrial goods/materials.

4.3 Energy Efficiency (embodied and operating energy) in buildings

Energy efficiency in green buildings means reducing the use of both embodied and operational energy. Embodied energy is that is consumed from the start to end of a project which includes manufacturing, extraction, transportation, distribution, assembly, installation, etc. in the building. Operating energy is which is used for the operation of all the services at the

occupancy stage which includes cooling, lighting, heating, etc. To reduce embodied cost/energy the sourcing of local materials should be considered. Nearby plants for materials and locally available materials will reduce the transportation cost instead of shipping them from a remote distance. Consider new/green/sustainable materials which have a high amount of recycled content or are directly used without any processing.

To decrease the operating energy, the structure should be designed as per the climatic condition, site context, etc. Use of windows, extra insulation, passive and active strategies, minimize the use of artificial lights, and maximize sunlight. The solar-based system should be installed for basic needs. Led lighting should be implemented instead of traditional bulbs that will cut down the energy cost. Smart appliances which have maximum energy rating should be used. Renewable energy is the future as can be used in numerous ways and has a good impact on livelihood.

4.4 Reduction of Construction Waste

Minimal construction waste during the work reduces the need for landfill, space allotment, cost, and transportation. Concrete, steel, wooden planks, and formworks are often excess on the construction site. Concrete is mainly premixed and delivered on the site but it is usually ordered in huge numbers to reduce the work delay as well to save the transport time. But, in the end, it is disposed of on the site or nearby area. Every material which causes waste should be ordered as well as used wisely by which the cost is saved, transportation is limited, landfill is reduced.

4.5 Green/Eco-friendly Materials and Their Benefits

The goal of using green building materials is to construct energy-efficient buildings.

- *Engineered Wood*—in the process of conversion of raw timber to wood products, most percentage of the wood is wasted. The wasted scrap is used to make walls, boards, etc. in the form of engineered wood. It contains different layers of wood such as scraps, softwood, etc.
- ***Bamboo:*** It is one of the most flexible and durable materials used in construction. They can be used to construct frames, walls, floors or support them, etc. The tree growth is fast so it is economical.
- ***SIPs***—Structural insulated panels consist of two sheets of oriented strand boards or flakeboards with a foam layer. They are used as walls and are available in large sizes. Skilled labor and heavy equipment to install.
- ***Insulated Concrete Form:*** These contain two layers with some space in the center. This space contains some arrangement for holding bars after placing reinforcement, concrete is poured. Lightweight and fire-resistant.
- ***Cordwood:*** Round pieces are laid one above each and are bonded with mortar mix. Environment friendly and strong with aesthetic appearance.
- ***Fibre Cement:*** Made up of cement, sand, and wood fibers. (S.Anupoju, 2021)

Including the above-listed materials, there are many more materials used for construction that have good qualities.

4.6 Construction Techniques

- Building for Energy Efficiency: Insulation
- Using Energy-Efficient Equipment
- Energy-Efficient Design: Passive Heating, Cooling, Ventilation, and Lighting
- Using Sustainable Building Materials
- Design for Low Environmental Impact
- Sustainable Resource Sourcing

4.7 Reducing Environmental Impact

Worldwide buildings are responsible for land degradation and energy crises. A huge portion of energy, water, electricity is consumed globally. Buildings account for 18% of global emissions currently. If new technologies in building or construction are not used during this time of rapid growth, emissions could double by 2050, according to the United Nations Environment Program. Vertical gardens, planting trees of the size of used ground coverage, and other methods should be measured.

(AMJAD NASSER, 2017)

4.7.1 *The four categories of green building materials*

Mainly the four categories are the ecological building material, the high-performance building material, the recycling building material, and the healthy building material

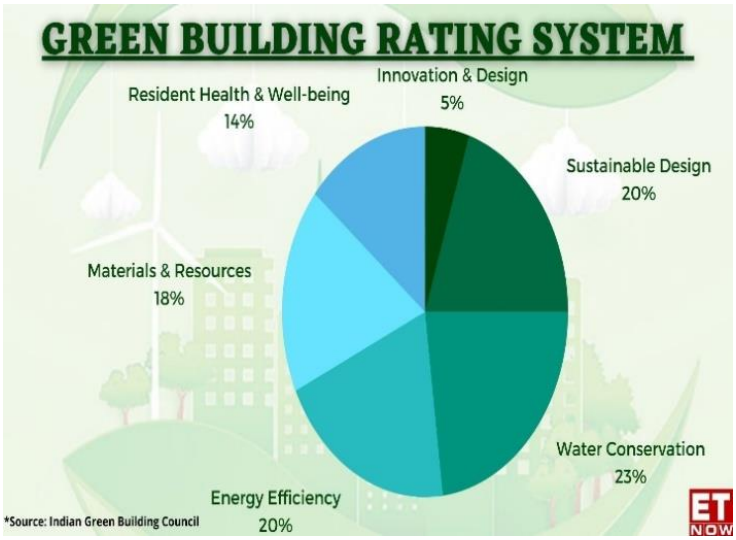
4.7.2 *The Ecological green building material*

In comparison with other conventional building materials, the green building material is the least processed for work. It should consume the least energy and resource.

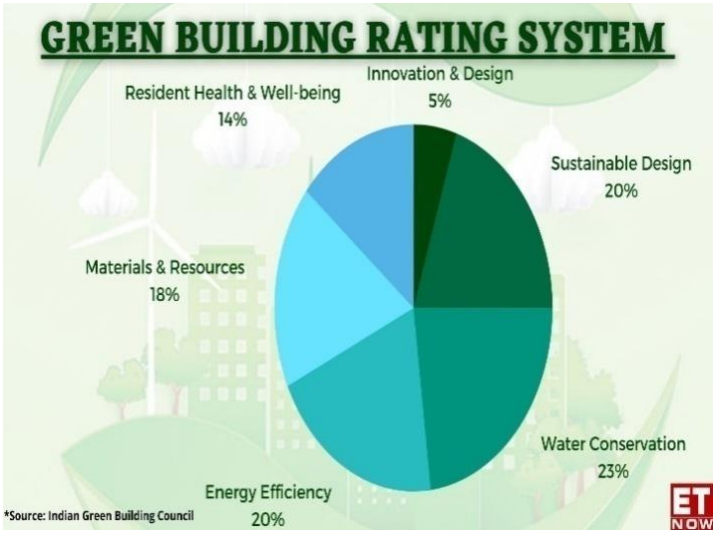
4.7.3 *Assessing methods and graph of green building*

- The three main rating systems in India
- GRIHA (Green Rating for Integrated Habitat Assessment)
- IGBC (Indian Green Building Council)
- LEED CERTIFICATION
- BEE (Bureau of Energy Efficiency) (AMJAD NASSER, 2017)

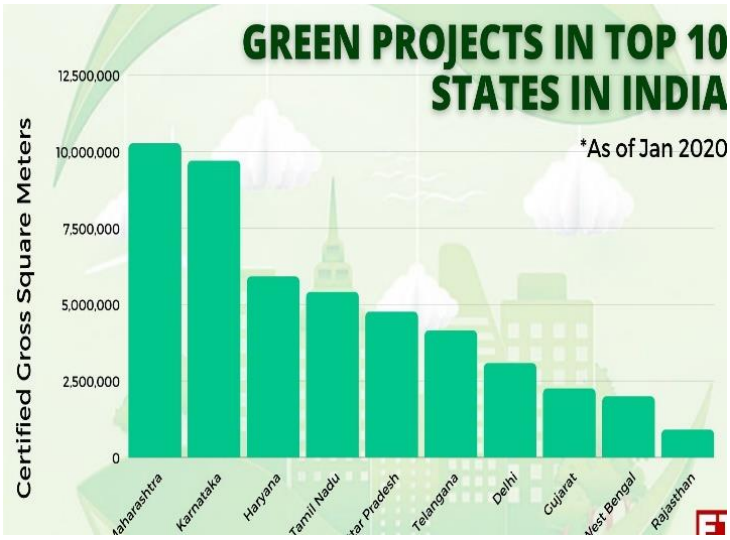
4.7.4 *Green building footprint 2020*



Source: Indian Green Building Council, ET NOW



Source: Indian Green Building Council, ET NOW.



Source: GCBI, USGBC, ET NOW.

5. CONCLUSION

With the rapid urban development, expanding economy, and globalization, A large quantity of carbon dioxide gas is emitted throughout construction. It is calculable that 40 percent of energy consumption and one-third of all greenhouse gases emissions worldwide (United Nations Environment Programme,, 2009) is caused by the building sector. Nearby 40-50 percent of electricity is consumed domestically for air conditioning (the National Climate Change Secretariat, 2012). Using Green materials will help not only in reducing carbon footprint but also in reducing temperature. It reduces construction, operational, maintenance cost. It will provide tangible and huge returns in the long term and have positive impacts of it on the environment and mankind. Also, to pursue a balance between economic, social, and environmental performance in implementing construction projects.

By this paper, we want to spread the thought of how positive impact and how optimistic are green materials. Also, to encourage them by spreading awareness that it is the future of the construction industry.

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Mythological Theme Parks: To Conserve the Indian Mythology & Culture

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ABSTRACT: Mythology is a collection of myths, mainly belonging to a specific religion. A mythological theme park is a culture-based theme park, a place having more focus on designed themes that revolve around a particular subject or group of subjects. All around the world, many countries have started to invest in mythological theme parks on a larger scale to conserve their Culture. Although India has begun to invest in Mythological theme parks like Surendrapuri in Hyderabad, its concept is still unfamiliar to India. This paper aims to study and survey the need for a mythological theme park in India by investigating people's awareness. To understand the relationship of architecture with Culture by considering geography and art style as source material, implementing these parameters for designing mythological theme parks in the future. By analyzing case studies where mythology meets reality, this paper helps spread awareness regarding our rich Indian mythology and Culture.

Keywords: *Mythological Theme Park, Myths, Conserve, Culture, Architecture.*

1. INTRODUCTION & BACKGROUND OF THE STUDY

The first theme park in India was in New Delhi in 1984, which became a favorite place for entertainment in the rise of the modern period known as "Appu Ghar" ("Appu" as an elephant and "Ghar" as a house in India). Besides being a space used for free time for enjoyment, it should not neglect the original history and cultural knowledge of the land. It was designed for entertainment as the word derived from their slogan says, "It's your world" "Refresh yourself. Generally, a theme park is a destination with play areas, shops, food courts, and an environment that is very distinct from the outside world behind its compound wall. Therefore, a "Mythological Theme Park" is "themed" on specific myths. All its elements of attracting areas and exciting rides are on this particular idea of myth. In this case, the "myth" refers to the "Mythology of India" and all the recreational elements used to show related ethnic diversity or multiculturalism. The first-ever opening of the mythological-based theme park was in Hyderabad in May 2003; however, it is on a small scale and not very popular as it should be.

It raises the question of why there is no large-scale mythological theme park in India. Moreover, why is there a need for the mythological theme park to conserve the Indian Culture? The research gap is due to the lack of global promotion and advertisement for countless segments of India. Which are culturally rich and worth knowing and can help in studies for architects and students. The basic idea is to create a mythological theme park, showing the diversity in Culture at its best by using mythical stories in the art style of its theme that defines "Indian." This paper aims to conserve Indian mythology and Culture. The main objective of this research paper is to investigate people's awareness of the mythological theme park. So the scope of the study help in understanding the people's choice and understanding of the topic, which will have an impact on the future in designing a mythological theme park. The study only explains the importance of mythological theme parks as cultural protection and architectural planning.

2. LITERATURE REVIEW

As Walt Disney said, "You can design, create, and build the most splendid place in the world. But it takes people's vision to make the dream a reality." The "word" between the dream and reality is mythology can explain many things in words, but some that are just imagined, but it can become a reality if we put our thought to it. The literature review includes research papers and documentation of articles. It is mainly about having a mythological theme park and catering to attention. The foreign country handling process for spreading social-cultural knowledge, promoting cultural and historical values,

geography, and heritage protection. The study is essential to understand a variety of discussions about the relationship of architecture to Culture, identity, and mythological stories like Ramayana Mahabharata in India and implementing it in designing the park. The main reason mythological theme park is to promote the global market and employment volume through tourism. It can help India develop fast and solve the issue of employment.

3. METHODOLOGY

This paper's methodology is on qualitative research methods. The questions were on "investigating the people's awareness" and visiting experiences, and the knowledge about the word emphasize meaning. I define my role as a student researching architecture on a mythological theme park on a social level. Hence, my understanding of this paper is from the survey questionnaire and case study analysis on how different thoughts have different views and experiences of the same "word." Participant answers and suggestions in questionnaires were through a google form, and case studies were online. The data collection understands the need for a mythological theme park in India. This methodology is in two parts survey and case studies.

The overall survey is on people's awareness of the term mythological theme park. The samples are between the ages of 18–55.

The questionnaire asked were five basic questions.

- Have you heard about a mythological theme park?
- Which of the following do you think is a mythological theme park? (Photos of four different theme parks to understand what they imagine a mythological theme park is)
- Have you heard about Surendrapuri's mythological theme park in Hyderabad?
- Do you think there should be a mythological theme park that will spread awareness of Indian Culture and mythology?
- What would you like to see in a mythological theme park?

3.1 Case Study: A. Neelkanteshwar Temple

Neelkanteshwar temple is in Maharashtra, located between Panshet and Khadakwasla (Figure 1). Dedicated to Lord Shiva, it is 40 km away from Pune. "Neel" represents blue, and "Kant" represents neck as per mythology story during Samudra Manthan lord Shiva held all the poison produced in his neck that turned his throat in Neel or blue that is how the name Neel Kant came.

Figure 1: Neelkanteshwar Temple Site Plan

Source: https://goo.gl/maps/xfCxWaRBY9kF2vGfA & author.

Devotees visit the temple on Maha Shivratri. The Neelkantheshwar temple's main feature is the display of various mythological stories in the form of statues made of cement sculptures of life-size. It makes us feel like "Amar Chitra Katha" coming alive in the form of sculptures. The temple is on a hilltop. We have to park the car in the valley and climb to get there. The orange color in (Figure 1) denotes the area where this statue is located. The blue color represents the area of a pond and Saumdra Manthan statues.

There are many magnificent statues on the hilltop telling various scenes from Indian or mainly Hindu mythological stories. After entering through the main gate, you see the pond area and statues of Shiva that lead you to the main temple or inner Sanctum. The temple has a Shiva shrine and sculptures based on his mythological stories. Near this temple, the owner has constructed a temporary structure of aluminum roofing sheet (called "patryacha shed" in Marathi) used for temporary shedding for the statues. This shed has statues and sculptures of the famous mythological stories of India that are Ramayana and Mahabharata. The figure narrates Lord Shiva, Lord Rama, Lord Vitthal, Lord Krishna, Goddess Kali, and Lord Hanuman. Main scenes from the Ramayana and Mahabharata are recreated through sculptures like "Draupadi Vastraharan." You can also see all the major characters during the Mahabharata setting in a Sabha in the scene of Draupadi vastraharan. There are sculptures of Dashavtara of Lord Vishnu in detail. Next to it is a classic scene of Ramayana, "Hanuman meets Sita in Ashok Vatika," and the statues of Navagrahas. Ashtavinayak, Kalika Mardan, Bakasur-Bhim story, Vaali-Sugriv yuddha, Sant Dnyashwar, Sant Ramdas, Shivaji Maharaj, Jesus Christ, and many more.

3.2 Iskcon Temple

Iskcon temple of Pune is located on the Katraj Kondhwa road. It is a Vedic Cultural center. The temple is dedicated to Radha –Krishna. The temple gradually slopes towards the north side (Figure 2).

Figure 2: Iskcon Temple Site Plan

Source: https://goo.gl/maps/vb9wDN3TBPVsSqwm9 & author.

It was built on 6 acres and took seven years to complete construction. There are two main temples and camps provided for devotees, a garden area for visitors, and shops to buy statues and books. Once you enter the temple, you see the statue of Lord Krishna (dance on its hood) stepping foot on Kaliya (snake in the mythological stories of Lord Krishna who is a multi-hooded snake in the River Yamuna) and playing his flute. The statue is surrounded by water from the fountain, which gives it a majestic look.

The main complex has a Radha Krishna temple. It was built in north Indian architectural style. They have used red stone and marble in construction. The second complex is of Venkateswara (Balaji) temple. Built-in southern Indian architectural style, it uses Kota stone, Similar to the Balaji temple in Tirumala. The temple has carved walls painted with colors depicting stories of Lord Krishna and Radha and other gods of the Hindu religion. Iskcon gives schooling in Vedic scriptures and Vedas. It includes the Bhagavad-gita and Srimad Bhagavatam.

3.3 Kingdom of Dreams

The Kingdom of dreams in Gurgaon (Figure 3) is a live entertainment theatre and a peaceful destination. It is a place for having fun, education, recreation and fantasy, and architectural style. Architect Naren Kuwadekar and associates design them. The client is the Great Indian Nautanki Company. Opened in 2010 has various buildings and open spaces designed on Indian architectural styles.

Figure 3: Site Plan of Kingdom of Dreams

Source: https://goo.gl/maps/qaPEoCMHVmvUNHe77 & author.

The façade of the building has been designed like an Indian palace with front entrance gardens and fountains. The challenge while creating was to obtain the look of the Indian palace within the existing structural parameters.

The entire transformation has been carried out using a combination of GRC (glass-reinforced concrete) and FRP (fiber-reinforced polymer) to achieve the desired façade look. A prefabricated building structure has been developed along with hybrid construction technology to create a lightweight and efficient structure to house the services. It increased the speed of construction and reduced the dead load on the structure.

"Amalgamation of various architectural styles from across India was an uphill task. Styles inspired by magnificent buildings and details like domes, jails (carved curtains), ornate columns, motifs were all recreated painstakingly"-Dilip Chhugera, Thematic architect, Kingdom Of Dreams.

