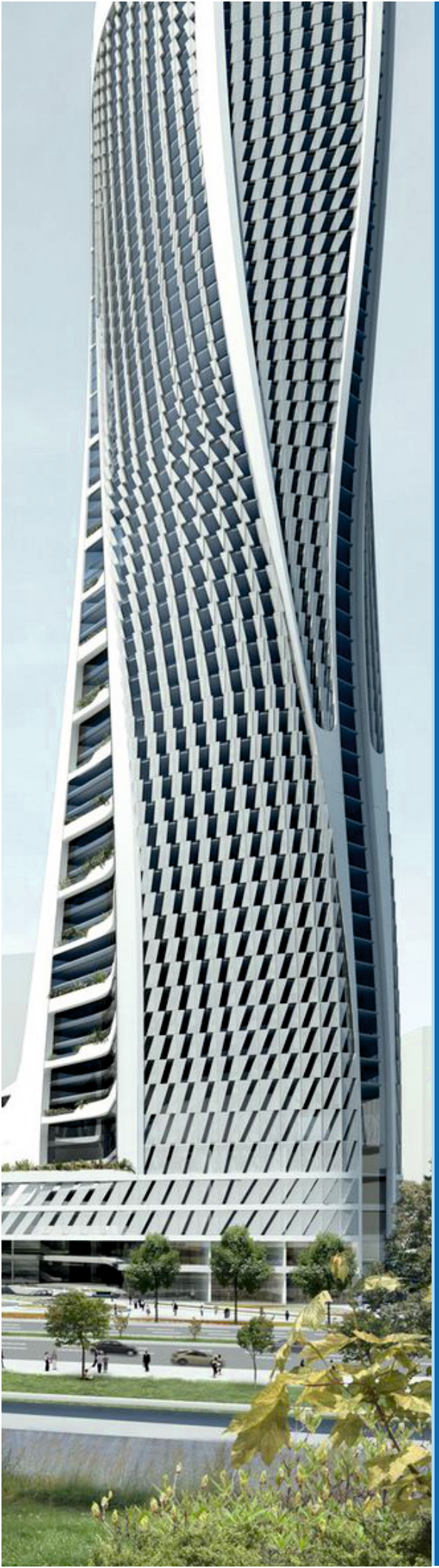

NITYA PUBLICATIONS

National Students Conference 2nd Edition

Research in Architecture
Organized by

D Y PATIL SCHOOL OF ARCHITECTURE

in association with

MAHARASHTRA ASSOCIATION OF SCHOOLS OF ARCHITECTURE [MASA]

ON

28th & 29th FEBRUARY 2020

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Principal : Prof. Shubhada Chapekar

Editors
Prof. Aparna Mhetras | Prof.PrathamaJhaveri
Prof.NikitaPawar

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Editors
Prof. Aparna Mhetras
Prof. Prathama Jhaveri
Prof. Nikita Pawar

Message from Chairman

I am pleased to know that D Y Patil School of Architecture is organizing the 2nd Edition of National Conference on "Research in Architecture" on 28th and 29th February 2020.

The conference will provide an opportunity to the student and teacher researchers to exchange ideas and learn about the developments in Architectural field. I hope the conference proceedings will go a long way in dissemination of knowledge of this noble profession.

I congratulate the Management, Principal, Convener and organizing committee, staff and all students on this occasion and I wish the conference a great success.

Dr. Ajeenkya D Y Patil
Chancellor
Ajeenkya D Y Patil University, Pune

Message from Advisor

I am delighted to welcome you all for this second edition of student's conference on "Research in Architecture" to be hosted by D Y Patil School of Architecture, Lohegaon, Pune.

I have been associated with the school of Architecture since 2011 and I am proud to see their progress and growth since the beginning.

This conference is another milestone for the school which is synonymous with their ethos and goals which focusses on the overall development of the students.

As the conference advisor I can witness the growth of this conference in these two years and feel proud to be a part of this.

I am sure it will be a grand success as the first edition hosted by the school last year.

My Best wishes to everyone associated with the conference.

Dr. Sushant Patil,
Advisor,
Ajeenkya D Y Patil University, Pune

Message from MASA President

Maharashtra Association of Schools of Architecture (MASA) works extensively to promote meaningful activities for students of Architecture. These activities are meant to support the core education of architecture and to widen their knowledge by exploring avenues for research like the Fellowship Program of MASA and the soon to be published biannual Research Journal. This kind of Students Conference for Research in Architecture, in Pune, is one such initiative where MASA is happy to be a Knowledge Partner.

We congratulate D Y Patil School of Architecture, Lohegaon for organizing and successfully conducting this conference and look forward for the third edition.

Best Wishes!

Dr. Ujjawala Chakradeo,

President, MASA

Message from Principal

It is my pleasure to write down my thoughts on the second edition of student's conference on Research in Architecture. After successfully hosting the first of its kind conference for the students last year, this second edition has been even more successful. We received an overwhelming response from students across the country.

The variety of topics that have come to light shows the broad range of thinking of students .This also shows the curiosity and enthusiasm of the students to go beyond Architecture and surely this bodes well for the profession. It was heartening to see students encouraging and supporting each other, a lot of camaraderie was visibly evident.

I congratulate the convener Prof. Aparna Mhetras and her team of dedicated faculty and students on successfully hosting this event. I thank all the paper reviewer and the panel of judges who gave their time and valuable inputs for the National Students Conference on Research in Architecture. I thank all the students from various institutes for contributing their research papers and making this conference a grand success.

The overwhelming response from the students has given us a lot of encouragement and we look forward to expand the reach and invite students at the National level as also Research Scholars from various universities in the future.

Best Wishes

Prof . Shubhada Chapekar,
Principal,
DYPSOA, Lohegaon, Pune

Message from Convener

It gives me immense pleasure and honour to be the Convener for the National Conference on Research in Architecture 2nd Edition hosted by the team at D Y Patil School of Architecture, Lohegaon, Pune.

The response received for this second conference from the fraternity, schools of Architecture, students and faculty was overwhelming and beyond description.

The first flier of the conference was sent during 2nd week of November 2019 and here began the journey of hard work for four months. The first detailed poster was sent to various colleges in December 2019. And we started receiving the abstracts as per the given date of 28th January which was extended to 30th January on request of many colleges.

This year we received 110 abstracts for B Arch out of which 90 were selected for full paper submissions.50 for M Arch and 47 were selected for full paper submission. This edition of the conference also included abstracts from research scholars and we received 6 abstracts from them.

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.

Full papers received were 67 for B Arch and 36 for M Arch. Out of which 40 were selected for presentation for B Arch & 22 for M Arch for the final days of conference. The total papers selected for publication are 59 for B.Arch and 26 for M.Arch.

The two days of the conference consisted of total 11 sessions with 7 sessions of B.Arch and 4 sessions of M.Arch. A special session for M.Arch students and faculty on" Guidance for prospective research scholars" was conducted by our eminent chief Guest Prof Tej Karki PhD.

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.

No idea can be executed without a dedicated team to work for it success. Three people who have worked behind the scenes tirelessly since the first flier was sent out in November 2019 and whom I cannot thank enough are our Principal Maam Prof Shubhada Chapekar ,the core faculty team, Prof Prathama Zaveri & Prof Nikita Pawar.

All my colleagues who were part of different committees and all the dear students, special mention Ms Arunima K, Ms. Manasi Kalyankar and Mr Naresh Sharma from 4th year B Arch for getting the student volunteers and helping in the smooth conduct of the conference.

All the members of Advisory committee, paper reviewing committee, panel members for all the sessions, we cannot thank enough for giving their valuable time and enriching all of us by their expert comments.

We are very grateful to MASA -Maharashtra Association of Schools of Architecture for being our knowledge partner and sponsoring the prizes this year too.

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 Aparna Mhetras,
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Physical Factors Affecting Quality of Public Open Spaces In Residential Neighborhood: Case of Wanowrie, Pune

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Abstract: Open spaces in a Residential Neighborhood provide scope of social interaction, an opportunity to engage with the society and a gateway from daily routine. These areas cater to various activities like social gathering, leisure activities, markets etc. The activities happen in different open areas such as street edges, community open grounds, public parks etc. Hence open spaces can be termed as formal and informal in terms of their character and activities. These spaces become the essence of a neighborhood and make it livable. The Research focuses on analyzing physical factors affecting the quality of these areas in terms of its user response, their social behavior. Methodology followed is case studies, activity mapping and photographic documentation. These cases have been analyzed based on parameters like furniture, lighting, vegetation. The research concludes by identification of status of such spaces as it is critical for a cohesive design.

Key words – Open Spaces, Residential Neighborhood, Formal and Informal Spaces, Desirable, Livable.

I. INTRODUCTION

In India out of the total population of 1210.2 million as on 1st March, 2011, about 377.1 million are in urban areas. The net addition of population in urban areas over the last decade is 91.0 million. (Urban Growth) In terms of absolute number of persons living in urban areas, Maharashtra continues to lead with 50.8 million persons which comprise 13.5 percent of the total urban population of the country. (Level Of Urbanisation) Hence, the process of urbanization has intensified in recent years and has affected cities in terms of its spatial organization. The existing land use, various changes due to urbanization has brought different characters to each neighborhood. These factors being dynamic change land use constantly. This process has happened without adequate attention being paid towards the planning of urban open spaces, a key element affecting the quality of life of the urban dwellers. (Dulcina QUEIROZ) Open spaces in these areas have their own character and form basis for human interaction, activities and behaviors.

Depending upon the area and scale of the space, activities take place. Hence these open spaces can be termed as formal and informal in nature.

1.1 Formal Public Open Spaces

Public parks and gardens can be termed as formal open spaces, as they have dedicated space, area and functions. People visit these places for a specific purpose, may it be leisure, relaxing etc. Sports centers, community gathering places, community halls have an open area along with a built functional space. Designation of such spaces is required to magnify its purpose and value.

1.2 Informal Public Open Spaces

A Street with small eateries, cafes with spill over spaces ending on the footpaths, weekly farmers market on open grounds, retail shop foregrounds are some of the informal public open spaces. These spaces are spontaneous and dynamic in nature, the place of activities change constantly.

1.3 Factors Affecting These Spaces

- Social factors
- Environmental factors
- Physical factors

1.4 Importance of Physical Factors in Governing The Quality Of Public Open Space

Basic physical elements are necessary for any kind of space to function. These elements are the fundamental factors either making the space vibrant or completely destroying its character. A user uses a certain space based on the environment, visibility, spatial aspects etc. Poor spatial Organisation may not be understood by the user but it can be sensed and is reflected in their social behavior, hence physical elements define a certain area, making it habitable or inhabitable.

1.5 Case of Wanowrie

Wanowrie is an affluent neighbourhood in Pune, India. It is located in the eastern part of Pune. It consists of historic temples and structures like Shinde Chhatri temple. Modern structures include Mahatma Phule Cultural Centre, Armed

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Force Medical College and Hospital (AFMC), Shivarkar Garden. (Wanwadi) The State Reserve Police Force campus (SRPF) is situated in Wanowrie, due to which the area has many Open Grounds and Maidan. Hence, the spaces studied are significant landmarks of the Neighbourhood.

II. METHODOLOGY AND LITERATURE REVIEW

In the past several researchers have studied the significance of open spaces. Hadiseh baghi mentions in the research paper that open space can be categorized into undesirable, moderate and desirable based on social, physical parameters. The paper also mentions access to residential open spaces, its impact on the surroundings and users. (Hadiseh Baghi).

Methodology used for the research was case studies, interviews and activity mapping with supporting photographic documentation. The cases chosen are different types of opens spaces in Wanowrie, one being a street, an open ground a public park. Photographic documentation was done at various hours of the day, on weekdays and weekends. Understanding the context, the scale, the surroundings in each cases became important to study the activities happening there. Three various types of public open spaces have been taken for case study, a park, a street and an open ground. The case studies have been analyzed on the basis of some parameters-The furniture including seating, installations and various equipment, the lighting pattern of that particular area and the vegetation of the space have been chosen as the study parameter of each case study.

IV. Case Studies

4.1 Open Ground

This open ground has been a private property converted into joggers track and Maidan for community festivals, fairs, exhibitions, flea markets and sports activities. It is located in the vicinity of residential complexes with eateries, restaurants and commercial plazas around it. It was observed that nearly half of the site has dense tree cover, used for dumping garbage and primarily occupied by stray animals, hence not being used to its optimum potential. Activity mapping of the informal and formal functions in and around the ground taking place on a weekday and on weekend was done in the evening hours. Use pattern of the space, with respect to the number of visitors, age group of people visiting and different activities taking place was studied.

Figure 1 exhibition at the ground
Source : Author

Figure 2 farmers market the ground
Source: Author

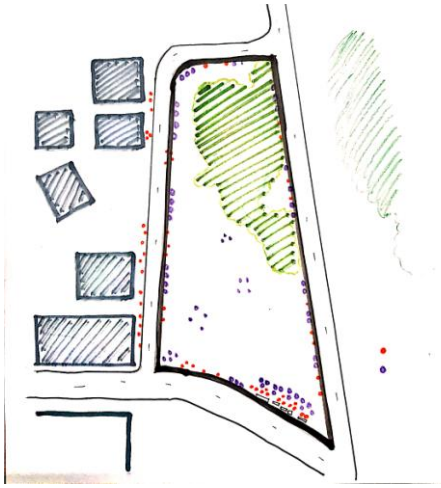

Figure 3 Activity Mapping on weekend(evening)
Source: Author

Fig 1 mentions the exhibition area on the ground, these type of larger activities attract small scale leisure, shopping activties in the surroundings. These activties become aid for large scale functions and provide a vibrant social atmosphere. Vegetable venders, fruit sellers were seen during the early morning hours and late evenings on weekdays, they mainly install their stalls at corner junstions and near the seating area where visiotrs gather for various activities like yoga, meditation, sports etc (fig 2). Weekends were priarily occupied by sports enthusiasts till the evening.

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The peripherals and part ground have been in use, however The rest of the area remains a dumping ground which also has an unpleasant impact on the footpath adjacent it. The Acitivity Mapping (fig 3) suggests that the corner part of the ground being used frequently and concentrates major activities.

4.2 Shivarkar Garden

The Front portion of the garden has dense tree cover around the play area and the central ground. The rear area of the garden consists of open gym, jogging track and playing lawns. The jogging track and open gym is used by frequent or regular users, majorly consisting of senior citizens and middle aged people. The lawn having two mounts and seating around usually see yoga, meditation groups in the early hours of the day. Occasional visitors comprising of families and children mainly use the children play area and the spaces around it. Weekdays see regular visitors and weekends are crowded with all sectors of users, the street along the garden also sees small eateries during the weekends.

Figure 4 View Of The Lawn And Tree Cover
Source : Author

Figure 5 View Of The Garden
Source : Author

Figure 6 Activity Mapping on weekend (evening)
Source: Author

(Fig 6) The mapping explains use pattern of the garden, senior citizens and daily visitors are seen near seating on the edges, whereas, families, children use open lawn and gazebo area (fig 5). Tree cover at various places helps bring down the scale of the large lawn, while dividing it visually. This naturally creates segregation of spaces and provides variation (fig4). Change in paving material from paver blocks to red soil separates the area keeping the purpose same and enhancing the experience as well. Users tend to use the spaces towards the edges of the lawns in day light and the central portion is primarily occupied by children and their caretakers.

4.3 Salunkhe Vihar Street

This street has mixed typology of buildings, from residential, commercial to office buildings as well, it has eateries, health care facility and working spaces. It attracts young crowd due to the environment and activities.

Figure 7 View Of The Street In The Evening
Source :Author

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Figure 8 Eateries And Spill Over Space
Source : Author

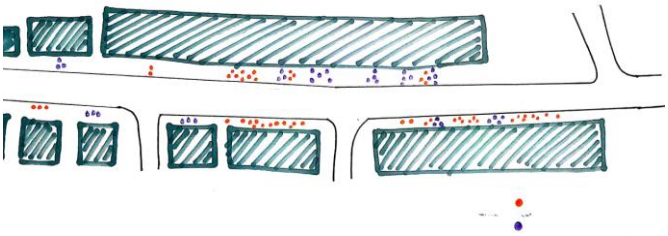

Figure 9 Activity Mapping on weekend (evening)
Source: Author

Regular visitors were seen near the commercial and smaller grocery stores whereas major concentration of activities happened near the eateries, users happened to visit places with vibrant lighting, it enhanced the character of the space as well as the street. Lighting, smaller peaceful areas tend to change the essence of an area, it is reflected in the social atmosphere of the space.