3.4 BAPS Shri Swaminarayan Mandir

BAPS Shri Swaminarayan Mandir is located in Pune (Figure 4). The mandir was established in February 2017 after only 24 months of construction. The mandir length is about 184.6 feet long, and the width is about 74.6 feet high, with a total area of 33,523.36 sq. ft. The structure is entirely made of carved stones without any use of steel. The stone used here comprises Indian red stone and pink sandstone and is designed in southern Indian architectural style depicting as southern Shilpa Shaili by Sompura. The mandir has a total of 140 carved pillars, about 109 toran (sacred arch), with 10,269 carved sculptures and gods representing the Heritage of Maharashtra.

Figure 4: BAPS Shri Swaminarayan Mandir

Source: https://www.baps.org//Data/Sites/1/Media/LocationImages/FullSizeImages/836_18545BAPS%20Pune%20Home%20Slider%207.jpg

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The mandir is devoted to Guruhari Mahant Swami Maharaj, Guruhari Pramukh Swami Maharaj, and Sants. The mandir has 23 samrans, of which seven are giant ones which give the mandir a unique look. The planning was done according to the rules of ancient Indian Shilpshastras. The site also has a book shop, and food court provided. The seating arrangement is semi-open while maintaining its privacy. It has symmetrical planning.

4. RESULTS & DISCUSSION

While surveying through a google form, I got 45 people's responses. Their educational Background is technical students, business, working, and architectural students. From them up to 66.7% were of 18–25 age, 24.4%were of 25–35 age, 8.9% were of 35–45 age group, no response from 45–55 age group. 53.3% were female and 46.7% male.

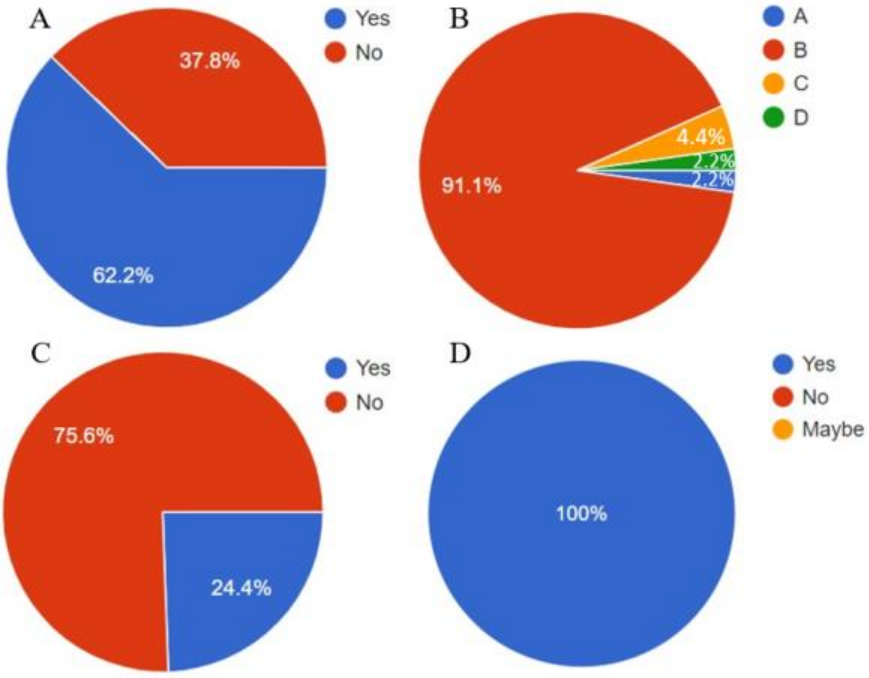

Figure 5: Pie Chart: A Shows the % of People Who Heard About MTP. B Shows the % of People Guessing the MTP of the given Figure in the Survey. C Shows the % of People Who Heard about Surendrapuri. D Shows the % of People Wanting MTP

Source: Author.

Up to 37.8% (Figure 5) said they had never heard about mythological theme parks. Up to 8.8% (Figure 5), people guessed the wrong photo. Up to 75.6% (Figure 5) never heard about Surendrapuri's mythological theme park.

They all think there should be a mythological theme park on a large scale in India. There were various suggestions on what they would like to see in a mythological theme park. Here is some advice from responders.

"Cultural diversity (all religions) great sculptures, knowledge center, museums, etc."

"Indian culture and historical phases are preserved in our memories."

"Stories of Ramayana, Mahabharata through the creativity which will attract the people towards such parks, " At that time, gardens, fountains, a system of water mgmt. There are varieties of trees, shrubs, herbs, etc., their arrangements and cooling mgmt in the garden, etc."

"Various Cultural and religious artifacts as well as secrets behind those,"

"Western Maharashtra culture of temples,"

"No boundaries, no religion barrier,"

"Sculpture, script, temples, drama based on Mahabharata, festivals started with a mythological concept, everything that depicts our Indian mythological Culture."

"Carvings of Indian mythological god and goddess. And similarly their ideals as well."

The three case studies above, "Neelkanteshwar temple," "Iskcon temple," and "The kingdom of dreams" give us an idea of how a mythological theme park can be. There are some things we can't neglect in the design process. From the first case study, the pros are that it replicated the stories very well, reflecting its unique identity. However, cons can be said the area where the structure is located and its maintenance. The road is not easily accessible to vehicles. You have to climb for 2 hours to reach the hilltop. There is less incense of architectural style while attracting visitors. The second case study tells us the difference in India's north-south architectural styles or structures. The third case study suggests facades and how they can be designed for the palace. The fourth case study shows the ethnic design of southern Indian architecture style, which follows the rules of ancient mandir planning, giving importance to the area for seating and garden design. It has a unique landscape with a symmetrical design to provide the mandir with a majestic look. The carvings are depicted from Hindu Culture. The con of the temple is that it doesn't have any particular area from the shoe stand near the mandir.

These case studies give us a basic idea of the importance of structural style, statues, sculptures, and art used while making, which can help design a better mythological theme park, which can help spread awareness of our Indian mythology and Culture.

Through the study of 45 responses and case studies, this paper has illustrated people's awareness of mythological theme parks. Despite the spread of Culture globally, countless Indian mythology and culture places are less globalized than imagined. The Neelkanteshwar temple can be one example. The domestic belief, costumes, traditions remain local. It's essential to have a place depicting Indian mythology and Culture, where they can see and learn India's rich history and cultural foundation. In addition, this awareness can be shown through a mythological them park, which has the said era's architectural style, statues telling stories, a sculpture of gods representing that religion or story theme.

5. CONCLUSION

This research paper vocal out numerous essential questions about the mythological theme park in India and why it hasn't been built on a large scale. The concept of a mythological theme park was not properly worked out and thought in depth in India until recent years. Considering the project of May 2003 of Surendrapuri in Hyderabad, the mythological theme park is still unfamiliar to India as a still developing country. The idea of the mythological theme park and its construction and understanding of myths and Culture are often neglected and are not valued. Construction of one such mythological theme park can increase employment and tourist attraction as future development in India. This can offer a chance of developing and reworking the area for heritage protection, cultural conservation, urban development in social Culture.

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I want to express my deep sense of gratitude from the bottom of my heart to my guide, Professor, Dr. Manjusha Gokhale and Associate Professor, Ar. Sarika Thakoor for their valuable guidance, inspiration, and encouragement. Their keen and indefatigable indulgence in this work helped me reach an irreproachable destination.

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Redefining the Use of Traditional Indian Elements in Contemporary Residential Structures

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ABSTRACT: India is a country that is rich in culture and heritage. We have seen different architectural designs that have come into emergence adapting to the situation in a particular period. What remained the key idea of all the styles was the use of architectural elements. The transition has been observed in these architectural elements that have evolved from traditional elements of the past to the contemporary elements that one sees today. The importance and evolution of these elements have been missing. We have forgotten about these elements and how much power it holds even in today's architecture. These traditional elements can help reflect on one's past because these elements have been a part of us and that is where we come from. The different types of elements identified are the intricate jaalis, carved doors, and windows, columns, jharokhas, courtyards, pitched roofs, and Mangalore tiles. Different residential house case studies have been studied further to understand some of these traditional elements and how they have redefined their use of them. The paper aims to study redefining the use of traditional Indian elements in contemporary residential structures.

Keywords: *Traditional Architectural Elements, Contemporary Residential Structures, Elements.*

1. INTRODUCTION & BACKGROUND OF STUDY

Architecture and human growth have always gone hand in hand. Several factors affect the change of architectural components concerning time, civilizations, climatic change, and geographies, resulting in a recognized indigenous style in every corner of the world. History has taught us that the invasion of industrialization and modernization has frequently taken over centuries of antique traditions and cultures in many countries. Indian architecture contains various unique architectural elements that are and can be still used in our contemporary structures in different ways.

Architectural elements are the particular part of a structure and aspect components that, together, form the architectural style of homes. This terminology does not consist of: The names of styles of building or architectural movement. (wikipedia, n.d)

These elements are a very important aspect as they constitute architectural design. The contemporary elements compared to the traditional ones lack sustainability as these traditional elements were typical of stone or wood. This research paper will help us analyze why it has become important and a major need that we take a step and provide Indian elements in the contemporary structure, because of the rapid growth of urbanization it is important that we bring the traditional materials which will be sustainable and also which will act as an Indian element. It will also help us to understand how the structures should have a perfect combination of old and new traditions. Besides, it will also help to process and bridge the gap between the so-called traditional Indian elements and the contemporary structures. (Sharma, 2014)

The scope of this paper will help us understand the importance and the use of elements. With the increase in urbanization, traditional architecture has been lost in today's era. The objective of the paper aims to achieve and understand how these traditional elements redefine their use of it into the contemporary residential structures, to understand how the elements reflect on the Indian culture and their lives, and the use of elements and their evolution through different case studies. These two case studies studied are residential structures one from Jalandhar and another one from Mumbai. Furthermore, this research paper will be only limited to the study of Indian Traditional elements in contemporary residential structures and not the overall traditional architectural style.

2. METHODOLOGY

The paper has been analyzed based on both qualitative and quantitative methods. The paper has been studied based more on descriptive analysis. Through qualitative method case studies have been studied further as a source of secondary data with the help of photographs and notes. While the quantitative method has been observed through a survey based on the research. Through the online case studies of the residential structures the elements and redefining the use of them in the Contemporary have been analyzed with the help of material study through sources like the articles, research papers etc.

3. LITERATURE REVIEW

1. *Use of Architectural Elements in Evolution of Regional Style in Jaipur by Shubham Sharma, 2009:* This paper aims to study the use of an architectural element in Jaipur and its evolution of style. It helps us to understand the different types of elements used and the evolution of its style throughout considering the climate. The paper also examines and states that Traditional architecture still stands today and is relevant because it has always has addressed sustainability. It has also helped to understand and learn the different styles and how one can evolve and blend the style in architecture. This paper is only limited to the Jaipur style of architecture and its evolution from time to the elements used in it. (Sharma, 2014)
2. *Glimpses of Indian Traditional Architecture by Ar. Tania Bera, 5th May 2020:* This paper aimed to study and understand the different types of traditional architectural styles that evolved in India. It also helps us understand the different types of elements that have been involved in the styles and to understand how the religious diversity aspect has played an important role in these architectural styles. This paper has helped to understand the importance of tradition and culture and how it has reflected not only on our lives but also on the architectural style. The history that is lost is still relevant and still plays an important role in architecture. It bridges the gap between traditional architecture of India, but also depicts the society, culture, religion, especially for the understanding of rituals and sacred practices in India. Furthermore, this paper is only limited to Hindu temples, Indo-Islamic architecture, and Rajput style. (Bera, 2020)
3. Spatial narratives in traditional Indian architecture: An interpretation for contemporary relevance by Yatin Pandya, 10th May 2017 - To study the different related narratives in traditional architecture by understanding its contemporary relevance. The paper aims to study the different narratives of traditional architecture through the tradition and culture of India and to understand the contemporary relation through its interpretation. It further analyses how one can relate to the different spaces occupied within the architectural traditional style. (Pandya, 2017)
4. How to infuse traditional Indian elements into modern homes by Preeti Singh, 10th May 2017: To understand the different types of elements and how to blend in the elements. One can be successful in infusing these key traditional elements into modern homes with the right tactic spots. Once you are able to contrast the balance and strength in the structure you will be able to create structures that are seamless and extraordinary. This article is only limited to the traditional elements of India. (Singh, 2017)

4. ELEMENT STUDY

- **Column:** A column or pillar in architecture and structural engineering is a structural element that transmits, through compression, the weight of the structure above to other structural elements below. In other words, a column is a compression member. (Wiki2, n.d.) during earlier times columns were not only used as a structural member but also used for aesthetic purposes. The columns from the traditional era were of stone as well of wood which was intricately carved. These columns from the traditional era were carved in a way that depicted and reflected the culture and the lives of the people from that time.
- **Intricate Jaali:** *A jaali is a term for a perforated stone or latticed screen, usually with an ornamental pattern constructed through the use of calligraphy, geometry, or natural patterns.* (wikipedia, n.d.) Jaali is one of the interesting elements because it allows the sunlight to pass through and creates an interesting play of shadow and light. The air that passes through the jaali gets compressed and thus lowers the heat effect of air and allows the cool air to pass through. Other than this Jaali also enables ventilation while providing private space for the users.
- **Pitched roof with Mangalore tiles:** A pitched roof is a roof that slopes downwards, typically in two parts at an angle from a central ridge, but sometimes in one part, from one edge to another. The 'pitch' of a roof is its vertical rise divided by its horizontal span and is a measure of its steepness. (Rajput, n.d.) A pitched roof with Mangalore tiles is one of the common aspects that can be seen in Indian villages. This kind of roof adds height to the structure as an

added advantage and is also suitable for the climate of India thus keeping the inner spaces of the structure cool. The Mangalore tiles on the roof adds more aesthetics and significance to the roof than a concrete one.

- **Jharokhas:** The Jharokha is a stone window projecting from the wall face of a building, in and upper story, overlooking a street, market, court, or any other open space. A common feature in classical Indian architecture, most prominent in Rajasthan. (Wordow, n.d.) Traditionally jharokhas were used in palaces by females of the court to keep an eye on the day's events without themselves being seen. This balcony has found many current adaptations across India in various materials like wood, marble, brick, and concrete.
- **Courtyard:** A courtyard or court is a circumscribed area, often surrounded by a building or complex, that is open to the sky. Courtyards are common elements in both Western and Eastern building patterns and have been used by both ancient and contemporary architects as a typical and traditional building feature. (wikipedia, n.d.)The courtyard is one of the most significant elements as it not only adds aesthetics to the place but is also tackles the climatic conditions of India. Courtyard follows the principle of convection where the warmth of air is removed and replaced by the cool air.

5. CASE STUDIES

A house in Jalandhar

Address – Jalandhar, India
Architects – 23DC Architects
Lead Architects – Shiv Dada, Mohit Chawla
Photographs – Purnesh Dev Nikhanj
Project Year – 2018

This house in Jalandhar is one the best example where the blend can be seen of traditional Indian elements in a contemporary structure. The elements that are blended in this structure are the columns, courtyard, carved door.

A courtyard in this bungalow is an element that is open to the sky which provides an outdoor space but is designed in such a way that it is away from the public eye. This space can be used by the families for different functions taking place there and also by the women and children of the house for their daily activities.

Another element that can be seen in this house is the columns. These ornamented stone columns provided are along the garden area and are white. These columns are not only used for structural purposes but also serve an aesthetic purpose and add value to the structure.

While the door is made up of wood the carved frame area of the door is of stone. Stone and the wooden material mixture make an element even stand out more. The wooden door along with the carved frame area of it looks aesthetically pleasing. These elements in the bungalow not only adds to the aesthetic but also contribute in the quality aspect of the space (Gonzalez, 2018).

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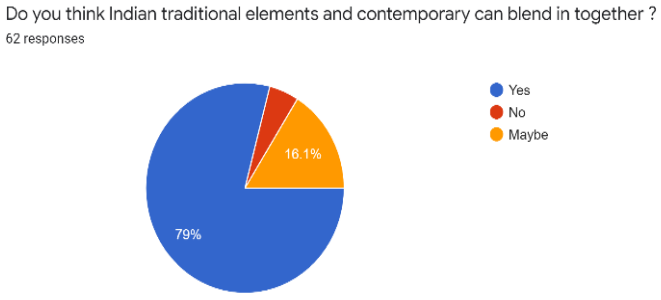
Bungalow in Mumbai

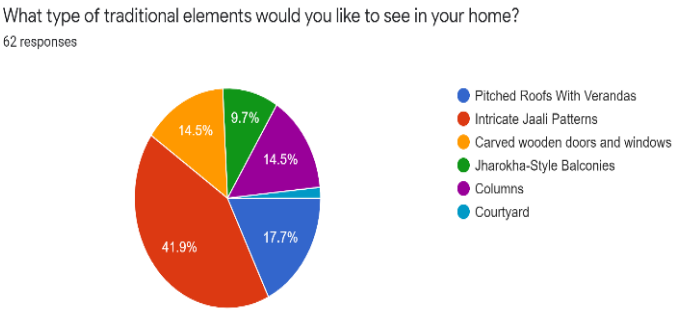
Address – Mumbai, India
Architect – Insitu by kalakaarihaath
Photography – Suleiman Merchant

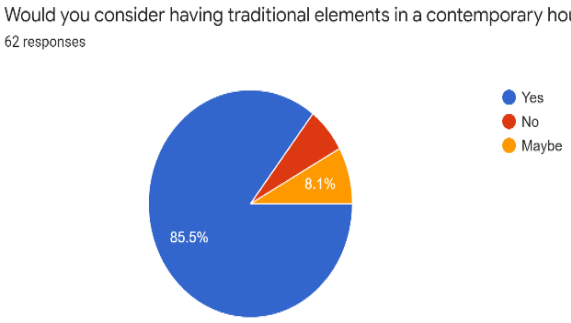

This project in Mumbai is a renovated project that is a two-storey bungalow that is restored with traditional Kerala elements. The elements included in this are the heavy ceilings, columns, and a carved front door with a frame.