V. DISCUSSION

The study of open spaces different in scale, character and form provides an idea about its requirement, value and current status. This also highlights the fact that open spaces in a surrounding hold important purpose as they cater to various user demands. A neighborhood has certain landmark, they may be notional as well. Therefore open spaces can make an identity of a neighborhood. These spaces are necessary for fundamental functions.

VI. CONCLUSION

This research attempted to study how physical factors of an open space affect its quality. The presence of various forms of open spaces is required for easy, active and appropriate functioning of a neighborhood. The research suggests need of sensitive, conscious design approach towards various types of open spaces, be it abused, underused or densely crowded zones.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my guide Ar. Meghana Patel for her valuable guidance, inspiration and encouragement.

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Site Selection is Vital : Importance and Different Criteria of Site Selection For Airport

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Abstract : Aviation plays a significant role in modern socio economics, providing connectivity and accessibility and facilitating commerce. Airports are critical nodes of air transportation system with this its user friendly designing is also important, starting with the preliminary stages of design that include site selection. There are various criteria that need to be followed, while selecting a site for airport construction. This include land use planning, characteristics of wind and weather conditions, interference with the existing road network, environmental and socioeconomic impacts. Study of these criteria for different sites provides us with the data of the most suitable site. This research aims to study the document of CIDCO with the other documents on airports and analyse the different criteria of selection by doing a comparative analysis on the different airports. This research is to describe such multicriteria approach of various existing airports and their role in designing an airport with the different criteria of site selection.

KEY WORDS : Airport, Site Selection, Criteria, Planning and Design , Comparative analysis.

INTRODUCTION

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. In any construction or design of a building the primary step is to select a site which is most suitable for that building typology specially for public buildings like airport. The site selection process includes a detailed evaluation of project needs, which are then measured against the merits of potential locations. Site selection of an airport is the comparative evaluation of alternative airport sites for their suitability. This site selection process is crucial in case of airport as it depends on multiple criteria which are to be considered, and then from the selected sites the most suitable in terms of accessibility, topography, area population , environmental issues and other specifications is selected. Understanding this is an important part of designing an Airport. Metropolitan city Mumbai in Maharashtra, India and Griffin city in Georgia ,USA are in need of new airports due to the increase in the economic activity and the increasing population. The case study on the two airport site selection will help us in understanding the criteria of site selection and the method they follow in the two completely different places.

Site Selection Criteria

Criteria can change with the purpose and the type of the airport. Although they can be changeable, there are certain criteria which are important for the authority.

- **Topography:**Topographical considerations that should be taken into account are:

(1) the grading that will be required to meet the standards for maximum runway grades, which vary from one percent to two percent depending upon the class of the airport

(2) selection of a site which departs sufficiently from thedead level to allow adequate natural drainage, but does not have portions sosteep that serious erosion may result (3) selecting an location where thesoil is pervious, yet has a suitable amount of natural binder, and where the watertable (ground water table) does not come too close to the surface.

- **Environmental Impact:**This impact can be categorized more than 3 subtitle such aspollution impacts, physical impacts, ecological impacts and historical resources.Wetlands, water quality, floodplains, historical sites, pollution impacts and wastefacilities are in this assessment. Several

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categories are considered under pollutionimpacts. The potential for noise impacts must always be evaluated for any airport.Other areas include air pollution, water quality, and solid waste. Physical impactscategory evaluates potential physical impacts related to physical factors ofconstruction of the airport. Included in this evaluation are impacts such as floodhazard, light emissions, and the airport's effect on energy supply or other naturalresources. Ecological impacts category evaluates the potential impacts on the natural and historic environment. Biotic communities, endangered species, and their habitat areas are included under this category. Historical resources category evaluates the potential impacts to historical or cultural resources that may be of national, state, or local significance. This includes impacts to properties eligible for the National Register of Historic Places, as well as the archaeological potential of each site.

- **Land and Development Costs**: The land and development costs of the airport should not be excessive. In addition to grading, drainage, and construction charges, the development cost is affected by the availability of suitable construction materials near the site and the nearness of necessary utilities.
- **Obstruction and Airspace:**An analysis of the relationship with the airspace requirements of the existing airport system is essential. It is also necessary to review the envelope area of each site for the presence or absence of potential obstructions to aircraft activity. Certain obstructions may be considered immovable or too expensive to move when other options are available (e.g., large land forms, tall communication towers, major power lines, water towers, etc.). Others, such as smaller power lines, trees, buildings, and roads, impose a cost of removal or relocation that must be considered.
- **Accessibility:**One of the most important factors influencing the selection of an airport site is its accessibility to the destination and source of the passengers and cargo. This is a particularly vital consideration for commercial airports since one of the great advantages of air travel is its advantage of shorter travel time over other means of transportation. To provide maximum service to an area, an airport should be located in reasonable proximity to the population centre it is to serve. The location in relation to business and industry should also receive attention. Preferably, the airport should be located adjacent to and visible from a major highway route. It is easy to access by using local and transient roadways. Driving time and distance to the centre should be maximum sixty minutes.
- **Residential Impact:**This factor examines the magnitude of property to be acquired for each candidate site. The airfield layout, the size and shape of existing parcel ownership, and other impacts to neighbouring parcels can affect the amount of property necessary to be acquired. Also included for consideration under this category will be residence acquisition. The sites should be eliminated if there is more than 10 households due to decrease cost of expropriation.(Gokgalay, 2014)

Case Study On Site Selection Of Navi Mumbai Airport &Griffin-Spalding County Airport

CASE STUDY ON NAVI MUMBAI AIRPORT

Mumbai metropolitan region is experiencing rapid economic growth which is increasing the air travel demands in the region. The existing airport is not able to fulfil the increasing needs of the region due to which there is a need to propose a new airport building. This will be done by analysing different suitable sites for the airport and then providing with the most suitable one.

In case of this new airport there were three different sites that were considered and analysed for the purpose which should have obstruction free approach, operational suitability, minimum disturbance to population, availability of land, accessibility and availability of physical and social infrastructure. The sites which were then considered are :

i)Mahapan in Sindhudurg District
ii) Rewas-Mandwa in Raigad District

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iii) Navi Mumbai Airport
(Centre of Environment Science & Engineering, June 2010)

Among these sites Mahapan in Sindhudurg is about 350km away from Mumbai due to which it is not easily accessible.

The comparative analysis is now restricted to RewashMandwa and Navi Mumbai sites.

Figure 1RewasMandawa Site

Figure 2Navi Mumbai Site

These sites are ranked on the basis of the following topic study :

a. Accessibility
b. Land Acquisitions
c. Displacement of population
d. Land reclamation
e. Sensitive location nearby
f. Loss of environmental aesthetics
g. Social culture
h. Air pollution
i. Water pollution
j. Construction material
k. Project cost
l. Drainage pattern

COMPARISON OF ATTRIBUTE SCORE

Table 1

ATTRIBUTTION	REWAS – MANDAWA SCORE	NAVI MUMBAI SCORE
a. Accessibility	24.0	4.93
b. Land Acquisitions	58.33	13.33
c. Displacement of population	70.0	52.50
d. Land reclamation	58.33	40.33
e. Sensitive location nearby	0.00	18.75
f. Loss of environmental aesthetics	30	22.5
g. Physical infrastructure cost	23.43	7.5
h. Social culture	18.75	11.25
i. Air pollution	35	52.75
j. Water pollution	12.5	30
k. Construction material	6.25	6.25
l. Project cost	60	28.20
m. Drainage pattern	63	42
TOTAL SCORE	459.59	330.29

(Centre of Environment Science & Engineering, June 2010)

Thus the overall environmental impact of constructing Airport at Rewas – Mandwa is higher than that at Navi Mumbai.

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Therefore the site at Navi Mumbai is more suitable for construction of new airport in Metropolitan city Mumbai and is less sensitive to environment.