"The main brief was to clean it up while maintaining the character of it, in a way that reconciled the aesthetic and the functionality of the space," says the lead architect of the project. The wooden carved ceiling is recessed into the existed structure to reduce the sense of weight and maximize the height of the structure. The outdoor facing wall is replaced with a glass facade which brings in ample sunlight to ensure that the wooden heavy ceiling doesn't darken the place.

Another element that can be seen in this are the columns that constitute the ceiling area. These columns are carved with wooden material and the same goes for the carved ceiling that also is wooden. The most traditional interesting element added to this structure is that the front door is an ornate wooden slab flanked by carved black pillars. The front door facade is made of laterite stone masonry, with a natural earthy texture that is a visual to the palette within. This project is an excellent example of Traditional elements with contemporary structure.







(Shankar, 2021)

6. RESULTS AND OBSERVATION

The analysis of the data collected through survey shows that majority of the people (85.5%) would consider having traditional Indian elements in their home while 79% of people also consider redefining the use of it through blending them in the contemporary structure.

The different elements people would consider having in their home are pitched roof, Intricated Jaalis patterns, carved doors and windows, Jharokhas, columns, and courtyard with a majority of people (41.9%) considering of infusing Intricate jaali pattern followed with other elements mentioned.

7. CONCLUSION

This paper reveals the use of these traditional elements in contemporary structure while redefining them. Blending in the traditional architecture along with contemporary designs is the best bet to keep alive the magic of the traditional Indian element along with the convenience of contemporary designs. Traditional Indian elements were not only about the aesthetic appeal but also rather blending in with the climate & atmosphere of a particular region. We must try and implement these aspects in our designs.

Traditional elements like jalis or doors and windows carved out or jharokhas with carvings tell many stories through those carvings which need to be preserved. These Traditional elements are a means to preserve them and our culture while maintaining the aesthetics while it gives us an irrefutable connection to the past – to certain social values, beliefs, customs, and traditions, that allows us to identify ourselves with others and deepen our sense of unity, belonging and national pride. Being connected to our roots is crucial. Secondly, these traditional design attributes, seen in traditional architectural elements are thought by the climatic conditions, availability of materials, etc. And hence prove to be sustainable and unique at the same time.

Redefining the use of these elements in a structure is a strong idea that needs to be considered by everyone as the amalgamation of both these elements would aesthetically highlight the structure as well as remind one of his/her history and culture. Redefining the use while blending these traditional elements in the contemporary structure becomes a design challenge that needs to be handled with sensitivity. The addition of the traditional Indian element should not be thought of as a mere aesthetic feature but should also contribute to the quality of the space. Provided these things are taken care of, Indian elements could very well be incorporated into contemporary residential structures.

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Impacts of Excess Mangroves

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ABSTRACT: Mangroves are found in tropical and sub-tropical areas, it is the forest between land and sea. They are keys to healthy ecosystem. Mangroves provide habitat for fishes and birds as well as stabilize the coastline.

But in some places like thane creek, excess of mangroves have grown which can be threat to biodiversity because of some dominant species. Growth of excess mangroves also impacts fishermen, flamingos and navigability of channel.

Land of mangroves is an anaerobic soil, in appearance the soils are often clayey mud or sand. Mangrove vegetation is increasing due to leaching and excess siltation, reducing the width of the creek and mudflats.

It will also effect on urban city development in future. The excess growth of mangroves might affect the soil of thane which will not be suitable for construction and other purposes like agriculture. Birds are a prominent part of most mangrove forests and they are often present in large numbers. The excess growth of mangroves also affects the habitat of flamingos, marine animals.

Keywords: *Thane Creek, Mangroves, Excess Growth, Soil, Sewage, Urbanization, Habitat, Coastal.*

1. INTRODUCTION & BACKGROUND OF STUDY

Mangroves represent the spirit of Mumbai – they are plucky survivors. But each day, millions of citizens in Mumbai pass these hardy plants imagining they are little, more than dirty, muddy weeds growing pointlessly along the shoreline. But people do not understand that how important mangroves are for the quality life of the citizens of Mumbai. By trapping silt, mangroves maintain the integrity of Mumbai's shoreline. This is a vital service to the city of Mumbai as it is very prone to erosion, having been built on reclaimed land that is battered by the sea on all three sides. The ecosystem has a very large unexplored potential for natural products useful for medicinal purpose and also for salt production, apiculture, fuel and fodder etc. Mangroves provide livelihood for the fish workers by breeding and nursing the fishes, prawns, mollusks and Crabs etc.

The Koli community in Mumbai worships mangroves because they know that these are breeding and nursery grounds for the marine organisms on which their sustenance depends (Sarkar, 2017). Costal biodiversity including the million migratory birds that visit Mumbai, are housed by mangroves.

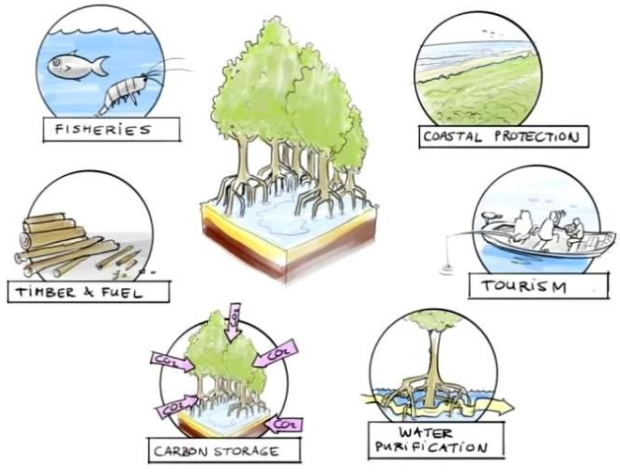

Figure 1: Importance of Mangroves

2. MANGROVES IN MUMBAI

At present patches of mangroves exist at Mahim and Gorai creek, and at coastal belt of Versova, Sewri, Colaba, and Bandra. Moderate mangrove patches are also present around Mumbai in coastal areas of Elephanta Island, Uran, Vashi, Vasai, Thane and Bhyander creeks. Mangroves provide a vast array of essential ecosystem services in mumbai, they are essential for flood protection and water quality maintenance, they serve as nursery habitats to countless species, and they help sustain our fisheries. They're also invaluable carbon sinks, and one of the strongest counter forces we have against climate change. But nowadays in some spaces growth of mangroves is increasing which will be hazardous.

3. THANE CREEK

Thane creek is 26 km long. It is connected to the Mumbai harbor on its south and joins by a minor connection with the Ulhas River on its north near Thane city. The creek is narrow & shallow at the riverine end due to the presence of the geomorphic head and broader & deeper towards the sea, it has increased from 68.11 sq. km in 2014 to 79 sq. km in 2020, which is a 10.72 sq. km increase in mangrove area in the past six years (Quadros, 2016).

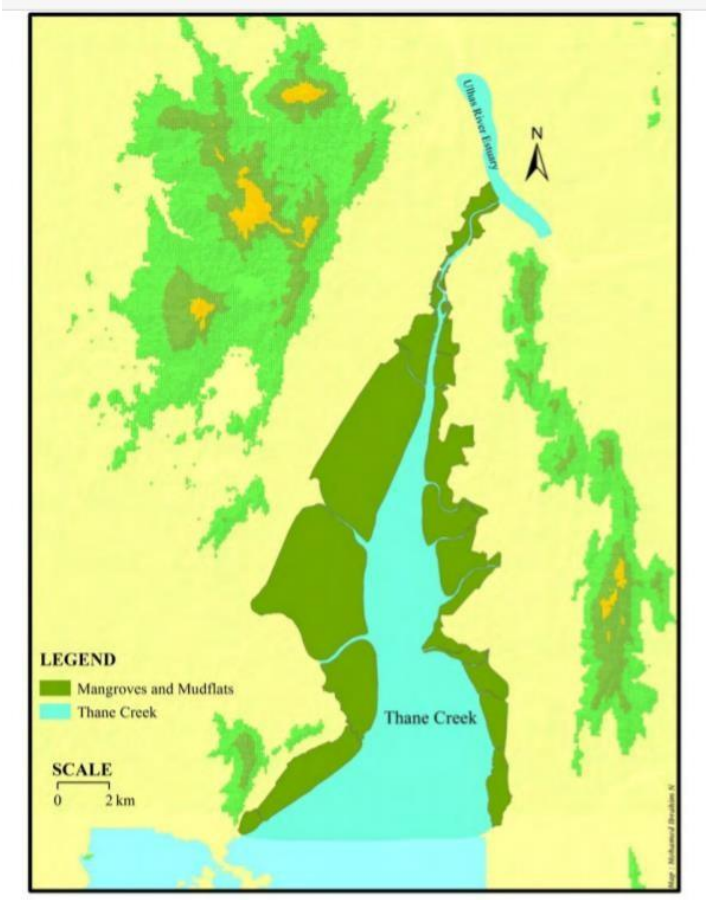

Figure 2: Map of Mumbai City Showing the Location of Thane Creek along with the Mangrove Area

4. REASON BEHIND EXCESS GROWTH

There are at least 12 different species of mangroves and mangrove associates found in the Thane Creek, but most of the excess growth is of one dominant species, Avicenna marina which could pose a threat to the overall biodiversity and urban city. However, the removed saplings will be replanted else, where after being sent to a nursery (Quadros, 2016).

The increase in mangrove vegetation is also due to leaching (liquid byproduct when waste gets decomposed) and excess siltation, reducing the width of the creek and mudflats as roosting areas for flamingos (Chatterjee, 2020).

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Figure 4: Map Showing the Distribution and Occurence of Mangrove Species Other than the Avicennia sp. Found in Thane Creek

Figure 5: Before Excess Growth

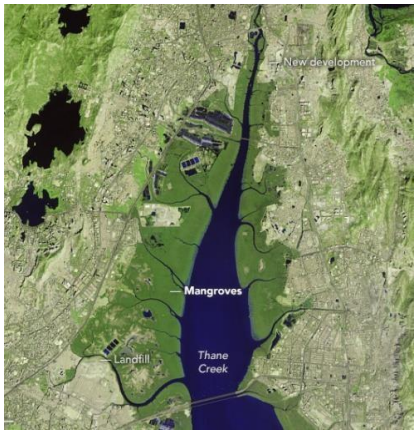

Figure 6: After Excess Growth

5. IMPACTS OF EXCESS GROWTH OF MANGROVES

Land of mangroves is an anaerobic soil, Mangroves grow on waterlogged soils that are poorly drained, lacking in oxygen and are often fine grained and rich in organic matter. In appearance, the soils are often clayey mud or sand. Mangrove vegetation is increasing due to leaching and excess siltation, reducing the width of the creek and mudflats. It will also effect on urban city development in future. The excess growth of mangroves might affect the soil of thane which will not suitable for construction and other purposes like agriculture. Birds are a prominent part of most mangrove forests and they are often present in large numbers. The excess growth of mangroves also affects the habitat of flamingos, marine animals. Environmentalists said declining creek width and mudflat loss could lead to a flooding threat (Chatterjee, 2020).

6. CONCLUSION

If increase in mangroves is in the creeks, it is not good news at all. And we believe that is where the growth has happened. The mangroves will eventually choke the creeks and the entire sewage and storm water drainage system. Removal of the excess mangroves is necessary to ensure that there is room enough for flamingos and it will also affect on urbanisation.

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I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. Vinita Kolhe for her valuable guidance, inspiration and encouragement. Her keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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MSME: A New Found Role, a Case of Jalgaon (M.H)

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ABSTRACT: Since the pandemic has resulted in a nationwide lockdown on March 2020, the economy was adversely affected to a large extent. The MSMEs sector plays a key role in creating its own sources and supply of goods needed by the country, reducing its dependence on imports and supporting the GOI's initiative of "ATMANIRBHAR BHARAT".

The purpose of the research is to examine whether forest MSMEs that are dependent on natural resources can shift to a more sustainable practice like agroforestry through the medium of architectural intervention. The characteristics of the intervention helps the existing forest MSMEs of Jalgaon where the site is located, in the way of getting raw materials locally rather than being dependent on forest or other mediums more to sustainable methods like agroforestry.

Jalgaon situated in north-west of Maharashtra has agriculture as its primary occupation, is viewed as a case to study Forest MSMEs and to establish and promote agroforestry in the region.

Keywords: *MSME, Agroforestry, GDP, Atmanirbhar Bharat, Lockdown, Sustainable.*

1. INTRODUCTION

The forest industry deals with products derived from the forest, such as timber, paper, gum, tobacco/bidi, match, sports goods, plywood, etc. Such Industries had their existence way back from many years as forest was natural resource of raw material for such industries. The existence and successful practice of these industries had contributed to the economic development of the region and served as a supply chain to various other sectors.

Forest sector is the second largest land use after agriculture. In remote regions, communities and other local people depend on forest resources for their energy needs and raw materials for forest industries. For easy accessibility of raw materials, all forest industries are located in rural and semi urban areas where land is more affordable with labour and needed equipment. As forest industries serve as a supply chain to various other sectors producing finished goods, neglecting this sector may negatively impact the progress of other sectors and can even decrease their economic contribution. Forest industries tend to export products that are locally prepared, thus proving their dominance in international markets. Forest MSME are seen as a threat to the environment since they can lead to deforestation and an environmental crisis. Therefore, it is important to take measures that may aid in finding alternate raw materials besides forests. In India, the majority of rural and semi urban population is dependent on agriculture, so agroforestry is an ideal solution to reduce reliance on forests for raw materials as well as benefit farmers by providing a secondary source of income and causing their land to remain fertile. Other such measures may also be researched and looked at in order to help such MSMEs that have an important role in contributing to the economy and the market when it comes to the products they produce.

"Agroforestry is defined as a land use system which integrates trees and shrubs on farmlands and rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability" (National agroforestry policy, 2014).

BACKGROUND OF STUDY

Due to the pandemic and national Lockdown situation there was a huge loss in the economy, as many of the businesses, services and industries were shut down and resulted in many negative factors such as permanent shutting down of industries, Loss in Jobs, salary cut for employees etc.

There comes into notice where the country's MSME sector was holding the economy and maintaining the flow of supplies needed during the pandemic like manufacturing PPE kits, RT PCR test kits, Sanitizers etc. Many of the MSME were then converted to produce needful products which were at the need for the most, during crucial times in pandemic like sugar factories were used to produce sanitizers and textile industries were producing PPE kits and masks.

As such many other MSMEs have potential to grow and develop which would create employment, learning and technological advancement in their respective fields. The Financial budget for year 2019–2020 presented by government of India allocated highest amount of money slab as 20,000 crores INR in total for MSME sector which includes various schemes for the MSMEs holders, who will be boosting their MSMEs after lockdown and can get relief from ongoing lockdown situation, holding a projected rate of growth helping the country to achieve its best figure in economy and country's GDP considering the main focus of government to lead by achieving the maximum possible gains by such sectors. MSMEs are complementary to large industries as ancillary units and this sector contributes significantly in the inclusive industrial development of the country.

Such factors have drawn the attention of the government to look at the MSME sector that is considered to be important for a country's growth, gaining all government attention in regard to the formation, training, and execution of schemes for MSMEs.

RESEARCH QUESTION

- What role does a Forest related Industry plays in MSME and how does it impact on the community running the business?
- How to reduce Environmental concerns as Forest related MSME depends majorly on natural resources as a source for their produce?

Aim

- To find the need of MSME sectors which are benefitting to the economy of community and society involved in Forest MSME and to study their existence to run the MSME at the location which they are based.
- To Uplift MSME Sectors in forest related industries which are dependent on natural resources as a source of raw materials with incorporating sustainable practices like agroforestry.
- The Thesis/research aims to find the relation between Forest MSME and Agroforestry which generates a model for demand and supply, thereby creating domestic markets for the community practicing the agroforestry and forest MSME.

Objectives

- To reduce the dependence on Natural resources for MSME which are dependent on natural resources to run their business particularly – Forest MSME.
- To propose a model which caters the demand and supply of the raw materials to forest related MSME in the region where such industries are based.
- To explore Similar MSME sectors depending on forests and co-relating their Importance to the region and the community practicing MSME.

Scope

- Generating employment in rural settlements where Forest related MSME are based.
- To create good market and value for produce goods by forest MSME.
- Exploring various MSME sectors with similar work patterns or requirements as Forest related MSME.
- MSME gives women a boost to carry out their own ownership business model from their households and to contribute to the progress of these sectors.

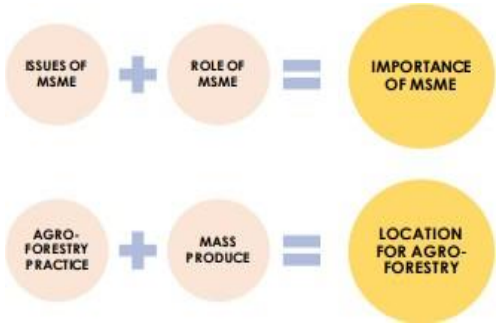
Limitations of the Study

- Research focuses on the MSMEs located in Rural - Semi Urban areas.

2. LITERATURE REVIEW

Literature reviews became an important part in the research which consists of studying various journals, papers, Internet data, books and news articles. The literature study creates an understanding about the opinions given by various experts in the field which results in selecting different zones in the research to focus on. For ease of understanding the literature. Literature review in respect to the research and design intervention was done in four parameters as:

- Studying various issues and challenges faced by MSMEs in India.
- To find the role of MSMEs at the location where it has been practiced.
- To find relation of Agroforestry practices with practitioners at different locations in India
- Agroforestry for Industrial use as a source of raw materials to forest MSMEs.



Source: Author.

2. METHODOLOGY

The research is carried out in a way to study the aspects and prospects of MSME sectors and agroforestry practices in India which leads to finding an ideal solution in terms of architecture for both the sectors. The research is taken forward as a case of jalgaon where existing forest MSMEs are set up and also had agroforestry practices in its context. As a result, site analysis is detailed out to study its context and its suitability for new architectural intervention. Thus, the design program evolved as a result of extensive research done during the time through the medium of case studies, site visits and literature reviews.

- **Data Collection:** The initial process of data collection started with a vision to get details about the structure of the MSME system followed up with agroforestry as both can relate each to other in terms of creating demand and supply. In the process various informal talks with people involved in the business paved the way to carry out the research forward and thus the result of the research can be looked at as an architectural intervention. As both the sectors involve different groups of peoples, policies, etc, collecting and compiling data individually showed a way for research as such, which can surely cater to both the sectors in the intervention.
- **Case Study:** Case studies for the research were selected after literature study which covers both the aspects to be provided in the architectural intervention. Live case studies data sums up the existing work pattern of the MSMEs with respect to the space and the context.
- **Site Selection:** Understanding the research as a case of jalgaon, macro and micro details of the city were studied which provided with necessary potential sites in the city which further took as the selection of one site for the intervention. The maps exploring the city which are later analysed in research shows the potential of the site to hold the intervention with a suitable design program.

Architectural Intervention: The design program evolved at the end of the research is a result of the requirements of the architectural intervention followed by the site selection. The architectural intervention for jalgaon acts as catalyst in transformation of forest MSMEs to Agroforestry from forest and other sources like imports, etc. The intervention focuses on:

- To Propose the use of agroforestry on agricultural land or any other land which ensures proper land use and creates a direct supply of raw materials to Forest related MSME in the region.
- A site to be developed, where various MSMEs can be designed near the source of raw materials to benefit the communities involved in agroforestry as well as the forest related MSME.

4. RESULT AND DISCUSSION

4.1 Micro, Small & Medium Enteprises

The Micro Small and Medium Enterprises (MSMEs) sector is considered to be a major contributor for the socio- economic development of the country. The MSME sectors are flexible in terms of promoting and producing goods at different levels at various times which makes them key producers of goods and services to industries as well as directly to the consumers.

Forest MSMEs under agro based industries is known to be an important MSME sector which shares its produce, being a constant supply chain to various micro and medium enterprises in India similarly providing direct goods to the consumers creating good domestic and international markets.

These MSME due to their existence for long time, are widely spread across the country which creates a network of forest MSME in the major part of the country thus enabling an architectural intervention may reach out at any places simultaneously encouraging the community practicing these MSMEs. After government encouragement to the MSME sector this sector is again gaining its strong hold in contributing to the economy, generating employment, bringing new technology and investments to the country.

4.2 Linkage of Wood Required for Forest MSME

Forest MSMEs are dependent on other Forest MSME for manufacturing their concerned goods.

- Wooden logs first received in saw mill, sawn into rectangular cut sizes followed by storing and left out for drying in order to reduce moisture content.

The produced timber is then used by other forest MSME like plywood, board industries, to prepare ply and board.

- Ply and boards are then used by the furniture and packing industry for producing their goods.
- The by- product of saw mills, furniture, ply and board industries, then used by paper and pulp industries for their process, similarly products like waste wood is used as fire wood and saw dust used in bricks manufacturing process.

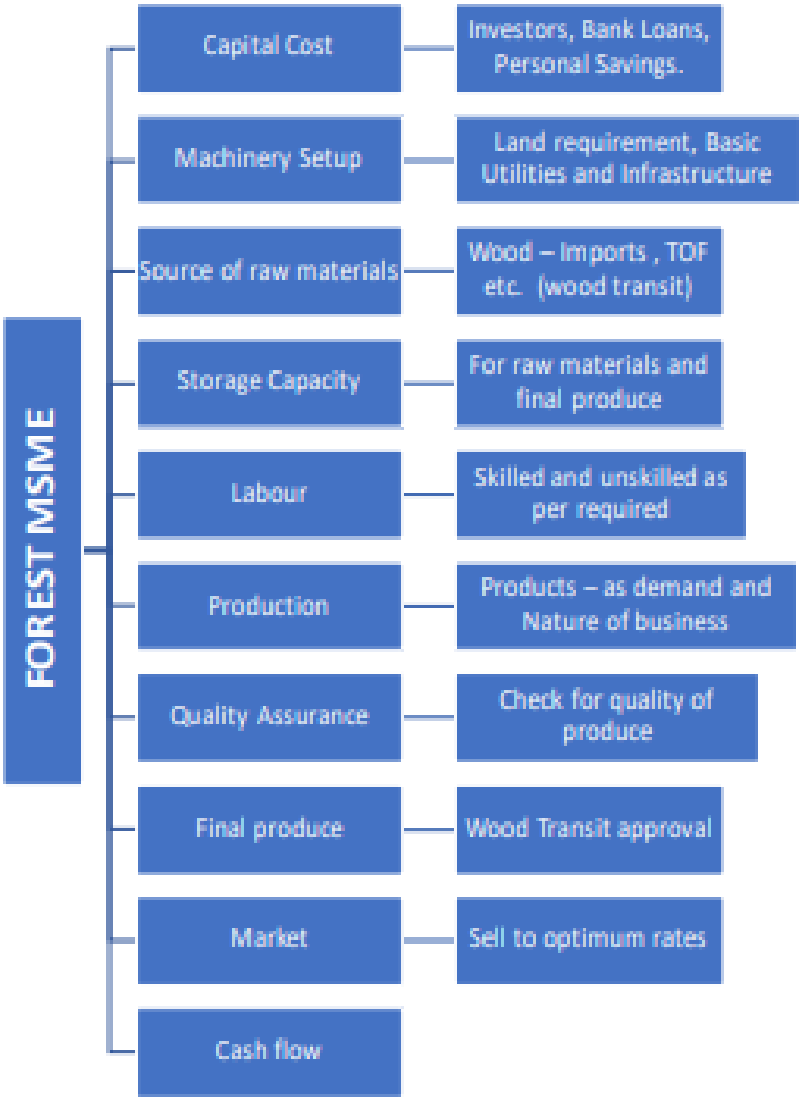
List of Current MSME Sectors in India

S. No.	*Group*	*Industries*
1.	**Agro based and food processing**	Village Oil industry Aromatic Oil Honey & Bee keeping Palm Gur & other palm products Fruit & vegetable processing Pulses &Cereals Processing Industry Spices & Condiments Processing industry Wood Based industry Bamboo, Cane & Reed Industry Organic Dyeing Industry Animal Husbandry Medicinal Plant Collection & Processing Industry
2.	**Mineral Based Industry (MBI)**	Hand Made Pottery, Glazed & Ceramic Pottery, Pottery as Home Décor, Pottery for Food Industry Stone Cutting & Polishing Industry Ceramic Tiles Industry Granite Cutting, Polishing, Stone Carvings, Sculptures, etc. Brass Metal and other Metal Crafts Industry
3.	**Wellness & Cosmetic s Industry (WCI)**	Wellness & Cosmetics including Soap & Oil Industry Aromatic Oils & Fragrances Industry Cosmetic and Beauty Products Industry Hair Oil and Shampoos, Toiletries Industry Bathing Soap Industry Agarbatti Industry
4.	**Hand Made Paper, Leather & Plastic Industry (HMPLPI)**	Hand Made Paper and Paper Products Industry Paper Conversion Industry Leather Industry Plastic Industry Natural Fibre other than Coir Industry
5.	**Rural Engineering and New Technology Industry (RENTI)**	Bio-Gas, Non-Conventional Energy, Bio-Manure, Vermi-Compost Industry Carpentry & Blacksmithy Industry Agricultural Implements & Tools Industry Electric & Electronic Products Industry Dry Dairy Household Metal Utensils & Articles Manufacturing Industry
	Service Industry	Small Business-Trade-Retail/wholesale Maintenance and Servicing of Electrical and Electronic Goods Farm Aggregators (Pre & Post Farming)

Source: Author.

4.3 FOREST MSME AS ORGANISATION

Most of the forest MSME have a similar flow of working as one MSME acts as a supply chain to other forest MSME. The ecosystem derived in by all such MSME creates a balance in providing produce to the markets enabling a smooth cash flow with consumers, traders, manufactures and agroforestry practitioners. The need of raw materials depends upon the produce prepared by the MSME which reflects in generating employment and the domestic market.

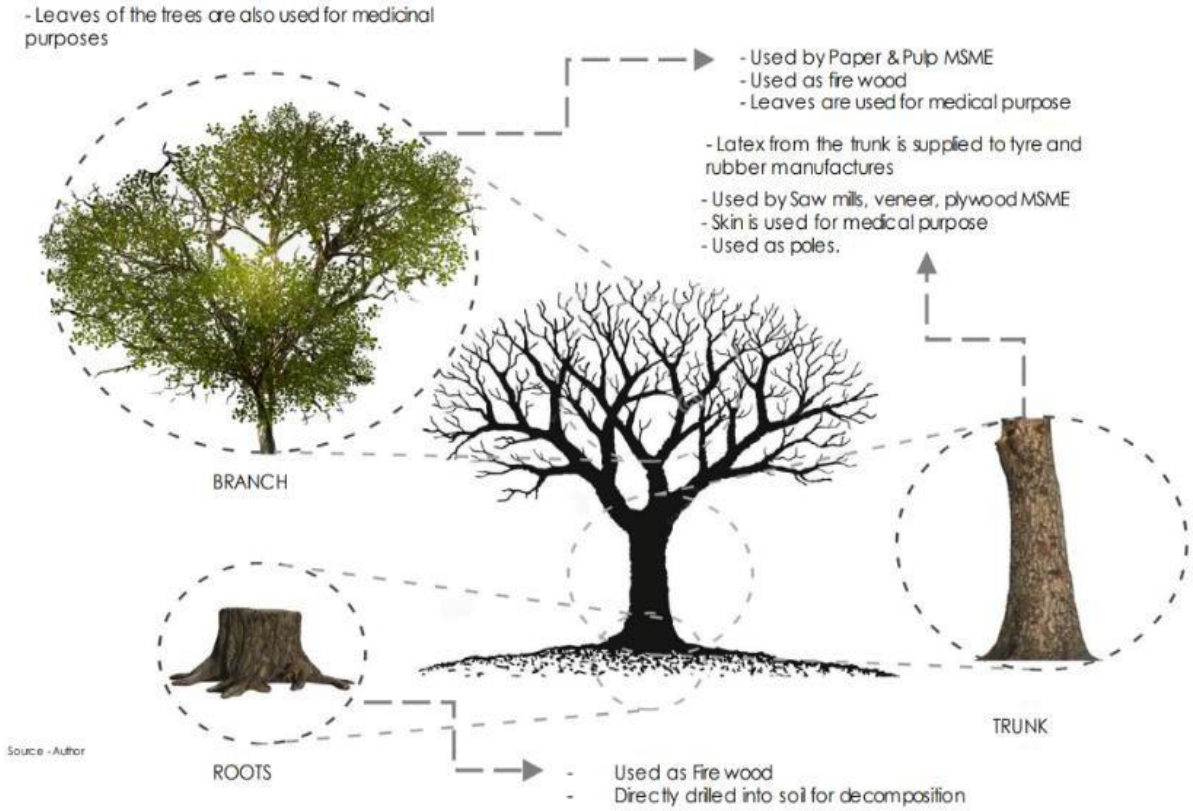


Source: Author.

Working groups for Forest MSME:

1. **Businessman/MSME Holders:** They are major people running forest industries and are in a higher percentage in terms of investment and profit margins.
2. **Traders:** Traders usually hold the market and play a role in marketing the product of forest MSME.
3. **Workers:** Classified as Skilled and unskilled are part of Forest MSME as demanded by MSME.
4. **Artisans:** They hold a particular place in forest MSME which depends on both MSME holders as well as traders.
5. **Commission Agents/Brokers:** They are the supplier of raw materials to all kinds of Forest MSME and are the market runners for providing raw materials to MSME.
6. **Agroforestry Practitioners:** These are mainly farmers and agents who are keen to produce wood through sustainable methods.

Tree Use by Forest MSME



Source: Author.

Wood Transit

Wood transit affects the working of forest MSME as the transit rules imbibe for both buying and selling of raw material and produce respectfully. The idea of decreasing the need of transit can be further took into consideration in architectural intervention, which decreases transit cost, pollution, labour cost making the produce more economical and saleable.

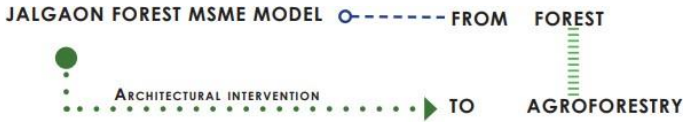
Jalgaon Forest MSME

Jalgaon District is located in the north-west region of the state of Maharashtra. Jalgaon City is the headquarter of the Jalgaon District. It is located within the productive, irrigated agricultural region of Khandesh, and is a significant collection and distribution centre of agricultural goods and agriculture-based industry.

Analysis of Jalgaon Forest MSME

The Saw Mill MSME which is one of the most important MSME in the city is spread across numerous locations. The amount of raw material required depends on the type of work performed by a sawmill. A preliminary requirement is obtained through the method of primary data collection.

Despite being considered as a semi-urban area; agriculture remains the primary occupation in Jalgaon. Regarding the increasing demand for wood in and around the district, there is a substantial amount of Forest MSMEs across the city, which in fact will benefit from the opportunity to purchase raw materials locally and leads to increase its share on districts economy, Jalgaon as a home for MSMEs and farmers when connected through an architectural intervention will create a new way as a solution for sustainable MSME. Agroforestry promoted to the farmers of the region will surely help to achieve the demand of forest MSME as it will be the only sustainable method to harvest wood. Agroforestry as analysed in the research and taken forward to the city like jalgaon with favourable agricultural practices reduces the dependency of the MSMEs on other sources of wood and connected to a permanent solution in the way of agroforestry.



Source: Author.

5. CONCLUSION

Promotion of Agroforestry with forest MSME will reduce the dependence of forest MSME on forests for their source of raw materials and also generate additional revenue for the farmers in the region.

A model then generated with an architectural solution will inspire other MSMEs with similar working patterns. The characteristics of the intervention also helps the existing forest MSMEs of Jalgaon where the site is located, in the way of getting raw materials locally rather than being dependent on forest or other mediums from more sustainable methods like agroforestry.

ACKNOWLEDGEMENT

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PARADOX of URBAN VOIDS: Revitalizing Interstitial Spaces of Flyover

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ABSTRACT: Paradoxical architecture attempts to challenge the current methods of architectural rationalization and realization of projects. The very nature of a paradoxical situation opens up opportunities for architecture to be expressed in a unique manner which addresses both the contrary.

In any city, infrastructural development leads to creation of spaces which do-not occupy any form and are residual or termed as urban voids. This research intends to understand the case of urban voids, specifically the underutilization of residual space created by construction of flyovers. This scenario is a case of urban paradox, 'Negative space created as a result of positive infrastructure'. Such spaces are abundant in a metropolis that remain unclaimed, have great potential and need ideal solutions to mitigate the issues affecting the community in vicinity and thereby utilizing the space to its optimum levels.

Interstitial spaces under the highway flyover at Majiwada Junction, Thane, are highly underutilized and provide great opportunity for holistic development by thoughtful provision of socio-cultural, and economic programmes.

Keywords: *Paradox, Contradictory, Urban Voids, Interstitial Space, Underutilization.*

1. INTRODUCTION – THE URBAN PARADOX

Paradoxes in architecture have the potential to act as the anti-logic methodology in the deployment of architecture. They can work under the theory of what dialetheism paradox calls a "true contradiction", meaning that it is not impossible for a [concept] to be both true and false.

Paradoxes could be a logic device that expands the space between the logical and pragmatic and the illogical and deficient and sit in the interstitial space between them as the anti-logical and the paradoxical.

'Negative spaces as a result of positive infrastructure' is a paradox that the urban cities are currently grappling with.

Because there is no adequate planning regarding these negative spaces, they are redundant and not used to its optimum.

There is no way around not having such spaces created as architecture works in dualities such as exclusion and inclusion, outside and inside, public and private, the same and the different. By deploying paradoxical thinking, it has the room and potential to allow one to look at two architectural entities that do not seemingly belong, whether it is two typologies, two architectural devices or a mixture of the two, put them together to create the feeling of shock and understanding much like what a paradox provides.

Cities are composed of many types of space, including that which exists between the built environment, wedges of spaces defined by the infrastructure of transportation, communication, industry and development. This includes what Jacobs (1961) refers to as the 'Border vacuums', what Trancik (1986) calls 'urban anti-space' or 'Lost space'.

This is the odd shape leftover where highways cross, where a once active waterfront goes unused, where a stretch of land borders a campus or large complex, where railway tracks have been abandoned, where a building has been burned down and the lot has gone into weeds.