CAE STUDY OF NEW GRIFFIN – SPALDING COUNTY AIRPORT

Griffin is a city in Georgia USA. There is an increase in the turbine aircraft activity at the existing airport due to which there is a need to expand the airport. The feasibility of expanding the existing Griffin – Spalding county airport in the existing location is impractical due to the encroachment of residential and commercial land uses surrounding the airport. Due to this reason the cost of building a new airport will be less expensive than expanding the current facility. For this there were 8 sites which were considered on the basis of the preliminary evaluation criteria which included population centre accessibility, proximity to nearby NPIAS airports, state roads, future land use, airspace, population density, streams, wetlands, floodplains, landfills, railroads, transmission lines, obstructions, and terrain. After further evaluation two sites were selected which : Site 6 , Site 7.

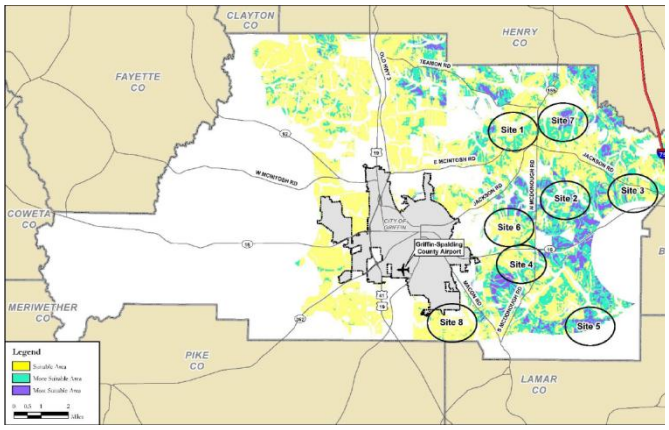

Figure 3 suitable site for new Griffin-Spalding County Airport

These two selected sites were further evaluated on the basis of the following criterias :

a. Infrastructure and land acquisition
b. Environmental considerations
c. Constructability
d. Operational capability
e. Industrial compatibility
f. Project cost

Rating score was giving on the following basis:

- 1 – criteria are not desirable
- 2 – criterias are neither desirable nor undisirable
- 3 – criterias are desirable

COMPARISON OF ATTRIBUTE SCORE

ATTRIBUTION	SITE 6	SITE 7
a. Infrastructure and land acquisition	1.83	2.83
b. Environmental considerations	2.40	2.10
c. Constructability	1.67	1.5
d. Operational capability	2.00	2.00
e. Industrial compatibility	3.00	1.00
SITE AVG. SCORE	2.18	1.79

(Consultant, 2009)

Project Cost of Site 6 is 4 billion and that of Site 7 is 5.2 billion.

Thus, the overall impact of constructing airport at Site 6 is lower than that of constructing it on Site 7. Therefore Site 6 is more suitable for constructing a new Griffin – Spalding county airport.

COMPARITIVE ANALYSIS OF THE TWO CASE STUDIES

- The two case studies are completely diffreent in terms of location. One is in the state of Maharatra, India and the other is in the state of Georgia, USA.
- Inspite of there location the two case studies used mostly the same criterias to compare the site that they have selected to attain an end score for the most suitable site.

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- Scoring criteria is different for the two case studies.
- Both Navi Mumbai and Griffin Airport use the criterias that are important to the authority which include land and development cost, environmental impact, assessibility, topography and residential impact.
- Navi mumbai airport has a detailed study on site selection criteria which includes criteria like drainage pattern and construction matreial on the other hand Griffin Spalding airport end scoring did not include such criteria study.
- In both the cases site location makes a huge difference in the project cost which shows the impotance of proper site selection.
- Criteria used for site selection of Navi Mumbai airport are mostly based on their sensitivity towards the environment on the other hand criteria for Griffin airport are not only focusing on environment they are also based on contructability of the siport inthat loaction.

CONCLUSION

With the study on the two case studies for Navi Mumbai airport and Griffin – Spalding County airport we got to know the criteria that are considered while doing site selection for an airport. It is a long procedure which is followed by going through merits and demerits of the different sites by evaluating the needs of the project. This multicriterian approach of various existing airports helps to design an airport which is both environmentally friendly and cost effective.

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I would like to express my special thanks of gratitude from the bottom of my heart to my guide Prof. Prathama Javeri for her valuable guidance and encouragement. Her conistant supervision and assistance helped me to reach this level.

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Architecture of Traditional Ali in Pune, A Case Study of Tambat Ali

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Abstract: ***Pune, the cultural capital of Maharashtra, has a long legacy of Alis. Alis are the craft skill by lanes. During the Peshwa rule in 18th century, Kasba Peth was the centre of Pune, where the supporting trades like Tambat, Burud, Kumbhar, Kasar, Badhai, etc. got located. Tambat Ali (an Ali named after Tambat community) is an area where copper and brass items are manufactured. It has been observed that, in Pune these trade practices, which carry heritage value are undergoing rapid changes. For example Pagadband Ali where Pagadbands used to make Pagdis (caps), which had great importance particularly in Peshwa period, is now on the verge of decline. In order to avoid the loss of such significant heritage skill, it has become necessary to record the existing picture of Alis. The aim of this paper is to give analysis of changes in the evolution of the Tambat Ali. This paper attempts to document, the existing working craftsmen's in Tambat Ali, along with a set of recommendations that would help to preserve the character of this area.***

Keywords: Tambat *Ali*, Pune, Architecture, Craft skill, coppersmiths, building typology,

Introduction:

Pune is a historical city and Kasba Peth is the oldest part of the city. Down the centuries, Pune has been ruled by several dynasties. In 2003 some artefacts were found in Kasba peth area from the Satvahana period which evidences the settled life in that area around 200BC. One can find the references to the Pune region in copper plates dated 758 and 768 A.D. issued by Rashtrakuta ruler, in these copper plates Pune is referred as 'Punya vishay' and 'Punaka Vishay' respectively (i). Punya meaning 'holy' and Vishaya meaning 'region'. It was so described because the city has a confluence of two rivers Mula and Mutha, which is considered holy in the Hindu religion (ii). From 9th century Pune region became the part of Yadava Empire, which was defeated by the Mughals in the 11th century. During the 12th and 13th century, Pune was under the rule of Allaudin Khilji and later Muhammad Tuglaq, for a long time Pune was under Muslim ruler (ii).During 1600-1817 v AD Marathas ruled Pune. Pune city was the seat of Peshwa, the prime minister of Maratha king from 1713-1818 AD, Nine Peshwas ruled Pune city during this period. In 1735 Peshwa I shifted capital city from Satara to Pune which increased the political and economic importance of the Pune city. Over 18 Peths were established during the 18th century. The Maratha power ended in 1818 and the British set up an empire in the Pune city (ii).

According to the author of the Gazetteer, the starting point of the settlement in Pune was near the river bank of Mula-Mutha, he reasons that the presence of river attracted the settlement. According to the local tradition, there were three original villages-'Kasarli', 'Kumbharli' and 'Punewadi' (iii). It is more likely that they were small hamlets rather than villages. We can still find these three villages as Kasar *Ali* (Tambat *Ali*), Kumbhar wadi and Kasba peth respectively. By the time of Peshwa rule these small hamlets had grown and became a Kasbe Pune.

The Bara Balutedar system was a hereditary village servant system of twelve trades which existed at the time of Peshwa rule. The Balutedari system was important part of socio-economic life of city of Pune. Kumbhars (potters) and Tambats (copper smiths) were one of the important members of Balutedari system. Peshwas invited people with specialised skills from different areas to come and settle in Pune. People of one community carrying one trade lived together and their area of residence were named on the basis of the trade they carried out, like Tambat *Ali*. This neighbourhood settlement gave rise to very typical cell-like formation of Indian urban life. The cell like localities were further emphasise by their shrines and temples for the worship of community deities, like the Goddess Kali temple belonging to the Twasta Kasar community(3). Kumbhar *Ali*, Tambat *Ali* and other trade

basedAlis such as Bhoi *Ali*, Shimpi *Ali* and some other are all a few minute walk from each other. This shows the compact placement of Kasba Peth. The streets named after profession or trade still exists. The documentation of existing workshops is done by site visit along with survey method.

Tambat *Ali*:

*Ali*s are the craft skill by lanes - places where groups of people with special skills lived together and carried out their trade. These *Alis* were named after the trade or profession they carried out. All the *Tambats* (coppersmiths) used to live together in *Tambat Ali*. The name '*Tambat'* came from the Marathi word '*Tamba*' which means copper and hence people working in copper are called as *Tambats* and place where they live together is called as *Tambat Ali.* Peshwasinvited *Tambats* some 400 years backfrom Konkan region of Maharashtra to come and settle down in Pune (v).

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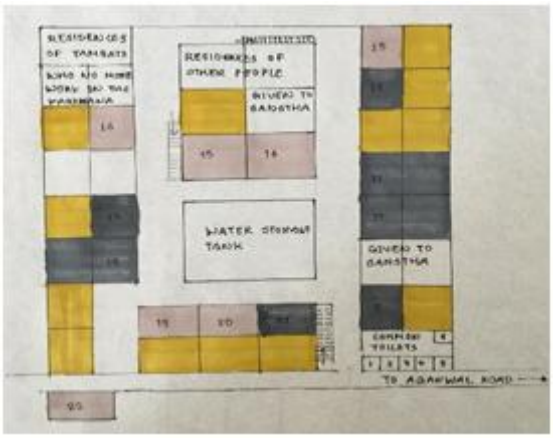
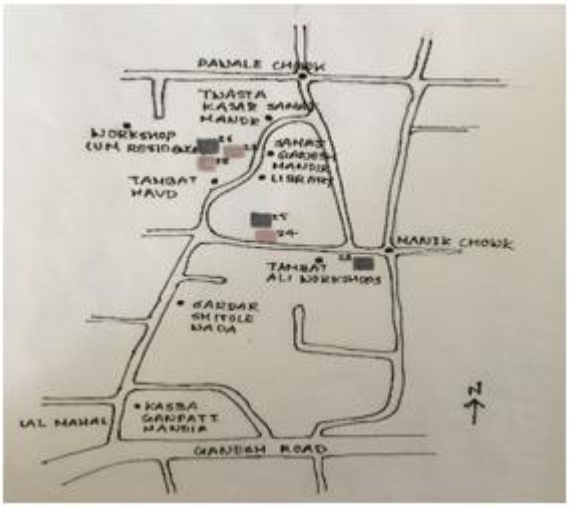
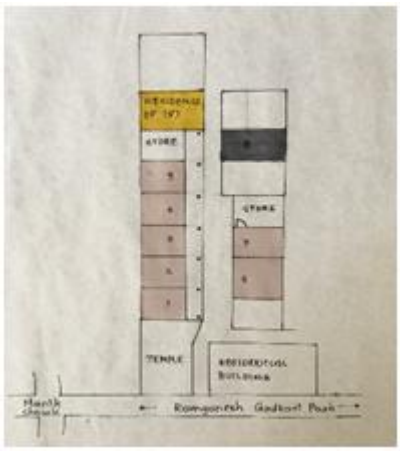
Tambats settled in Kasba Peth. Before Tambats this neighbourhood was occupied partly by *Bramhins* and jewellers. Initially there were 200 houses of *Tambats* in *Tambat Ali* who used to work and live in the same premises of *Tambat Ali* in Kasba peth (v). These people still practice as coppersmiths in their old workspace where their generations had worked and this can be referred as a living heritage of Pune. During Peshwas period, *Tambats* used to manufacture variety of copper products right from swords to fight in battle to copper utensils used in kitchen. Tambats experienced boom in their profession till late 19th century but when stainless steel and plastic utensils got popular among the people, demand for copper products decreased.







Map 1: Location of existing workshops.

Expanse of Tambat Ali:

Ali is situated in the Kasba Peth of Pune city, which is the oldest part of the city. Tambat Ali lies between Manik chowk and Pawale chowk, well known chowks in Kasba Peth (refer map 1). Tambat Ali can be access from Agarwal road which leads to Pawale chowks and also from subsidiary road from Kasba Ganpati (Gram daivat of Pune). Initially there were 200 houses of Tambats and around 810 people were working in *Karkhanas* (workshops) as *Tambats* (coppersmiths) (v). Now in year 2020, survey done in *TambatAli*shows that there are only around 100 craftsmen's who are working in28 *Karkhanas,*which are still practicing in the same profession. Location of these existing *Karkhanas* (workshops) is shown in the map1. This shows decrease in the number of *Karkhanas* and craftsmen's due to lack of demand of copper products, Introduction of new materials such as stainless steel and aluminium.

Building typology and Existing condition of Building:

The earlier residences of the Tambats were not built as per their requirements, hence they purchased new plots and built houses which were suitable for them. Later on, increasing family size and the business made the available space inadequate and the need for new work place was felt, but further extensions was not possible because of lack of funds and lack of space (v). So the extensions become more open to sky and temporary. This has led to formation of an interesting pattern of open spaces interlinking roads and work places (v). But now many of the buildings are not in good condition (refer picture 4).

Types of *Karkhanas* (workshops):

Initially when the manpower was easily available and demand for copper products was more all the *Tambats* (coppersmiths) used to craft the utensils from raw materials in their own *Karkhanas* (workshops) itself. At this time 3-4

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craftsmen from the family along with 3-4 other craftsmen used to work in one workshop. The Tambats engaged themselves in melting copper, beating the molten mass into sheets and preparing utensils. But, later around 1910, metal sheets began to arrive from America which was used for the manufacture of the utensils (iv). These craftsmen eventually decreased in number due to lack of demand, low returns and now only one craftsmen from the same family work in their workshop. During the late 19th century due to technological advancement some craftsmen who were economically capable bought their own spinning machines which helped them increase their production in less time with less manpower. Now there are mainly two types of workshop present here; one where the complete work is done i.e. Right from crafting the copper utensils to finishing and then selling to customers; other one where only the finishing work is carried out. The Craftsmen's who belong to type one workshops get more returns as compared to type two workshops as they have their own spinning machines. Location of workshops of both the types is shown in the map 1.

Picture4: Craftsmen working outside the workshop on roadside, as workspace is not in good condition,and doesn't have enough sunlight.

Planning of workshops and residences in *Tambat Ali*:

This typology of workshops further leads to the different plan form of workshops and residences. Picture 2 and 3 shows the layout of workshop type-1 and workshop type-2 respectively. Area of type-1 workshop is more as compared to type-2 as it need to accommodate the spinning machine. Type-2 workshops consist of a single room which has a *Bhatti* (kiln) where melting work is done and extended shade acts as their main working area where they do all the polishing, finishing and *Matharkam* (Engraving pattern on copper utensil using hammer (refer picture-1)). As all these workshops are placed next to each other, the only way from where sunlight can enter is door, which is also shaded by the extended G.I sheet, hence only diffused light enters in the workshop which is not enough to do a detailing work and hence craftsmen's preferred to work outside in daylight. Materials used for construction are bricks, G.I sheets, wooden battens, teak wood.

Picture1: Craftsmen's engraving pattern on copper utensil using hammer

In the area near Pawale chowk Tambats were residing in wada where the dwelling units were constructed around a central open space with a verandah separating the dwelling unit and open space. The central open space in addition to providing light and ventilation, houses the common amenities like water storage and adjoining washing place was used as a working area. Earlier all families used to stay in small house of just two rooms. The outer semi covered room which was used as a karkhana and the inner room was used as a house, which included kitchen, living area and a small bathing area (*mori)*(for plan refer picture-2 and picture 3). The only way of ventilation for that room was through door and a small window. Common toilets in the wada were used by the families residing in that wada. Their children studying in schools and colleges found themselves disturbed by the beating noise and also the space requirement of other member from family increased, due to this from last few years many families moved out to some other places in the city as the living conditions here were uneasy. Though some families shifted to other places, their workshops still function from the same old karkhana and both rooms are used for the purpose of crafting utensils only.

Tambats had formed a 'sanstha' named as 'Twasta kansar samaj sanstha' for the benefit of *Tambats,* they had started a library and a study hall for 25 students as the noise level in this area is quite high (for location refer map 1).