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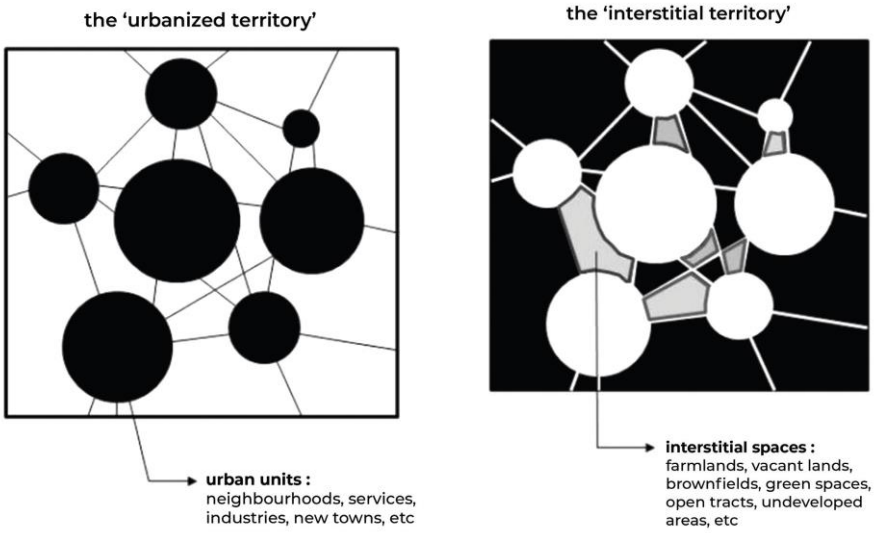

Figure 1: Urbanized and Interstitial Territories

Source: Author.

This may even be what Rem Koolhaas (2002) calls 'junk space' after its final demise: empty shopping centres, obsolete car showrooms, abandoned stores or fast-food restaurants, and their adjacent parking lots.

While people can and do often use these residual spaces for a multitude of purposes, these are not thought of as public space. When we think of urban public space, it is more often parks, plazas, malls, and squares that come to mind. Many of these programmed spaces have been created to be used in a certain way, at specific times, by certain types of people, for a limited set of purposes. But Interstitial Spaces offers opportunities to withdraw from the formal and informal control of public space to a less controlled territory.

Mumbai Metropolitan Region's growth has been accompanied & facilitated by the widespread construction of new and upgraded transport infrastructure. This vertical emphasis is set to continue with several elevated metro-lines and mono-rails currently under construction or proposed. But this rapid development is fueled by incomplete planning and in the process a lot of scenarios and spaces are left out to be documented.

2. CATEGORIES OF URBAN VOIDS

2.1 Planning Voids

Voids created due to inefficient and improper planning processes. These are created due to planning in isolation without understanding the fabric of the city. These are most visible in our cities also can be perceived using figure ground theory. Planning method is focused on functional aspect and urban voids are generated because of lack of holistic approach in planning. Land use zoning which results in segregation of infrastructure and public space is creating dead pockets in the city. Technique which was formulated, to resolve issues and generate planned cities for masses is giving rise to mechanical cities without life. It is very crucial to understand these voids which divide the city fabric and utilize them for active public realm.

2.2 Functional Voids

These are dead vacant spaces in the cities. When a space is not used like it was designed to use the space becomes defunct. These occupy precious land in the city and make the environment unpleasant. Old historic buildings, derelict factories or spaces, underutilized or abandoned spaces are examples of this category. Generally, these voids can be found in historic or old areas of city and these voids are generated with time and technological, socio-political or cultural changes. In Planned cities these voids can be seen if any built or unbuilt space is left abandoned because of legal disputes or such issues. Large amount of research in carried out in this by analyzing historical areas of city.

2.3 Geographical Voids

These areas are existing geographical features in the city. Geographical voids can be entirely new category but according to research done these voids are formulated because Natural features like river, Nalas or contoured land are not planned appropriately. These areas are kept reserved for conservation of nature, but as these areas are not treated as part of urban fabric and left unattended or not incorporated because of which these form dividing edges in the city fabric. As a result, these areas slowly get degraded or misused and disturb the continuity of a city. These are linear voids of the city running throughout the city with natural feature can be used to create avenues and vistas which can make city beautiful along with conservation of valleys.

2.4 Edge and Buffer Voids

These areas exist in setbacks, marginal spaces in plots, streets which are public in nature. Such spaces are often encroached by squatters for shelter purpose or hawkers for commercial practices.

2.5 Infrastructural Voids

Residual Spaces created due to infrastructure which is a waste of usable space, becomes center for illegal activities, increased crimes, and creates a gap in context.

2.6 Transportation Voids

Such voids occur when the transportation by vehicles is given importance over pedestrian movement. Oversupplied streets which become a hassle for pedestrians. Junctions are typical examples of transportation voids.

2.7 Large Scale Plots

Planning of the city is done for projected population and density after twenty-five years in Indian context. Sometimes chunks of lands are kept for future development, although these land invites negative activities because of its dysfunctionality and location in already developed area. These are not permanent voids although these areas are dysfunctional and neglected for 20 years or more sometimes. If we could utilize these areas for public till, they are needed for their actual purpose, then these may act as temporary stimulus for public realm. Unused abandoned land, parking lots, such areas which are disputed or there is a gap in development regulations create voids in the city fabric.

2. STUDY – INTERSTITIAL SPACES

Urban transit infrastructure, highways, freeways, once the backbone of prominent growth of our cities, currently have left us with dividing lines embedded deep into city development. Once a solution for accessing the city, these structures have cut off the city from the inside, removing vast quantities of land to make way for the automobile.

Where is the opportunity? With networks of highway systems becoming so ingrained into our city's fabric, being integral to the city's operation, is there an opportunity to reclaim the highway as an asset in urban development?
Examining the spatial conditions of the highway, we can find the vacancies, margins and in-betweens. Sites of vast potential, currently existing in states of ad-hoc under development, parking lots and city storage facilities, these spaces are too valuable to remain as leftover programs. Through means of interventions and outreach, creating public engagement, the participatory process is paramount in aiding in the unrealized potential of these spaces.

A negotiation between top-down planning policies with bottom-up emergence will help foster a proposal that moves beyond the traditional green public space. This proposal asks what new forms of urban public experience can emerge from the creative activation of these seemingly under-utilized, vacant and residual urban spaces.

3.1 Interstitial Space (Characteristics)

1. Distinct Morphology: clear, simple, identifiable shape: narrow, taller than it is wide, and long
2. Habitable
3. Between at least two other spaces whether connected to them or not

4. Secondary when seen in context
5. Supportive, in that it makes the primary spaces more useful
6. Often not programmed or Net Assignable Space, simply circulation space that takes on greater importance and meaning than at first glance. Part of Allowable Gross Square Footage

Table 1: Various Interstitial Spaces in a City

Indicator	Safety		Health			Economy	
Negative Spaces	Anti social Activity	Safety from vehicles	Waste Disposal	Breeding from insects (waterlogging)	Stray animals	Dedicated program	Modification / development of program
Land along Nala						***	Not Applicable
Space underneath flyover						***	Not Done
Temporary Exhibition Space						Temporary	Not Done
Vacant Land						***	Not Applicable
Neighbourhood Park						YES	Not Done
Public Park						YES	Not Done
Alleys						***	Not Applicable

(LOW) (HIGH)

Source: Author.

3.2 Thigmotaxis

The need for narrow interstitial spaces has been demonstrated through neuroscience as well as in the writings and observations of Christopher Alexander and Jane Jacobs. In their work Cognitive Architecture: 'Designing for How We Respond to the Built Environment', Ann Sussman and Justin B. Hollander explains the concept of thigmotaxis. They define thigmotaxis as the "wall hugging trait" or edge sensitivity. In other words, people like walking along the edges of space.

People gravitate naturally towards the edge of public spaces. The setting of interstitial space of the flyover is such that its presence incites the thigmotaxis behaviour because of the security of highways on both sides.

Figure 2: Thigmotaxis Behaviour in Humans

Source: Author.

Figure 3: Interstitial Space's Innate Characteristics are a Response to Agoraphobic Nature as they are 'in between' Spaces.
Source: Author.

3. INTERSTITIAL SPACES OF FLYOVER

We see the space under the flyover having wonderful potential. The uniqueness of flyovers lies in its character of an overhead shelter with generous underneath space that is longitudinal and barrier free. It is sheltered from the rain and heat of the sun. Surprisingly, it is also free of much of the politics, land tenure disputes and real estate speculation that plague much of the developing cities today. Thus, the negative effects produced by flyovers can be reduced through careful design and more importantly, incorporation of the spaces below into their surrounding urban environment. Flyovers, may solve traffic problems but in general, are considered as pretty negative elements within the urban fabric. The average traffic/civil engineered flyover is no elegant thing, and when inserted clumsily into existing urban fabric, can wreak far more havoc to communities and the general sense of place than we might initially think.

4. CRITIQUE

As the research dwells deeper into the interstitial spaces of the flyovers, questions arise.

1. Is the under belly of the flyover the only negative space in the urban fabric?
2. Does the space above the flyover qualify as an interstitial space?
3. How to quantify and what kind of space can it be termed?
4 Is there a parallel approach to deal with grey urban infrastructure?

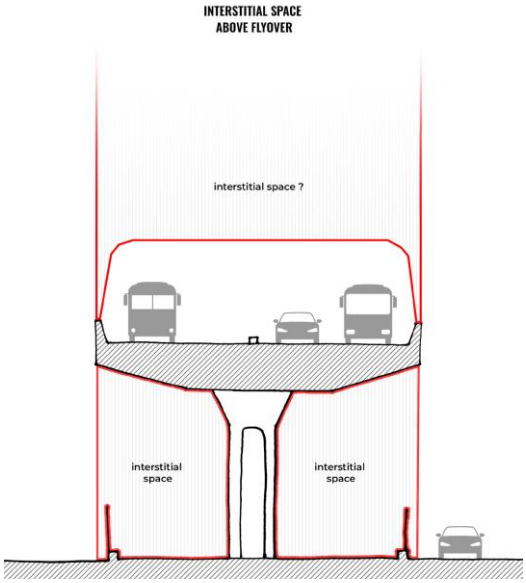

Figure 4: Speculative Interstitial Space above Flyover
Source: Author.

These questions give rise to a paradoxical solution which can be pivotal in the way interstitial spaces are dealt with for flyovers. Reasons why this could be a better solution:

1. The vehicles don't require an open to sky environment for propagation.
2. Such solution can be implemented for smaller sections.
3. Add a character to the space and give identity.

5. METHODOLOGY AND SITE

In a city which isn't based on a block system of urban planning, there are slivers and portions of awkward places in the city. They could be in between the buildings, the setback of the plots, occupying certain edge conditions, very skewed plot area to occupy any typical building layout etc.

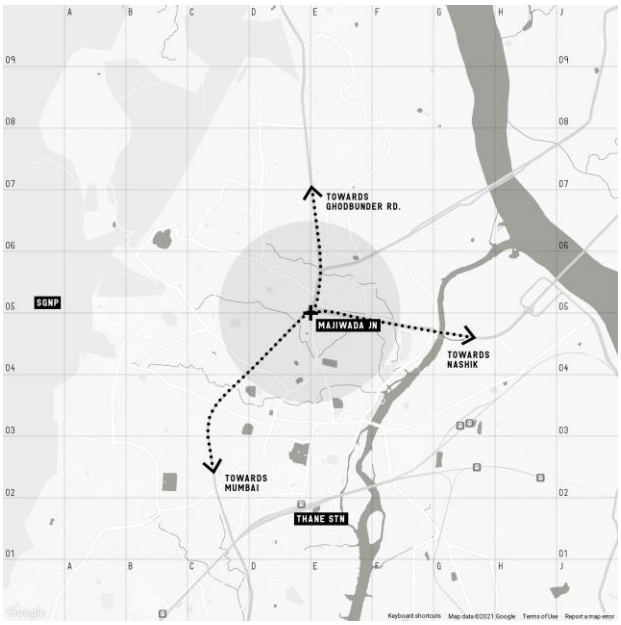

Figure 6: Majiwada Junctions Connections

Source: Author.

Site for research is selected as the Majiwada Junction, Thane. The interstitial space underneath the national highway is highly underutilized.

Majiwada Junction is the first point of entry to the Mumbai Peninsula on the Central Corridor and continues as one of the 2 road spines connecting the Northern Central suburbs to South Mumbai. There is heavy movement of traffic through out the day and the junction is modified over time to suit the vehicular mobility foreshadowing the pedestrian stakeholders.

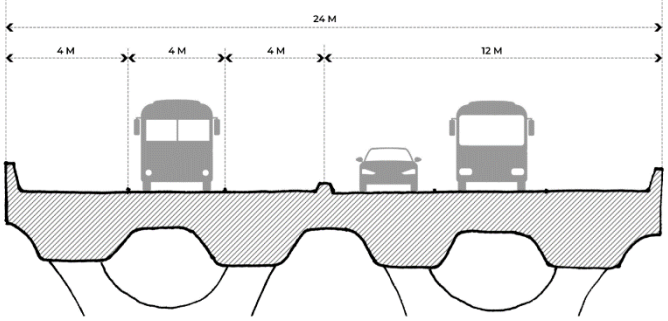

Figure 7: Right of Way of Flyover

Source: Author

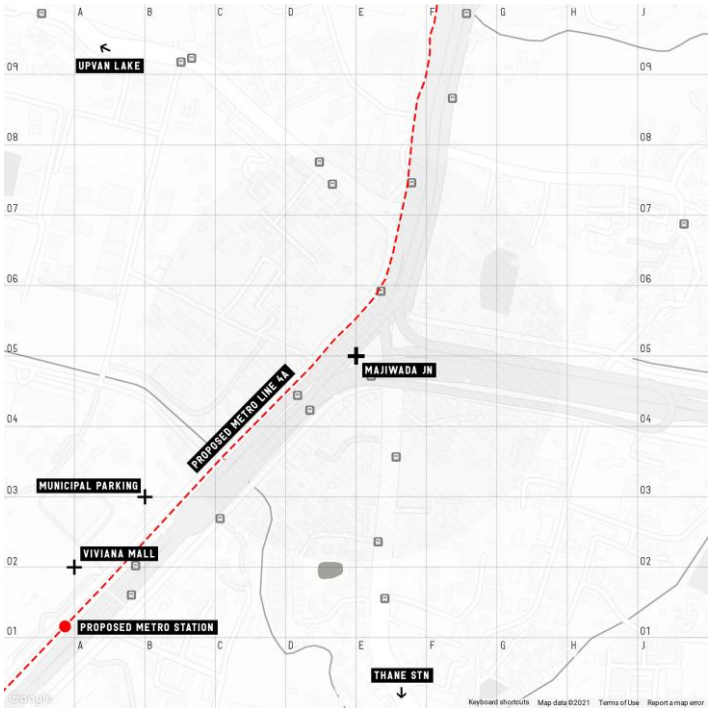

Figure 8: Important Landmarks Adjoining Site

Source: Author.

4.2 Site Study Criteria

The site was studied via certain lenses or criteria's:

1. Major connections
2. Number of traffic movements
3. Frequency of the traffic flow
4. Noise level mapping
5. Right of way
6. Area available
7. Clear height of spaces
8. Existing Functionality
9. Land Use around
10. Contextual impact
11. Future Development influence
12. Stakeholders' diversity

Photo 1: Underbelly of the Existing Flyover

Source: Author.

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5. RESULTS AND DISCUSSION

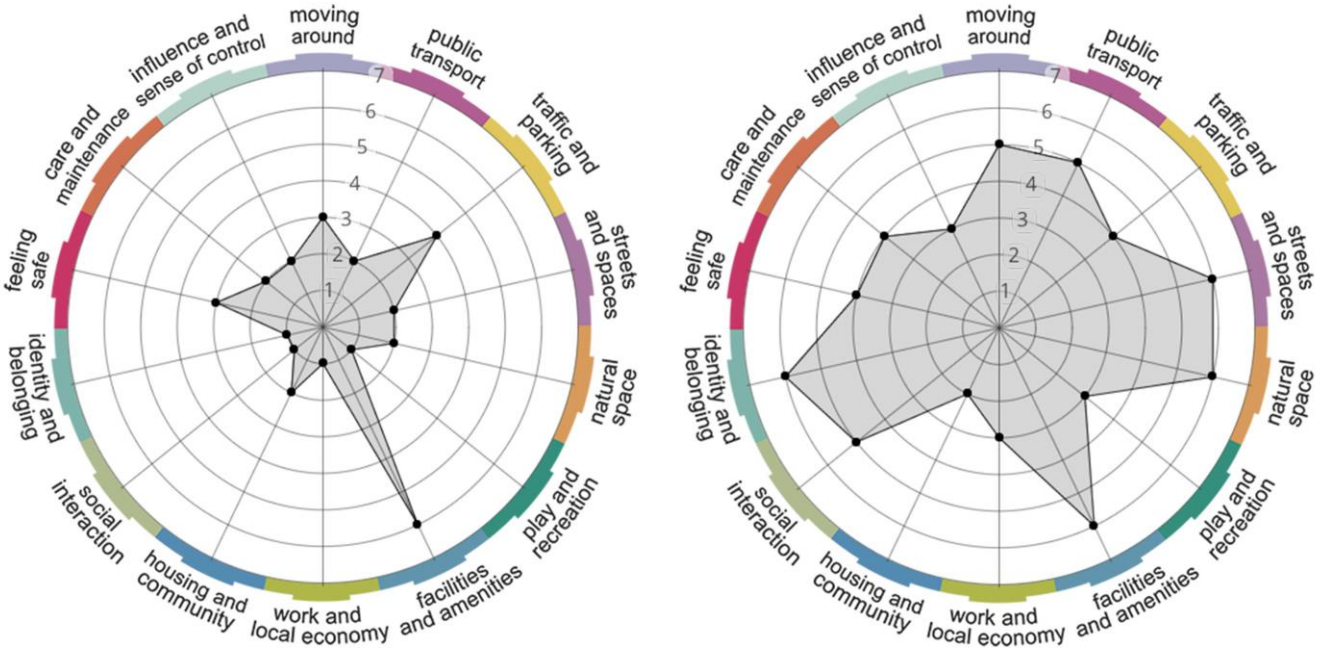

Figure 9: Placemaking Factorial Diagrams with Current and Desired Scenario

Source: Author (www.placestandard.scot)

The area was analyzed using the placemaking factors as mentioned below:

1. Moving Around
2. Public Transport
3. Traffic and Parking
4. Streets and Spaces
5. Natural Spaces
6. Play and Recreation
7. Facilities and Amenities
8. Work and Local Economy
9. Housing and Community
10. Social Contact
11. Identity and Belonging
12. Safety
13. Care and Maintenance
14. Influence and Sense of Control

6. CONCLUSIONS

- What new form of experience can emerge from the creative activation of interstitial spaces which are highly under-utilized and vacant by understanding the ideals of paradoxical architecture?
- Will flyovers continue being an infrastructural barrier used as a mode of transgression or be a potential opportunity for knitting together the city fabric by spaces of congregation?