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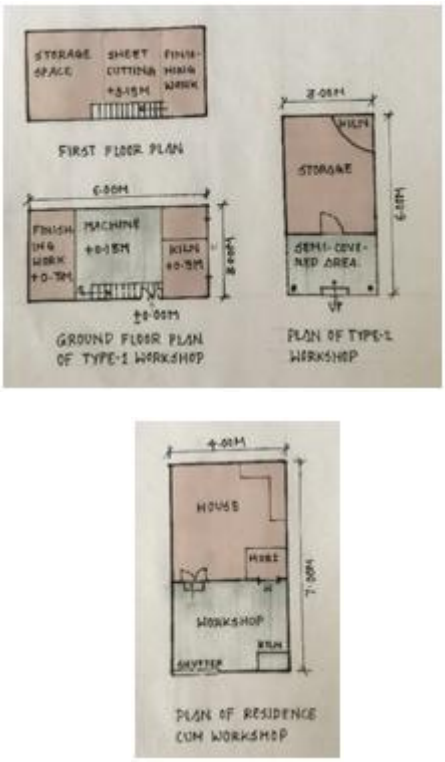

Picture-2: typical layout of workshops and residences.

Picture3: Workshop cum residence.

Conclusion:

Because of the lack of demand and invention of alternative materials like plastics aluminium etc. this profession is on the verge of decline. As it involves hard work and returns are very less next generation of coppersmiths is not ready to take forward the legacy of Tambats. The size and condition of their residences is not good enough. Now it is the high time when we can promote this craft kill and improve the lifestyle of craftsmen's and preserve this living heritage of Pune.

Recommendations to preserve the living heritage of *Tambat Ali*:

If the current generation of coppersmiths will not pass on this legacy to their next generation, then this traditional craft skills will stop here only, and it will be huge loss of our heritage. Here are some recommendations which might help to conserve the character of Tambat Ali.

- Economic help can improve their present condition.
- Promoting the benefits of using copper utensils will increase the demand and hence production and supply.
- Better infrastructure will increase the efficiency of craftsmen.
- To pass on this legacy of craft kill to next generation workshops and training camps should be arranged.
- As the beating noise is one of the major problem, for this use of sound absorbing materials could prove a better solution.

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Note: All the pictures are taken during the site visit.

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Architecture as a Tool to Restore Identities in The Regions Of Warfare

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Abstract : In the regions of conflict, the damage as a result of war can be seen in the form of destruction of structures. Wars also have long-term social and cultural consequences. The research paper aims to study the impact of war on architecture and its occupants. A question needs to be raised as to what should be the future of these affected structures. The study attempts to find appropriate strategies by analyzing events in warfare regions through archival data, book case-studies and photos. Architecture can be a tangible tool to restore the identities of individuals and communities.

Keywords: War, architecture, community, impact, strategies, restore

I. Introduction

"War, painfully enough, is good for architecture".

- Rem Koolhaas, during the 2nd annual lecture on 'Warchitecture', Amsterdam.

War is a state of armed conflict between different nations, states or armed groups. Architecture is a target of war where an attack is done to destroy settlements and cities resulting in loss of life, loss of home and loss of identity, thus the loss of culture. The impact of war on a building is not just physical but also has a perceptual impact on our memory. Building is memory. [1] As a result f war, within instants the spaces of dialogue and living become fragments of volumes where these fragments and remains of the buildings become the determinants of that space. The images of scarred facades and volumes of rubble make one to relive the moments one had associated with the

"War and architecture have a long and often parasitical relationship; the building and the unbuilding of urban centres, the making of enclaves, walls and segregated

residential city zones has been fundamental to urban form and human experience. The destruction of buildings and cities has therefore always been an integral part of winning and losing wars." [2]

Buildings are the targets of high priority as they are the shelters of human beings, the primary targets causing the inception of conflict. The result could be seen in the late 20th century and the last two decades where a study stated 90% of the people directly affected by wars were civilians. [3] A question has to be asked as to what should be our approach towards such structures. Should we use the fragmented volumes and remains to our advantage to create something new or should we continue to let the past being destroyed?

The study aims to analyze the post-war strategies of the affected buildings with the objective to understand the impact the war had on the architecture. As this impact on architecture can result in the loss of culture, it is relevant that architecture itself can be an impetus to restore or preserve a culture.

"There has always been another war against architecture going on-the destruction of the cultural artefacts of an enemy, people or nation as a means of dominating, terrorizing, dividing or eradicating it all together." [4]

The scope of the research is limited to study architecture as a casualty of war where a war is waged specifically to target architecture and to destroy it intentionally.

1. Sir Richard Cornelius MacCormac
2. Charlesworth E. (2006).Architects without Frontiers: War, Reconstruction and Design Responsibility
3. European Union's European Security Strategy, Brussels, 2003
4. Bevan, 2006:8

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II. Theoretical Framework

In past, researches have been done studying the causes and the effects of war on architecture of particular regions. There have been researches published on the housing of the migrants and the refugees of the war affected regions. This research paper refers the article published by Ar. Lebbeus Woods on War and Architecture: Three Principles which discusses the approaches for the architecture of a post-war world.

Principle 1: Restore what has been lost to its pre-war condition.

Principle 2: Demolish the damaged and destroyed buildings and build something entirely new.

Principle 3: The post-war city must create the new from the damaged old.

III. Methodology

The research applies thematic sampling as a method to study case specific structures through secondary data sources like books, archival data, articles and tries to apply these principles as to what must been their post war-approach. They can be a guideline for what approach a war affected structure can have, if any, in future.

IV. Data Analysis and Results

Principle 1: **Restore what has been lost to its pre-war condition.**

The idea of this principle is to restore normalcy where war is only an interruption in the ongoing flow of normal.

Credit: Joe Ravi

Fig.1. The Taj Mahal Palace Hotel, Mumbai

Credit: Khaled Desouki/AFP

Fig.2. Eliyahu Hanavi Synagogue, Egypt.

The 26/11 attack on The Taj Mahal Palace Hotel (Fig 1) Mumbai shook the whole nation where terrorists intentionally targeted the 117 year old hotel built in the revival style. Great efforts were taken to restore the scarred facades of this splendid hotel and revive it back to its original glory.

Egypt unveiled the newly restored Eliyahu Hanavi Synagogue (Fig 2) on 10 January, 2020 in the Egyptian coastal city of Alexandria. One of the largest synagogues in the Middle East, it is also one of Egypt's oldest Jewish temples. It was rebuilt in the 1850s after the original building, which dated back to 1354, sustained extensive damage during the 1798 French invasion of Egypt.

Inferences:

- Restoring the architecture to its original state might help in erasing the memory of war from the minds of the people.
- The attempt of trying to forget the past might lead to the loss of identities of the victims affected by the events of war.

Principle 2: **Demolish the damaged and destroyed buildings and build something entirely new.**

Building on the past for the future.[5] The new can be something radically different from what existed or something more to that of pre-war normal. A new modified normal can only be created with consent and partition of the people.

5. Reem Al-Rawi (2010). The Architecture of War

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Courtesy: Japan Monthly Web Magazine

Fig.3. Hiroshima Peace memorial, Japan

In August,1945 the city of Hiroshima became the first city in the world to be targeted by an atomic bomb by America and within instants the whole city was transformed into rubbles and killing 1,40,000 people. In fig. 3 we can see the Hiroshima Peace memorial where a lone partially destroyed building stands as a testament to the attack whereas at the backdrop we can see the transformed skyline of Hiroshima trying to forget the past by adapting to the new technology of the world. Though the city strives to forget the past and honor the dead, the effects of the attack are still experienced by the people affected by the radiation.

Inferences:

- The principle tries to forget the trauma/psychological effect on a person caused by violence and destruction.
- If the proposed 'entire new' is not thoughtfully planned then that might destroy the local culture of the place entirely.

Principle 3: The post-war city must create the new from the damaged old.

As the finances are depleted by war, salvage the building stock to build the 'new city'.

"The spatial volumes are not meant to fit within their surroundings, but to stand as proof of old and new, safe and dangerous, past and present."

- Vrilio, Paul, Bunker Technology, Princeton Architectural Press

The re-construction of old buildings will enable new ways and ideas of living and thinking. This can be well implemented into workspaces and be a constant reminder to the future youth and a message to the world.

Courtesy: Daniel Libeskind

Fig.4. One World Trade Centre, USA

Credit: Ninya Regalado

Fig.5. Mansion in Talisay City, Philippines

America and the entire world was shaken after the 9/11 attacks on the World Trade Centre(WTC). In fig 4. we can see the proposed One World Trade Centre which opened in 2014 on the same site as WTC making a mark on the skyline of New York.