6.1 Hypothesis

Infrastructural developments in the city often create redundant spaces. These create opportunities to elevate the quality quotient of such negative pockets by thoughtful and apt architectural interventions that benefit the neighborhood and the city as a whole.

6.2 Goals

- Engage the community in the design of public space.
- More adaptable, non-traditional public space.
- Create more pedestrian friendly junction for transgression.
- Embrace the highway as the context, but mitigate for human use.

- Create a Site-specific space, but applicable and adaptable to similar conditions in another place.
- Mitigate the Highway: Issues of noise and scale.
- Rethink the idea of interstitial space of flyover and develop further.

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Throughout the process of this research, I have received a great deal of support and encouragement from a number of individuals.

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Risk Management in Infrastructure Projects – Pune Metro Case Study

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ABSTRACT: India's Economy is mostly centred with metropolitan and major cities of the India. Lots of population consistently migrating from Rural areas to the metropolitan cities. As such the population of cities have increased to the high level. Hence the transportation of people is becoming major challenging task in the cities. To cope up with the situation the Govt of India has taken up the projects of Metro Rails across the Metropolitan. However, the success of projects mainly depends on the risks being encountered during the project cycle time. Hence Identification of the risks and their management is one of the key factors for completion of the project. Thus, to make the success of the metro projects attracts to scientific approach to accomplish successful completion of the project.

This Paper focus on the Identification of such risks encountered during the execution of Mega Metro projects. This research aims to deals with the various risks encountered in Mega Metro projects during construction through application of scientific approach to accomplish successful completion of project, in time with assured quality without any impact on environment, social and the most important within an assigned budget of the project. This study focusses on risk management by taking the interviews of techno experts, politicians, social activists, citizens, politicians as well as questionnaire survey conducted of professionals at all levels.

Keywords: *Infrastructure, Risk Management, Scientific Approach, Analysis.*

1. INTRODUCTION

Infrastructure is vital sector for faster economic growth and alleviation of poverty in any country. The adequate infrastructure in the form of roads, railways, ports, airports, power sector etc. and their efficiency is the need for the economic growth of the nation. The building of infrastructure needs investment of huge capital. Lack of infrastructure leads additional cost in terms of time, efforts and money of the habitat for accessing essential social services and basic needs of modernization. With large investment in infrastructure India has become second largest and fastest growing country in the world, but recently it is slowed down due to stalled of an infrastructure project.

According to world bank estimate developing countries made investment of round about $ 500 billion in new infrastructure which is almost equal to 20% of GDPA. But the need of infrastructure is still large. Railways and roads are one of the most important amongst the infrastructure sector. The world bank estimate 10% rise in infrastructure assets directly increases GDP by 1%. Hence the infrastructure projects are high on agendas. (Most of infrastructure project suffers from significant under management of risk throughout the life cycle of project as the management of risk is not properly accounted for during time. Variety of stakeholder are associated with completion of infrastructure projects hence risk/uncertainty is most likely throughout the life cycle of the project as such the risk has direct impact on time cost overruns and quality of the project. Hence each project should undergo risk identification, analysis, control and thereof.

Construction industry highly prone to the risks that may encounter at any period throughout the life cycle of project with different likelihoods and impacts. The risks associated with the construction sector can generate more or less severe consequences for an organization (Aven, 2011). Risk in a construction context is typically referred to as a variable in the process of construction whose occurrence results in uncertainty as to the final cost, duration and/or the quality of the project (Odeyinka et al, 2006). To try to mitigate or eliminate construction risk, the count on risk management, which is an integral part of project management. Construction risk management is a positive and proactive process intended to reduce the likelihood and impact of unsatisfactory consequences to the project in its different stages, such as design, construction and operation (Rohaninejad and Bagherpour, 2013). Hence, the main purpose of construction risk management is to identify, evaluate, and control the risk for project success (Lee et al, 2009). Overall, risk management process includes the following main steps: (1) Risk identification; (2) Risk assessment (qualitative and quantitative) and (3) Risk response (4) Control of

Risk. Risk identification process reveals and determines the possible project risk as well as conditions and arising risk. The qualitative risk analysis process is regarded as the most useful part of risk management where the result gained is used extensively in subsequent stages. Important information about risks such as the likelihood of occurrence, the risk severity and risk ownership are required at this stage. The quantitative risk analysis process involves the creation of a model which represents the project being studied and the general uncertainties. Consequently, the process of management of risk includes risk response strategies that are defined as risk retention, risk transfer, risk reduction, and risk avoidance (Khodier and Mohamed, 2015). Risk management tool which helps in identifying the uncertainties and develop a strategic response to mitigate it. The systematic process of risk management is associated with risk classification, risk identification, risk analysis and risk response. Risk response can be handled with four actions accept, transfer, mitigate and avoid (ATMA). Risk management is a such an effective method is does not only help to understand various risk but even helps in managing risks in various stages of the project.

2. LITERATURE REVIEW

Literature 1

A New Type of Risk in Infrastructure Projects. Mihnea Creciun - "New Type of Risk in Infrastructure Projects"; The Author expressed several approaches to infrastructural risks. He is in the opinion that there is large array of risks typologies based on which this can be analysed. Amongst the many categories, the risks could fall in to, many categories, only a few can be expressed as Macroeconomic risks, regulatory risks, risk related to competition, risk related to resources or access to resources and approach like that of Grimsey and Lewis, researchers of public-private partnerships funding structures, identifies new risk that affect each and every investment in infrastructure project: Technical risk, construction risk, operational risk, risks impacting the income, financial risks, the risk of force majeure, regulatory risks, environmental risks. The manner in which the effect of these risks can be mitigated or diverse, in many cases, risks are being transferred to external partners such as customers, suppliers, insurance companies and international guarantying entities. A substantial part of them, however, remains in the project company- this means that, ultimately, funding risks are still extremely high. The global financial crises have led to increased funding cost for all projects and effects will be seen over many years, so there is expectation that number of completed projects will decline substantially in the near future.

Literature 2

Risk Management in Megaprojects

Ana I. Irimia-Diégueza; Alvaro Sanchez-Cazorlaa; Rafaela Alfalla-Luquea published the papers on risks management in Megaprojects in 27th IPMA World Congress wherein the author is focused on the first of these phases: risk identification. The purpose is to establish the state of the art in risk management in megaprojects, systematize the risks studied in the literature, as well as to identify potential areas of further research. The author expresses a bibliometric analysis of the papers that focus on risk management in megaprojects; a systematization and classification of the risks; two matrices comprised of the proposed risk categorization, first in relation to the sector studied, and second related with the different stakeholders; and an identification of gaps in the research in risk management in megaprojects. The systematization of the risks helps managers towards their identification within the megaproject, and to follow the subsequent steps in the risk management process. The Author defines risk management as the systematic process of identifying, analysing and responding to project risk. It has six steps: planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk monitoring and control. The risk management is a process composed of several phases. This paper is focused on the first of these phases: risk identification. This process of risks management is composed of six steps: planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, and risk monitoring and control. One of the objectives of this paper is to focus on the phase of risk identification through the development of a systematization and classification of the potential risks to be managed in a megaproject. After identifying the risk, a quantitative and qualitative risk analysis would be necessary. Finally, the risk needs to be planned, monitored, and controlled.

Literature 3

Risk Management in Infrastructure Projects. Pawel Szymanski- Risk Management in Construction Project: The Author says risks is present everywhere, in area of industries. One of such area in construction agencies, where risk is ever presents element of a great puzzle. Therefore, the effective risk management required to have golden mean in relation to the

implementation project. Uncertainty is to be seen in a decidedly distinct way from the well-known concept of risks, from which it has never really been separated. The main point is that in some cases the risk is measurable magnitude, while in others it has completely different nature; depending on the type we have to deal with there are far reaching and fundamental difference in the understanding of this phenomenon. The author expresses the risk in construction projects mainly in five groups such as preliminary design, tender, detailed design, construction work and financing the investment. The methods and tools used for risk management are brain storming, pelphi method, SWOT analysis, sensitivity method, modelling and computer simulation and risk matrix. The Author conclude scientific research and data derived from everyday operation have shown that risk is measurable entity and destructible. Risk management in a project is not limited to noting down all the Cros and Cons or putting label 'negative risk' on each disturbing and causing thrill of positive emotion event.

Management is complex, long lasting and far-reaching process that begins long before investment and sometime and last even after risk completion. To Wisely manage risk does not mean to avoid it but identify it correctly and determine all associated opportunity and hazards.

3. METHODOLOGY

1. Conduct open interviews and literature review to know about present scenario of Infrastructure Projects.
2. Define objective based on the necessity concluded from present scenario.
3. Preparation of set of questions based on literature review, pilot survey, PMBOK or conducting questionnaire survey focused on defined objective.
4. Unstructured interviews and discussions with road project participants to validate the factors short listed in the above step.
5. Questionnaire survey among the professionals and experts associated with relevant field, officials of public body, Govt. organization, project management consultant.
6. Analysis of data, by relative importance index method, obtained from the Questionnaire survey to rank the attributes frequently affecting the performance of the project.

Due to the non-availability of organized information related to the occurrence of risks and their management in infrastructure projects, a questionnaire survey conducted by using direct responses were collected from professionals engaged with the execution of infrastructure projects. In the questionnaire simple and straightforward questions were used to minimize ambiguity. The responses collected from professionals through the questionnaire survey. A sample of questionnaire is as follows,

Sr.No	***Attributes***	***Rating Scale***					
1.	Non-Availability of required land execution	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	
2.	Opposition by local due to inadequate conceptual design	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	
3.	Addition in scope of work	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	
4.	Deletion in scope of work	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	
5.	Inadequacy/clarity in defining scope of work	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	
6.	Discrepancy in drawing and scope of work in written	Probability	Minor	Low	Moderate	High	Extreme
		Impact	Minor	Low	Moderate	High	Extreme
		Response	Avoid	Transfer	Mitigation	Accept	

Chart 1: Figure Showing Sample Questioner from which Responses are Collected

7. Analysis of data, by relative importance index method, obtained from the Questionnaire survey to know the impact of attributes on the project affecting the performance of the project.
8. Analysis of Risk Response Strategy recommended by the respondents for each attribute.
9. Risk Assessment and recommendations through case study.

4. RESULTS AND DISCUSSION

Using the objective methodology to evaluate the Likelihood and Potential risk impact helps the organization to understand the Inherent Risk.

Inherent Risk: Is risk that exists in the absence any controls or Mitigation Strategies. When inherent risk is identified organization needs to consider Key Risk Driver that can be organized in the following categories.

RR-Risk rating.

Risk Impact Table

Table 1: Table Showing Risk Impact on Other Risk Attribute

RR	*Legal Impact*	*Financial impact*	*Business impact*
5	Imprisonment,	Total business loss	Adverse events such as not meeting production and constructional agreements requirements & can result in heavy operating losses,
4	Fines,	Reduction in turnover	Embargos plant shutdowns
3	Penalties,	Share price,	Demerits in respect of fulfilment qualifying criteria's
2	Product seizure	Potential future earnings	Inability to operate
1	Debarment.	Loss of customers	Not meeting commercial needs

			Consequence				
	Significance		1. Insignificant Impact	2. Minor impact to Project objective	3. Moderate-minor impact to Project objective	4. Major impact to Project objective	5. Major impact to Project objective
Likelihood	1	Rare	Low	Low	Moderate	High	High
	2	Unlikely	Low	Low	Moderate	High	Very High
	3	Moderate	Low	Moderate	High	Very High	Very High
	4	Likely	Moderate	High	High	Very High	Extreme
	5	Almost Certain	Moderate	High	Very High	Extreme	Extreme

Chart 2: Figure Showing Risk Significance and Consequences

Project Risk Management Assent and Control Matrix

Table 2: Table Showing Risk Man agement Assessment and Control Matrix

Risk Attribute	*Project Risk*	*Probability (p)*	*Impact*	*Risk Assessment Rating*
Land acquisition	Time and cost overrun	0.81	100	81
Design and drawing	Lack of co-ordination between structural and architectural division	0.32	22	66
	Delay in approval of drawings	0.49	34	
safety	Damages to life and property	0.40	100	60

Risk Attribute	*Project Risk*	*Probability (p)*	*Impact*	*Risk Assessment Rating*
	Loss of life	0.20	100	
Relocation of utilities	Changes in structural drawings	0.70	25	41
	Time and cost overrun	0.45	16	
Sub contract	Time and cost overrun	0.35	21	40
	Quality of work	0.20	12	
	rework	0.13	7.5	
planning	Time and cost overrun	0.24	7.20	12
	Idling of resources	0.18	5.40	

5. CONCLUSION

The risk attributes from questionnaire survey, literature review brainstorming sessions are land acquisition, change in design, utility relocations, change in scope of works etc. These risk attributes are consistently in countered in the execution of Infrastructure projects. These attributes are leading towards the,

1. Delay in completion of projects – Time Overrun.
2. Increase in cost of budgeted cost – Cost Overrun.
3. Impact on quality of construction
4. Challenges to be achievement overall project achievement.

The attributes of non-acquisition of 100% land at the time of launching of project or acquisition of additional land after commencement of project is difficult task. It is affecting directly on the completion of project in time and require additional capital for compensation towards acquisition of additional land. Delay in acquisition further affects the idling of machinery, manpower, underutilization of resources.

The data of infrastructure project is not maintained from risk management point of view i.e., regular review meeting for identification of probable risks, brainstorming sessions for identification of risks in anticipations, assessment of risks impact of risks in terms of time, cost, quality and goals of the projects. There is lack of dedicated risk management call which is required on mega infrastructure projects.

6. RECOMMENDATION

The preferable contracting methods shall be combination of EPC & item rate contract. Definite scope shall be including in the lump sum contract. Variable parameters shall be considered under the item rate part to minimize the risks during the execution.

Land acquisition problems become certain for each project with more or less %. Project should be launched after confirmation of at least 90% land in possession before award of contract. For balance land, i.e., accepted risk, the time frame for acquisition shall be finalized and binding over the parties.

Relocation of major utility shall be excluded from scope of principal contract and it should be executed through separate agency prior to the commenced of principal contract.

Application of risk management at site through deployment third party or in house risk management unit as a part of contract. They should dedicatedly work of identification of risks in anticipations, assessment of risks already identified, impact of risks, risk response planning and close monitoring of the same.

7. FUTURE SCOPE OF WORK

It is observed that, the attributes like that land acquisition, change in design and drawings, sub-contractor selection, change in scope of work can be eliminated or minimized at pre-tendering work is study of present scenario of risk management during pre-tendering stages.

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Investigation of Solid Waste Management Practices for Street Vendors in Pune City

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ABSTRACT: The city of Pune along with the various large metropolitan cities in India is subjected to uncontrolled urbanization and various environmental and health hazards due to insufficient solid waste management in the various sectors of the city. Street vendor's also known as street hawkers and/or roadside vendors are a popular and integral part of the cultural and social fabric of the city. Street vending is a dominant informal business activity and a sector that constitutes to the major sources of solid waste generated on the streets. Inappropriate management and poor disposal due to lack of storage, non-access to improved handling and disposal systems can pose risk to public health, pollution, poor environmental conditions and obstruction to pedestrian traffic.

The research aims to investigate the type of waste generated, waste classification and characterization and identify the existing waste management system of waste generated due to street vendors for the selected areas in the city of Pune. A survey of solid waste generated and current practices of solid waste management of the street vendors in the selected areas was conducted to identify the sources and generation of solid waste in the selected sector .A survey by interview was conducted for 15 random street vendors to determine the solid waste management practices of the street vendors. A survey of 109 street vendors was recorded from the selected streets to identify the quantity and composition of solid waste generated. The research intends to propose the necessary control measures and appropriate potential solutions for organized and well implemented solid waste management guidelines for the street vendors.

Keywords: *Street Vendors, Waste Classification and Characterization, Waste Control Measures, Environmental Hazards, Waste Management System.*

1. INTRODUCTION & BACKGROUND OF STUDY

Street vendors also known as hawkers, roadside vendors include all those in public spaces such as sidewalks, street corners, or in regulated spaces such as hawking zones. The vendors may at fixed locations, by bicycle, motorbikes, or Wheeled pushcarts. Wastes generated from these streetfood vendors are a major cause of garbage on the streets. Ifnot

Managed properly, it is not only aesthetically offensive but it also poses risks to public health and also it can lead to clogging of drainage systems. Solid waste is widely different such as mixture of vegetables, food items, paper, plastics, glass etc. The most common problems associated with improper management of solid waste include diseases, odour nuisance, fire hazards, atmospheric andwater pollution, aesthetic nuisance and economic losses.

Research aims to study Solid waste management practices for street vendors in Pune city.

Research objectives are as follows:

- To study the general guidelines and policies prevailingfor solid waste management in India.
- To analyze the profiling of street vendors and wastegeneration rates and waste composition
- To observe and conduct a survey of solid wastemanagement practices in street sector.
- To observe the problems and issues in the currentsystem.
- To propose guidelines in relation to the issues identified. This study would cover various street vendor's sector areas in Pune to understand the problems towards solid waste management.