To honor the people who lost their lives on that day, landscaping was done in place of the footprints on the 2 existing buildings. The basements were restored and a museum was proposed in its place to depict the history of the attacks. In the museum we can see the original structure of the old towers which was destroyed.

Talisay City in the Philippines features a mansion (fig. 5) built by a sugar magnate at the turn of the last century that was twice destroyed during the Second

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World War in order to prevent Japanese forces from using it. Once on their way out of the Philippines, the USA air force bombed and strafed the home, and Philippine rebels burned it down to keep it from falling into Japanese hands**.** Currently only the facades remain and the mansion has been converted in a museum for visitors.

Inferences:

- This principle embraces the war by retrofitting the two objects, destroyed but usable old and developed new, to transform the damaged structure.
- Architecture will act as a constant reminder to it users about the war. Though it may in a way honor the memory of the lost ones, it might also act as a fear causing element if not implemented in the right sense.

- **V. Conclusion**

• As opposed to the dignified wars fought on battlefields outside cities, modern warfare has taken a devastating toll, unwillingly dragging people and architecture to its death.

• While war can result in destruction of a culture, architecture can be a tangible tool to restore the identity of an individual.

Discussion

The research paper can further its study by physically visiting few of the cases mentioned in the paper and attempt to understand people's take on the applied approaches on the buildings, observations, etc to gain more information helping strengthen the research paper.

Acknowledgement

I am thankful to my guide Dr. Abhijit Natu for his valuable encouragement and guidance which allowed me to further develop the research. I also offer my sincerest gratitude to all those who gave their valuable insights throughout motivating and guiding me for the research.

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Study of Bazar on Street

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ABSTRACT: The bazaar is a place for the exchange of economic and social-cultural activities; that include selling, buying, eating all with variations in their spatial attributes. This research aims to study the Placemaking of a bazaar on the street through spatial attributes in architecture. Hence, the objectives include studying the evolution; with reference of secondary data and secondly, to study spatial attributes; physical mapping is done through the various layers. The expected outcome of this study would give an insight into the reasons of why a bazaar on the street is the focus of amalgamation of activities and how spatial attributes and spatial organization influence its Placemaking.

INTRODUCTION:

The bazaar is a place with a varied display of commodities intended to be sold to costumers and earn money. Hence a space is dedicated to thisfunction. Bazaars in the past were located around a religious place for the strategic importance of trade, accessibility and its location. The bazaar was not only a trading place, but also had residences on the top storey of shops. Thus, the streets along these developed a character different from normal streets.In Indian context, the bazaars were located around temples, as it attracted trade and various socio-cultural activities. The spatial organization of the streets changed, depending on seasonal changes, types of selling items and also during various festivals

Likewise, a bazaar on the street is lively because of the people in them.Hence, a street which is normally used for commuting from one position to another is lively because of mixed use happening there, due to the presence of the bazaar, the spirit of place changes.

The people define the street, Thatis, any street has a certain character that is given to the street by the people example eatery on the road wouldn't have sustained until people visited them, hence every space is converted to a place when a certain activity or set of activities is tied to it. Thus, the spatial attributes that define a place are a reason to attract people and are hence given a certain identity. By the people, for the people and of the people. Social and spatial structure are partially related to an intervening factor of human. (Lynch k.)

AIM:

To Study the place making of bazaars on the street through spatial attributes in architecture.

OBJECTIVE:

1. To study the evolution of bazaar on the street
2. To study the spatial attributes of the bazaar via place making and spatial distribution onthe bazaar.

Spatial attributes include study of the parameters that include selling items, reference to space, changes in patterns during different seasons, types of displays and variety in them any and any aesthetics added. The spatial distribution includes study of architectural features like roofing style, sellingspace, display,scope of interaction for shoppers, sellers and visitors, materials used, volumetric analysis

RESEARCH QUESTION:

1. How do the spatial attributes and spatial distribution influence the place, making of Bazaars on street?
2. Do spatial attributes and spatial distribution attract the people to bazaar and what impact does it have on them? Have architectural features also added to the focus of attraction to bazaar?

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RESEARCH METHODDOLOGY:

The research is a qualitative as well as descriptive type research where in case studies are used to study the response of the people to the spatial attributes and spatial distribution is analysed. Literature reviews are used to study the evolution of bazaar on the street that include secondary data like earlier research, literature references like books, articles etc. and oral history is also relied on.To study the spatial attributes of the bazaar like types of commodities sold, primary data collection through case studiesare done through activity mapping via, observations, opinions and behaviour of people are accounted on the basis of their responses on each spatial attribute. Hence, these are evaluated by questionnaires, opinions and experiences. Spatial distribution to be studied via graphical mapping through the various layers.

SCOPE AND LIMITATION

The area of study for research is limited to Tulsibaug, Pune and Mahal, Nagpur. The area to be studied is selected in a range of 50m radius. The reasons to limit the study area being a detailed spatial studyare needed for the expected outcome.

LITERATURE REVIEW

Paper 1: Role of bazaars as unifying factor in traditional cities of Iran: The Isfahan Bazaar. In this paper cities are regarded as valuable cultural, technological and social achievement over centuries. Urban places like bazaars are the integrating factor of cities like Iran. The bazaars have evolved over history, creating a place for economic, social, cultural, political, and civic activities of people. The main body of the city can't be defined without bazaars. Over the year's bazaar has evolved from a place of importance around a Masjid and then a continuous street linking the ends of the city with various other spaces as well. Thus, making it the spine of the city. Thus,the paper concludes saying that bazaars are central to the idea of the traditional Iranian city and they integrate different parts of cities like residential as well as social political and trade centers. (Pourjafar, 2014)

Paper 2:The Sustainable Architecture of bazaars and its relation with social, cultural and economic components.:This paper talks about how sustainable architecture when integrated within the public spaces enhances the design and its response to its physical environment. The climate responsive design not only makes the space sustainable, but also ensures comfort of visitors and shoppers. Hence making it a good place for interaction, social activities etc .Thus the design becomes socially, ,culturally and economically dynamic .Also how types of goods sold influence the architectural elements of the bazaar; for example: The lane selling silk is covered with roofs covered with roof and as the size of goods change the lane width also changes in proportion leading eventually to a public gathering space like courtyard .This helps to keep the heat as well as protect from cold weather during winters .Thus, learning from past and importance of traditional cities is important and inculcating that in modern contemporary architecture is important. (Kalan & Oliveira, 2015)

Paper 3: Traditional Markets in Islamic architecture: successful past experiences: The paper stresses on traditional architecture of Islam and how it effectively responds to its physical environment. It explains bazaar as a place of social, economic and cultural attraction and hence how these parameters were important back then and how they can be practiced in today's contemporary architecture. The case study explains how various architectural elements were influenced that is their design was responsive to the type of goods sold, the climate of the place and the surrounding context. For example, the lane selling silk was covered with the roof and every change in lane was the indication that type of goods sold also changed hence a varied rhythm was developed. As you reach the end there is a huge courtyard rather a public common square which explains the importance of scale and proportions. Talking about the climatic aspects the roof is that of vaulted dome and skylights are made in the domes. Which responds to the extreme weather conditioned of Isfahan. (Hmood, 2017)

Paper 4: The qualities of Tabriz historical cities of Iran: The Tabriz bazaar: The paper again talks about how a bazaar is responsible for social-cultural integration of the urban life and how this parameter has continued over a period of time and how these

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parameters can be included in designing of current day megamalls. So these are the physical and functional potentials of a bazaar that can be integrated into the planning of megamalls. Thus, for physical parameters the spatial distribution is studied which derives upon a model wherein there are multiple bazaars and a city centre, which would cater all the people around the city and no one have to travel to the centre of the city to bazaars, thus reducing load on it and at the same time retaining its identity. (Ahour, 2011)

CASE STUDIES:

Mahal, Nagpur

Brief History: The heart of any city, with a rich history and culture, is often regarded as the. The same is the case of the old part of Nagpur that is Mahal. Founded by the Gond king BaktBuland Shah the city evolved after the fall of the Gond Kingdom the Bhosles took over Nagpur and are one of the Historical families of Nagpur. The residence of the Bhosleswas located in the present-day Mahal area.Hence, the area has a rich cultural and heritage importance.