This study is restricted to areas under the Pune Municipal Corporation.

2. LITERATURE REVIEW

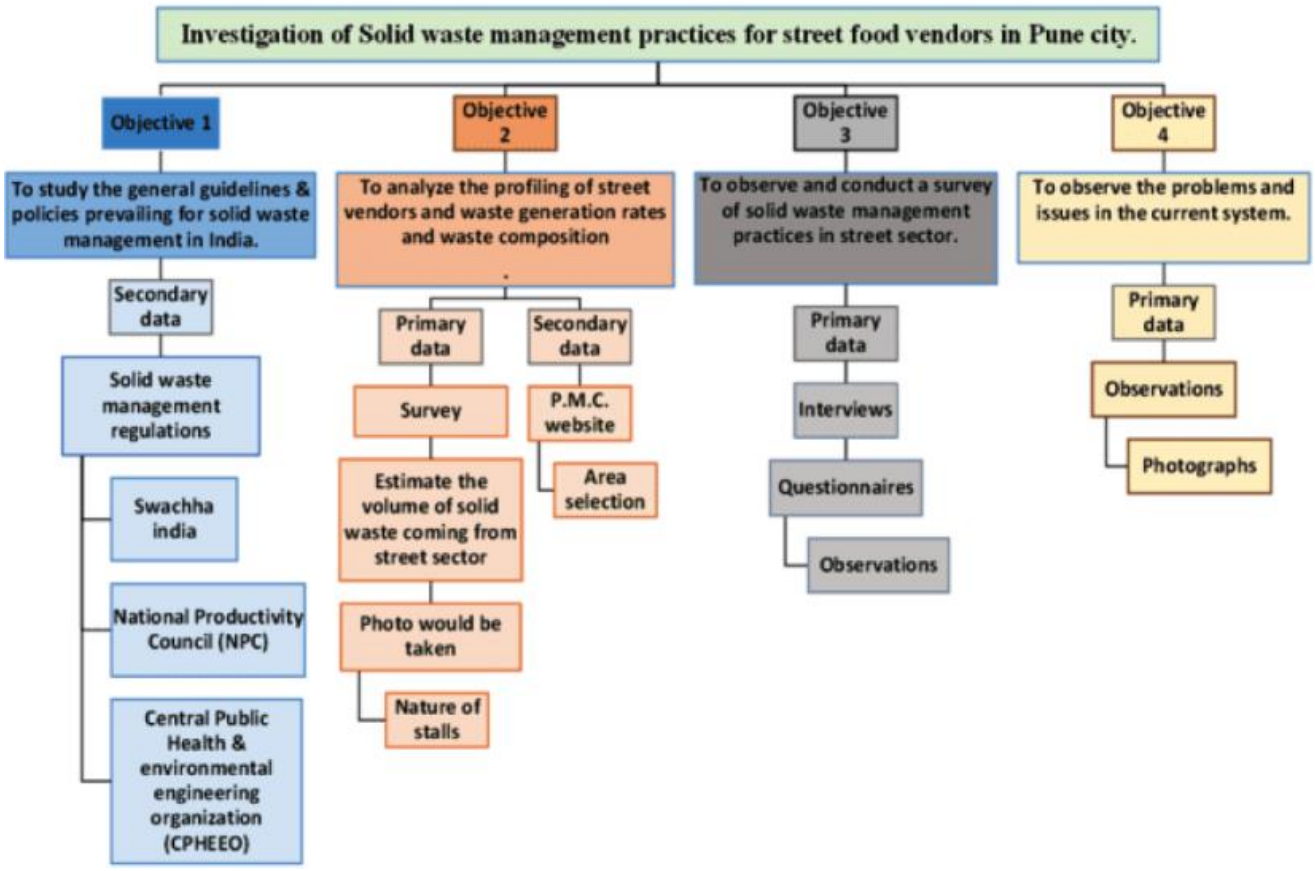
To understand the process and the methods to be followed for research two research papers were reviewed. The first research paper is "Waste management in developing countries, street food market, kolkata-india". The research was done in stepwise. To give suggestions first they have investigate current solid management system, after identifying they interviewed 5 stakeholder like, Street food vendors, Public sweeper, Private sweeper hired by the (CHMU), Individual informal waste collectors, Informal shop keepers selling waste to the industries. The policies ((legislation and planning), practices (collection Transportation, treatment and disposal) were studied. In a second stage waste sampling was performed to 2 selected central streets of Kolkata for characterization and quantification purposes. In total 77 food stalls were surveyed. The amount of waste generated is estimated in kg/day per stall. The modelling of the environmental impacts of the generated waste was performed through EASEWASTE software. The results generalized in the whole city indicate that the total street food vending activity poses an environmental burden. (Christensen, 210) In the last stage they have given the suggestions in compliance with the already founded policies and aim in facilitating their application. Thus they relate to the waste sorting and the adoption of a suitable treatment technique. (Christensen, 210)

The second research paper is "Solid waste management practices in the street food sector in thu duc district, ho chi minh city." This survey is on the solid waste management practices of the street food sector which was conducted in Thủ Đức District, Ho Chi Minh City located in china. First all the street food vendors in the area were recorded, classified according to the nature of their stalls, and also categorized according to the type of food vended. For the survey interview was conducted with 62 random stalls to determine the solid waste management practices of the street food vendors and their customers. Waste samples from 32 different stalls were collected for weight and volume measurements as well as visual determination of waste composition. About 1158 stalls were recorded in the area, generating about 8.20- 12.66 tons of wastes per day, roughly 3% – 5% of the total municipal solid waste in the district. (Cabaltica & Hung Dinh Nguyen, 2016) Biodegradable waste accounted for about 89% by weight followed by non-biodegradable wastes, and recyclable wastes at 7% and 4% respectively. Reused grocery bags were the most common waste receptacle used by vendors. They have also check how the segregation of waste happenon site from each vendors.

Segregation is limited to the materials that vendors can reuse or that the informal sector of recyclers buy and is prevalent only in stalls selling beverages, with plastic bottles and metal cans as the most recycled components. The rest of the wastes are commonly wrapped in bags or in burlap sacks for bulky wastes and left on roadsides awaiting collection. (Cabaltica & Hung Dinh Nguyen, 2016)

3. METHODOLOGY

1. Profiling of street vendors – to estimate the volume of waste coming from the street food sector and the timing of waste generation. The nature of food stalls and the types of food sold were noted and their exact locations were determined by marking them on a map.
2. Nature of street vendors – Street food vendors were divided into three groups according to the nature of their stalls. Example of each type is:
   - Fixed stalls are those kiosks put up in front of the vendors'own or rented space.
   - Semi-Fixed stalls are those mobile kiosks, or wheeled pushcarts that are set up on the same spot on a daily basis.
   - Mobile Stalls are those where goods are carried by vendors either on their backs, or on pushcarts, or mounted on motorbikes/bicycles as they move around the city.
3. Street vendor's categories according to the type of goods they sell – Street vendors were also categorized according to the types of food sold and the similarities inthe type and volume of expected wastes produced.
   Coffee, tea, and soft drinksSnacks and sandwiches Fruits and vegetables Flowers
4. Determination of waste generation rates and wastecomposition.
5. Survey and observation of the solid waste managementpractices in the street sector.
6. Result and discussion



1. *Solid waste management regulations*

- A Bin Is A Must For Street Vendors - All street vendor should keep suitable containers or bins for storage of the waste generated by them such as food waste, disposable plates, cups, cans, wrappers, coconut shells, leftover food, vegetables, fruits etc. They are also responsible for their own waste and should deposit their waste at a waste storage depot or container or vehicle asnotified by the local authority.
- Minimize use of plastic carry bags
- Promote eco-friendly compostable carry bags (conforming IS/ISO: 1708 (Swachh India, n.d.) (India, 2016)8).
- Carry cloth bag while going for purchasing vegetables.
- Dispose the plastic waste only in designated (dry waste)bins.
- Use of Carry Bags made from compostable Plastic or material
- Collect waste from vegetable, fruit, flower, meat, and poultry and fish market on day to day basis and promote setting up of decentralized compost plant or bio meth nation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions
- Collect separately waste from sweeping of streets, lanes and by-lanes daily, or on alternate days or twice a week depending on the density of population, commercialactivity and local situation.

2. *Profiling of street vendors and waste generation on siteby each vendor.*

The P.M.C. has done the survey of solid waste management ward wise. According to that survey got to know that which are the area / wards are in the problematic zone where there is need of improvement in solid waste management.

Streets are selected for the research which are:

(a) Shakar nagar, Pune
(b) Bibewadi, Pune

(a) *Sahakar Nagar, Pune*

Length of Street (m.)	*Road Width*	*Types of Street Food Vendors*	*No. of Street Food Vendors*	*Average are of Vendors were they Sit (m²)*	*Maximum Footfall Timing (Morning/Afternoon/ Evening)*	*Timing*	*Content and Sources of Solid Waste*
48	8	Flower	1	3	Morning and Evening	12 P.M. to 9 P.M.	leftover flowers
		Vegetable	22	3	Evening		Leftover vegetables
		Fish	2	3	Morning and Evening		plastic, Paper
		Tea Stalls	1	2	Morning to Evening		food waste

Type of street vendors	Weight /Day/Street Vendor (Kilo)	No. of street vendors	Aaprox. Weight of the Total Waste Generated (Kilo)	Photographs
Vegetable	5.5	22	121	
Flower	0.6	1	0.6	
			122	

(b) *Bibewadi, Pune*

Length of Street (m.)	***Road Width***	***Types of Street Food Vendors***	***No. of Street Food Vendors***	***Average are of Vendors were they sit (m²)***	***Maximum Footfall Timing (Morning /Afternoon/Evening)***	***Timing***	***Content and Sources of Solid Waste***
650	8	Fruit	17	3	Evening	7 A.M. to 12 P.M. and 5 P.M. to 9 P.M.	Leftover fruits
		Flower	14	3	Morning and Evening		leftover flowers
		Vegetable	40	3	Evening		Leftover vegetables
		Pooja Sahitya	8	3	Morning and Evening		plastic, Paper
		Tea Stalls	4	2	Morning to Evening		food waste

Type of Street Vendors	*Weight/Day/Street Vendor (Kilo)*	*No. of Street Vendors*	*Approx. Weight of the Total Waste Generated (Kilo)*	*Photographs*
Vegetable	3.1	40	124	
Fruit	16	17	272	
Flower	0.1	14	1.4	
			398	

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3. The questionnaires were made in Marathi which is thelocal language of Pune city.

Questionnaires were made for 3 stakeholders

1. Street vendors
2. Road sweepers
3. Waste collectors
4. Results & Discussion

4.1 Site analysis

1. Waste containers/locations on site

Figures and the map showing the waste locations of buckets of street vendors and the waste dumping area of street. Each vendor keep their own bucket for waste and when they leave they throw their waste here. It is observed that vendors do not separate their waste into dry and wet waste they just keep their waste in a one bucket. When the waste collector collect these waste from this place they separate the waste not the vendors.

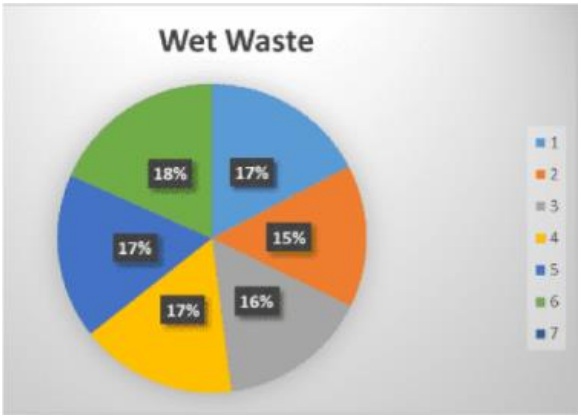
Bibewadi, Pune

These are the locations of wastes of street vendors.

Each vendor throw their waste on road side or on footpath only. They leave their waste on road side and waste collectors collects these waste from roadside. It is observed that vendors do not separate their waste into dry and wet waste they just throw their waste on road side area/footpaths. When the waste collector collect these waste from this place they separate the waste not the vendors.

Waste Generation Rates

The primary garbage collection & transportation vehicle with the capacity of 6-7 ton comprising mainly closed body structure with two compartments for dry & wet garbage. This segregated garbage is collected & transported katraj ramp station for processing. This bell truck goes to collect garbage.



According to this data it is seen that on Sundays waste is only collected from home by ghanta gadi not from the streets. Generated Quantity of waste is more on Saturday. **Waste collection and disposals**

Waste Collection: Street waste collection is done from Monday to Saturday except Sundays. Waste collecting vehicle didn't come on Sunday.

Waste collection timing:

Morning: 7 AM and Evening: 6 PM

Frequency of waste collection: Waste collection is done 2 times in a day (morning and evening)

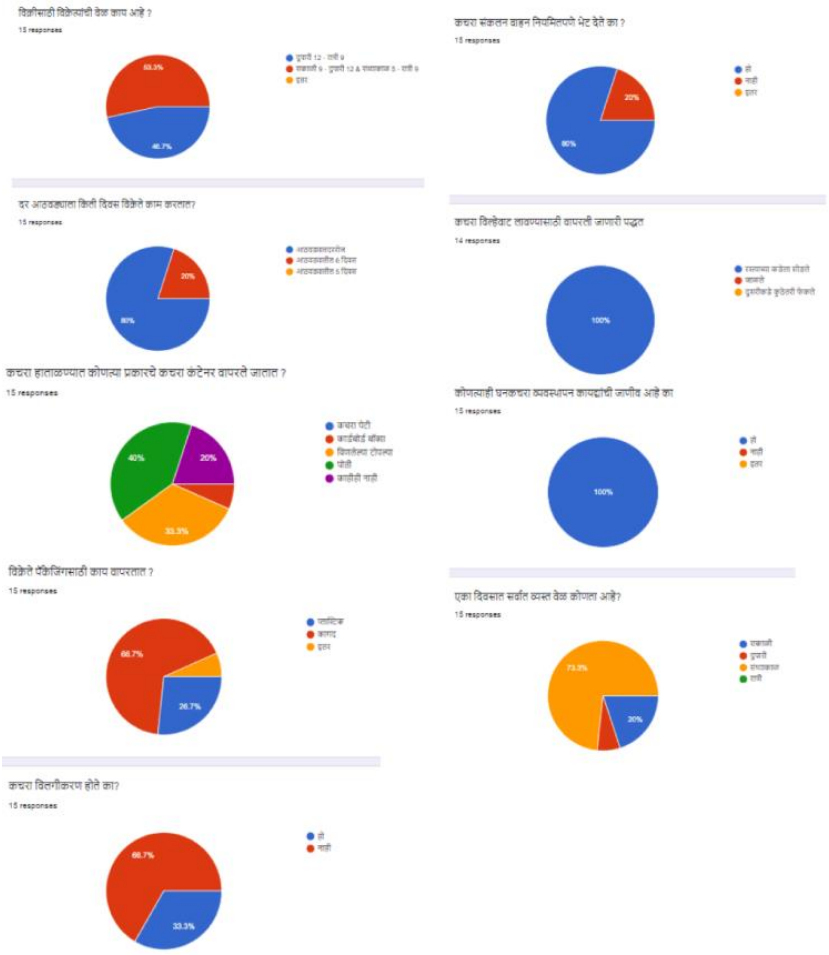
Treatment: Collected Waste goes to the nearest treatment plant which is Katraj ramp where the waste treatment is done .A biogas plant is there in Katraj that uses the organic waste to generate electricity to power street lights. A plant to create fuel pellets that can be used in industrial furnaces is being experimented.

Segregation and other methods of disposal on site: Segregation: Waste is segregated in wet and dry waste andthe road sweeping waste is collected separately.

Physical segregation: Each vendor have their separate waste receptacle in which they keep their waste. The waste is not segregated by vendors they just keep their waste in one bucket/receptacle.

- *Treatment:* This segregated garbage is collected & transported katraj ramp station for processing.
- *Management:* Most of the street vendors not separate their waste into wet and dry waste because of that waste collector have to separate.
- *Involvement of External Agency:* SWaCH has beenauthorized by the PMC to collect waste.

Results of Interview



According to the survey conducted it is seen that half of the vendors selling timing is in the morning and the evening and half are from afternoon to evening till 9 PM i.e. the waste generation timing is from 9 AM to 9 PM . And they work every day in a week.

The segregation of waste is done by the waste collector people.

In general, waste stream coming from the street food sector is considered a municipal waste. Thus collection was done by the same ones collecting household wastes. From the survey conducted, 80% of the respondents said that their wastes were collected regularly.

100 % of the respondents left their wastes on roadsides for community collection.

The waste generated from road swiping and from street vendors is not mixed and collected separately.

5. CONCLUSION

The research study and the survey concluded that improvements and efficiency can be achieved beginning from handling of waste at the source for the selected cases.

- The unavailability or non-visibility of waste collection systems like bins or waste receptacles on the streets does not encourage the buyers and street vendors to dispose their wastes properly. Hence Waste receptacles should be provided at strategic locations on the streets and pedestrian pavements for efficient collection by the municipal authorities and to keep the streets andpavements clean.
- The waste receptacles can have designed loading capacities for collection of waste. Explicit and appropriately designed signage's for appropriate collection and segregation at the source isrecommended.

- Careful planning for each aspect which can only be achieved after consultation with all stakeholders. There is also a need to include the vendors in the mapping out of the solid waste management strategy.
- Responsibilities as well as the benefits of appropriate solid waste management shall be conveyed to the vendors, municipal authorities and other stakeholders to adopt their potential support and create environmental consciousness.
- Incentives for adopting best practices and innovative approaches of solid waste management shall be given to encourage the vendor-public partnership for effective and appropriate solid waste management.

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AAWAS: An Animal Welfare and Rehabilitation Society

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ABSTRACT: The ever-increasing human population increases the need for area (For better living, transportation, ease to access and mobility) space, infrastructure, etc. We, humans, need good facilities and comfort Hence, we have developed our towns and cities but forget the other earthlings or god's creatures. As per the Literature study, the count of stray animals is in crores with around 30% of new-born stray animals surviving on the street, 50% of stray animals are left to starve each day and close to 60% of stray animals face cruelty from humans. Humans are becoming greedy to fulfil their needs while exploiting nature and encroaching upon natural surroundings – land, and water, leaving little to no space for stray animals. This study will provide to understand proper treatment of rescued stray animals and homeless stray, abandoned animals will get their forever home where they will have their rightful freedom.

Keywords: *Treatment; Animal Abuse; Shelter; Awareness; Animal Equality; Human-Animal Interaction.*

1. INTRODUCTION

The process of urbanization continues deplete the biodiversity of cities and need of biodiversity in our neighborhood. Human is exploiting nature and continue to do so on. They have no idea about the damage that they done from the long period of time. As human think about human only and their foremost surrounding, but neglect a major part encircling them in their sub-conscious mind, that is the other earthlings(thoughts, nature, and animals). A few problems made by human to other animals are habitat loss, animal cruelty, factory farming, animal experiments and animal abandonment, caging and torture. These issues raised because human taking their claim over animal habitat and animals, just because we are at the top of the food chain, but human cannot take advantage over the ones beneath them. We need to think about other earthlings also not in the terms of performance and aesthetic but as life itself. This research paper aims to make people aware of the life of stray animals in the present scenario, animal abuse, and cruelty; to make people aware of their duties towards other earthlings. The objective of this paper is to study the medical facility for the stray which are rescued from accidents and deadly diseases, to develop animal-human interaction, to understand animal behaviour and space design to maintain psychological equilibrium. This project provides us wide scope to study the different animal's behaviour, life span, treatment, and lifestyle, etc. This research is limited to the specific category of animals such as dogs and cat. As an architect we shape the world around us to increase comfort and strive sustainability for better future. Neglecting the habitat for animal makes a gap in the sustainability as the world is not purely anthropocentric. So it's the responsibility of an architect to connect human being to other earthlings via architecture.

Animals need to receive the same possibility as people to have claim over the land we stay.

- Freedom from starvation and Thirst – through equipped get entry to sparkling water and a diet to preserve complete health and vigour.
- Freedom from pain – by using offering the proper environment along with shelter and a comfy resting location.
- Freedom from pain, harm or disorder – by using prevention or speedy prognosis and treatment.
- Freedom to express everyday Behaviour – by using imparting sufficient area, proper centres and company of the animal's personal type.
- Freedom from worry and misery – by using making sure conditions and remedy which avoid intellectual suffering.

2. LITERATURE REVIEW

In early modern era human and animals lived in the closed proximity; our language preserves the sign of that time. Animal-human relationship is beneficial for health and well-being of both. This also includes emotional, physical interaction, psychological and the environment. The importance of bond between animal human already well documented in the history across culture and in recent research. However the value of attachment with companion animal is degraded in the mental

health field in past year researcher approves the benefit and encourage the human animal bonding via therapeutic program application. Animals had been considered divine. Animal burial in ancient Greece and Rome discovered their importance to a human companion. Those animals have been buried with blankets and meals along with their human associate. Animal Necropolises in Egypt is a burial for animals, nearly as royal as the human burials. Ancient manuscripts have stated dogs to be guided in the afterlife and cats to be the protecting powers of the sun. In later years, when civilization was superior, cats and dogs had been so valued that they had their own servants. Lap puppies became popular as comforters. Animals have been bred to form a particular breed which signified royalty. Handiest the rich humans owned pets. Within the present situation, we see these animals badly abused and brutally killed. Cats and dogs are killed for fur. Cruel treatment and exploitation in overwork and gaming has sparked advocacy of animal protection corporations and laws in England in past due 19' century.

The government does now not hold any crime facts. But, the Animal Welfare Board of India continues facts of proceedings on stated cruelty to animals. The flora and fauna Crime Bureau additionally offers with the violation of the wildlife safety Act, 1972. The statistics on crimes regarding cruelty to animals are maintained by way of the regulation enforcement authority of the concerned States and Union Territories. The Animal Welfare Board of India (AWBI) in their annual record publishes the details of the court cases received in regard to animal cruelty alongside the action taken. The wide variety of complaints obtained in the Animal Welfare Board of India regarding cruelty to animals are forwarded to the worried States /Union Territories for taking vital movement. The info from the year 2015-sixteen to until date (as of 25.07.2021) is given hereunder:

Sl. No.	Year	Number of cruelty cases forwarded to the States/UTs
1	2014-15	155
2	2015-16	228
3	2016-17	256
4	2017-18	225
5	2018-19	144
6	2019-20	300
7	2020-21	383
8	2021-22	210 (as on 25.7.2021)

Figure 1: Showing the Cruelty in India

3. MATERIAL AND METHODOLOGY

A shelter facility designed with animal health and welfare at the centre can be transformative no longer handiest to the animals housed there but also to the people who take care of them and to the communities they serve. At pleasant most companies get one opportunity each 20, 30, or greater years to construct a brand new sheltering facility; therefore, it's far imperative that the design be proper. Deciding on materials and finishes in your safe haven is an exercise in balancing appearance with initial price, life cycle value, and durability. Whilst looking at look, consider what colours, textures, styles, and sizes are to be had.

The right floor could have those characteristics:

- Eye-catching visible effect.
- Durable.
- Without problems washer-friendly.
- Resilient.
- Nonabsorbent to beverages and odors.
- Prevents microbial boom.
- Sound absorbent.

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No single fabric is suitable to be used in all areas of your safe haven, and no fabric is a top performer in all of those classes, so selecting the "fine" floor is a matter of balancing the requirements for unique regions with the cost and performance of to be had materials while considering value, look at the initial price of the product, the fee of set up, the cost of maintenance over time, and the value of changing a less luxurious product while it reaches the stop of its life cycle. For example, vinyl tile may be bought and hooked up for as low as $1.50 in line with the rectangular foot, while porcelain tiles value inside the $10.00 in step with rectangular foot range. once the overall preservation costs for stripping, refinishing, and buffing the vinyl floor are factored in, the value differential may be offset in approximately five years, with the introduced benefit of getting a long-lasting and attractive floor that could final as plenty as 3 times as long frequently misplaced inside the desire to preserve initial construction charges low are the lengthy-term fees concerned in cleaning and renovation.

Of route, there is the alternative facet of life cycle price evaluation: if you may find the money for the initial value of cloth, it surely doesn't depend on how correct the cloth is.

Constantly comply with producer's tips for set up and protection of all materials. This is very vital for the guarantee of the product and to your own delight. Make sure that you completely understand both producers' and installers' warranties. Use business-grade merchandise. talk to humans in other animal shelters who've used the goods you are considering. Investigate the advertising claims of a product to peer how those claims examine to its actual overall performance.

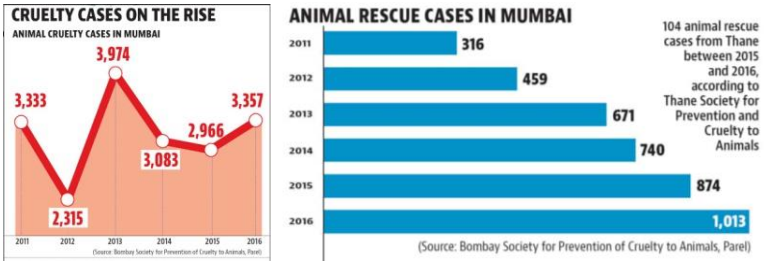
Building materials are delivered each day claiming to be the revolutionary option to the trouble. a few may fit that invoice, however be careful to make investments the effort and time to comply with thru on who is the use of them, in which they're used, in what packages they're being used, and if the installer and manufacturer will stand behind the substances and set up.

4. DATA REGARDING ANIMAL CRUELTY

People harm, maimed, killed, or even raped almost five lakh animals among 2010 and 2020, according to the latest file on violence in opposition to animals in India. The record, published by means of the Federation of Indian Animal protection businesses (FIAPO) and All Creatures brilliant and Small (ACGS), says that within the stated length a total of 4,93,910 animals have become sufferers of crimes dedicated by way of human beings. Those include over 2300 ugly and intentional acts of violence that brought about the animal's loss of life or irreparable harm, the report says.

As in line with the record, out of the 1,000 assault cases recorded against the animals, eighty two cases were of sexual abuse, 266 cases of bloodless-blooded murder, and over four hundred cases have been of violent assaults of thrashing, kicking, torturing, throwing acid or boiling water, maiming a part of the body, attacking with a knife or a blunt item. In keeping with the file, year 2019 noticed the highest wide variety of instances of crimes against animals (seven-hundred cases). Additionally, almost 4,230 puppies had been killed by using mass culling drives throughout the country.

"Because they may be animals, human beings tend to underplay the violence via calling it cruelty. But it's greater than cruelty. Its physical abuse; its psychological abuse; its rape; its murder. Intense crimes towards animals should be treated as legal,"



Graph 1: Statistic of Animal Cruelty in India

Some of the cases of animal cruelty in India are given below:

- A pregnant goat was gang raped by 8 men in Haryana.
- A female street dog was raped by a man inside his home in Kolkata.
- 100 stray dogs were culled and dumped in a forest area in Hyderabad.

- A man had unnatural sex with three cows in Vadodara.
- Eleven Monkeys were brutally killed and dumped near highway in Rajasthan.
- Several stray dogs were poisoned to death in Nagpur.
- A stray dog fractured its skull after being beaten with an iron rod in Mumbai.
- A cow was run over by a police vehicle in Chhattisgarh.
- A dog was mercilessly beaten to death by three men in Gujarat.
- 21 beagles were confined in cages for scientific experiments in Pune.
- A street dog was left to die when workers poured hot tar on it while it was sleeping.

5. CASE STUDY

After reading research paper, article, and animal cruelty cases; realize that we have a need of good and advance medical facility with rehabilitation centre in India. I have search for the animal shelter for the case study in India but there is no such shelter and rehabilitation society which is properly well planned. All the animal shelter has some issues. I also look for the shelter in foreign country and I found some of the best case study which is good for animal as well environment (sustainable).

Some of the case studies of shelter and rehabilitation society are:

- Palm Springs Animal Care Facility
- Canine Brigade
- Animal Refuge Centre
- Greenville Humane Society
- SPCA-Animal care centre

5.1 Palm Spring Animal Care Facility

Figure 2: View of Palm Spring Animal Shelter

This contemporary Companion Animal Facility integrates usual mid-century wasteland layout motifs with modern, present day Animal Care habitats and aid systems. The assignment graph is a reflect of the favoured operational waft of human beings and animals into and out of the facility geared up round a central Canine Adoption Garden shaded by means of cloth overhangs and cooled with the aid of misters. The exterior graph facets a sweeping roof overhang oriented toward the San Jacinto Mountain vary which each proclaims and hues three principal public entrances—the Main Public Adoption Lobby, the Intake Lobby and the Education Centre - every of which overlooks the City's actively used Demuth Park. These entrances serve the following needs;

- The Main Adoption/Business centres; is the place adoptions, licensing and associated enterprise things to do occur.
- Public Intake is positioned subsequent to the Adoption Entrance for the admittance of stray and surrendered animals so as to limit the danger of disorder transfer. The reception desks of these two entrances are backed up internally so that minimal body of workers can provider both lobby.

- The after-hours Education Centre/Classroom entrance is a neighbourhood oriented multi-purpose room. The format locations restrooms between the study room and Adoption Centre, which approves the rest of the facility to be secured after hours whilst neighbourhood packages and/or humane training lessons are in use.

5.2 Canine Brigade

Figure 3: View of Canine Brigade

The project grew out of two desires: on the one hand the wish to defend the website of distinctly industrialized surroundings opposed to the presence of the Police and additionally to improve the panorama workable of it (the presence of the channel and a meadow for canine training). The use of gabion is a hyperlink between the concept of safety and the thinking of landscape: used as cladding, it develops the poetics of the occupied wall (citadel, fortress, enclosure) with the aid of ability of a optimistic method (natural stone organized by way of hand in steel cages) ordinary of constructions alongside rivers or defending mountain roads. The application consists of three separate units. The first is committed to the administration, together with offices, assembly room, record writing room, locker rooms and toilets. The second combines the features associated to the puppies care, such as nursing, meals education area, assault man local, storage equipment. The third is committed to puppies' shelters which are dispatched into three zones: the assault dogs, the sniffer dogs, and the quarantine boxes. Each niche is composed of a the front location sheltered by way of a roof and an open-air returned courtyard. A steel roof constructions the website and connects the administrative phase to the logistic one whilst clearing a sheltered area beneath a cover to shield deliveries, loading, and unloading of puppies for patrols departures, and returns.

5.3 Animal Refuge Centre

Figure 4: View of Animal Refuge Centre

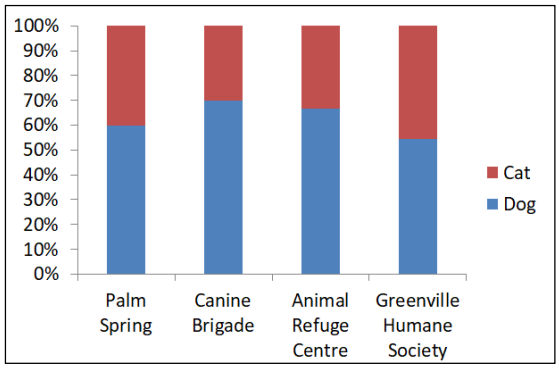
The two Amsterdam animal refuges in Amsterdam have been amalgamated—the new-built is the greatest pound in the Netherlands. The plot is in the town fringe, a curiously impossible wedge of cake. The "comb model" standard for this feature consists of a lengthy provider corridor, with a repetition of kennels at proper angles to it, separated with the aid of small outdoor spaces. This mannequin is dominated through railings and its seem of it carefully resembles a prison. We have had the carrier hall and the kennel hall converge in the Amsterdam Animal Rescue Centre. This creates a long, skinny ribbon building. This constructing is folded like a ribbon alongside the waterway round the plot. Inside this, two massive play areas for the animals have been created. The constructing faces inwards in order to minimize immoderate noise ranges (barking!) for the neighbours. In the excessive section of the building, the cat lodging is positioned above the canine kennels as a greater sound buffer for the backyard world. The central function of the entrance foyer determines the ultimate structure—a fluid object. Its cover is a pixel model of the grass on the historical dike subsequent to the location.

5.4 Greenville Humane Society

Figure 5: View of Greenville Humane Society

"The Greenville Humane Society engaged our design group for the renovation of a present 10,000 SF warehouse to residence an animal adoption centre and clinic. Rebranding itself as a no-kill facility and rethinking operational efficiencies, the shelter's dreams for the task protected accommodating about a hundred cats and puppies in an enticing surroundings and bettering quite a few revenue-generating components of the enterprise to guide the loss leader, animal adoption. Our architectural crew laboured intently with a public members of the family association and an indoors fashion designer in order to provide a holistic sketch method to the multi-faceted project. All three corporations laboured collaboratively on architectural, indoors design, and branding issues, with very few boundaries between the disciplines. Close and steady verbal exchange made the 8-month diagram and development agenda possible. All presented some diploma of pro-bono services. The aggressive time table was once similarly supported thru a plan construct relationship with the regular contractor, who coordinated donations of substances and fixtures and managed a volunteer landscaping effort. Many important points inside the constructing can be attributed to a crew effort in the subject between designers and contractors. From diagram to completion, the collaborative nature of this venture is the story of its success. As section of our work, the plan group grasp deliberate the last four acres for a canine park, protected pavilions and on foot trails. Within solely a few months of opening, our crew was once approached by way of an architectural studio at Clemson University with activity in these small initiatives as scholar work. Our association served in an advisory function as the college students designed and constructed two included seating areas in the courtyard, persevering with the story of collaboration for the Greenville Humane Society. The over-arching purpose of the layout has passed expectations—a functional, pleasant and attractive facility that helps a neighbourhood of pet-lovers—and a authentic crew effort."

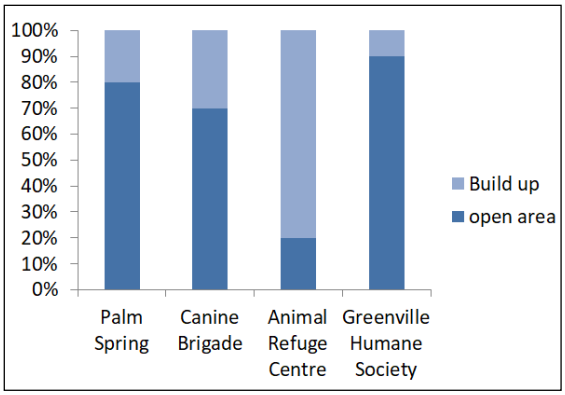
6. RESULTS AND DISCUSSION



Graph 2: Represent the Data of Treated Animal

As per the above data of bar graph we understand how an animal shelter helps the stray and abounded animal by proper treatment and shelter care. On an around 40% of animal life are saved by taking care of animal by shelter. Second bar graph

represent the ratio of built up and open area, in which open area help animal to heal from mental health easily and built up area help the heal the physical health of animal.



Graph 3: Represent the Data of Built up and Open Area

7. CONCLUSION

According to the literature review, data collection of cruelty cases against animal and case studies of animal shelter we understand the need of this type of animal society in India, as the cases of cruelty is high and the facility of medical treatment and shelter care is very few. If we have this type of facility the local people surely try to save the life of the other earthlings rather than neglecting them and leave to die on street. It will help the voiceless creatures to low down their pain by providing care and connection to the environment.

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