Area of Study:The Radius selected for Study is the 50m radius around the 400 years old Kalyaneshwar Temple, Nagpur. The history says that the area currently a bustling market place was the Nagarkhana of the Bhosles living in the proximity of the temple. The temple complex belonged to the soldiers who resided in the quarters in the Complex. Thus, the area around temple developed as a place for meeting, gathering for their families and had shops of basic needs like utensils, grocery, vegetable etc. A vegetable market "Mandi "was also present. But there are no changes as far in the typology of shops. It's basically a common man's market where everything froma pin to cloth to electronics everything is available at reasonable rates.Over the years the area evolved as a market place. A few shops in present daywere modified in the year of 2001, as NMC gave official permission to the shops outside temples. Currently the place is one of the busiest marketplaces in Nagpur with a variety of goods sold from wholesale to retail, with street shops to small eateries and hawkers, vendors etc, selling a variety of stuff. The area of study also includes the Temple precinct hence the typology of shops change. The spatial organization varies according to the type of shop or the selling items. As narrated by PurushottamGulabraoChikhale.

Tulsibaug ,Pune

Brief History**:**Tulsibaug as the name suggests was a garden of Tulsi(a plant).Balaji Bajirao,the third, was the person who had built temple. The complex is built on one acre of land and has three temples in it, the central and major being the Ram Temple, while others being Ganapati and Mahadeva temples on either side. The surrounding courtyard of the temple complex was once landscaped with flower beds but in present day it is paved with stone.

Since women living in the temple's vicinity had to go far away to shop, a small number of shops were set up in the compelx. Which were two storey buildings , where lower storey was the shop and upper storey usually had residence of the shop owner.

Present day the shops are still there with the same character and new generation handling the shops, while the temple precinct immensely developed with more commercial buildings, street shops.

Area of Study:The area selected in Tulsibaug is the radius of 50m from the Kaware Cold Drink house.the radius includes the Tulsibaug Ganpati, mandir. all the streets are bustling with various activities of buying,selling and eating.infact all the streets are identified as major shopping destination amongst all the age groups.with variety of selling items from clothing, jewellery to gocery,plasticstore, Poojaitems, utensil stores etc.

Figure 1:street view of kalyaneshwar temple

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Figure 2: A busy street in Mahal,Nagpur

Figure 3: A busy chowk in Tulsibaug,Pune

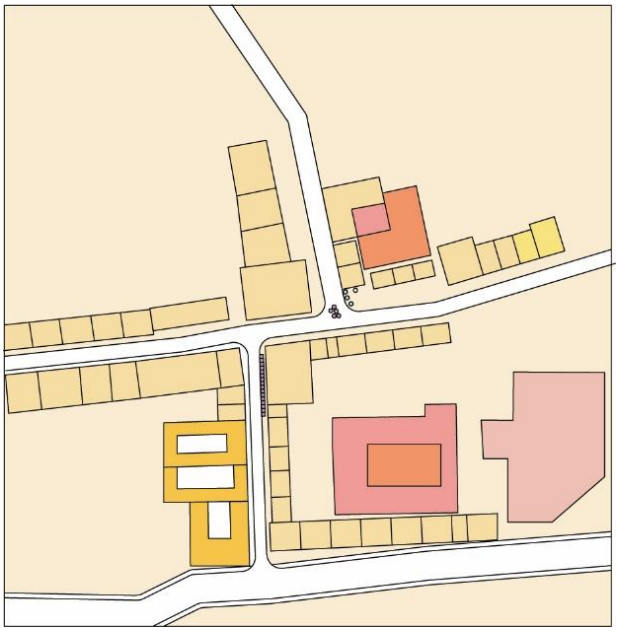

Figure 4:Base Map of Tulsibaug,Pune

Source: Author

(Rasterized Google earth map)

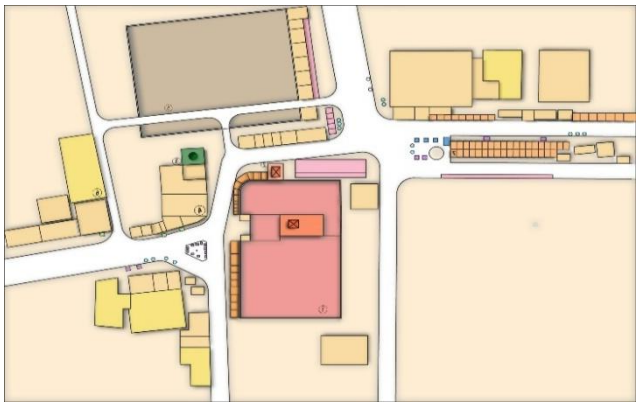

Figure 5:Base Map of Mahal, Nagpur.

Source: Author

(Rasterized Google earth map)

COMPARITIVE ANALYSIS

The parameters selected for analysis were spatial attributes that contribute to the placemaking of a street. The activities associated with all the shops and areas around it explains that:

- Similarities: Both Tulsibaug and Mahal are the core areas of the city from where they evolved hence both have a status of cultural and heritage importance.
- Both of them have Temple precincts in the area studies which also adds to the variety in the spatial attributes as well as the activities associated in the area studied. Differences: The character of streets change in different ways in both areas depending on the festivals.
- doesn't need a large space for display compared to the kiosk selling plastic items which also uses the space in its forefront for the display.
- Thus, the placemaking of the bazaar on a street is influenced by its spatial attributes.

ANALYSIS AND RESULT

For The case studies done in both the areas, the parameters were selected for analysis were the spatial attributes, that contribute to the Placemaking of a street. The activities associated with all the shops and areas around it explains that:

- The streets have a certain spatial organization because of the way a place or a shop is associated or identified with an activity.

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- The selling items and display are correlated with each other as they also define the type of shop or the architectural features necessary for the selling items to be protected or displayed. Fore.g. The kiosks selling jewellery doesn't need a large space for display compared to the kiosk selling plastic items which also uses the space init's forefront for the display.
- Thus, the placemaking of the bazaar on a street is influenced by its spatial attributes.

CONCLUSION

The bazaar on street is made up of various components but the major component being the people itself and the spatial attributes like selling items, types of displays, aesthetics etc. are designed or rather have the character or certain identifying features to attract people .hence, they influence the spatial organization along the street. People hence they influence the spatial organization of the street. Thus, placemaking of any space is important as it defines the way a [place is identified and moreover it is designed for the people that use them and create a sense of belonging to the place, that is what attracts the people to the bazaar.

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Table 1: Spatial attributes Mahal

Type of Shop	Description	Architectural Character	Selling items	Display	Aesthetics	Activity happening
Permanent	The shops are typical ones with window shopping and the type changes depending on the selling item. Usually a ground or G+1 structure	The shops have a typical rcc structure in rectangular plan with a single entrance and racks placed linearly for display. Some of them are G+1 structure while some have a few seatings for customers. Spread across the whole area	Copper and brass utensils clothes, plastic items, jewelry, footwears, eateries, grocery, Pooja items,	The items are either displayed on a rack or just stacked upon one another and kept at the entrances or hung from the ceiling on the main door. In the case of clothing the clothes are displayed on mannequins or on the display rack	The sound of copper and brass utensils being beaten, the bright display of colourful items	Buying, selling,eating Some just come to sit and chat in the temple precinct.
Temporary	The permanent shops also have their temporary stalls built up in front of their shops to attract more crowd and at the same time prevent	They are usually tables with roof cover of plastic sheets and arranged in a U shaped pattern.	Clothes,small jewellery (bangles,earings etc.),utensils and crockery	Usually stacked up in a definite pattern or hanged by strings across the stalls.	The selling items itlsef add to the aesthetics and also the bright LED lights used to enhance the display.	Buying, selling
Hawkers	Usually active during peak hours of shopping	Have a moving cart.	Eatables, toys	Usually stacked up or in case of eatables covered in utensils	Brightly coloured carts	Eating ,buying selling
Kiosk	They come under encroachment and usually have common characteristics	A small stall of an average area of 2 Sq.M. with roof cover of plastic sheet and an average height of 2.5 m.	Jewellery, foot wear	Usually displayed on top or hanged by strings in a definite pattern	Brightlly coloured cloth for backdrop and lights to enhance the display	Eating,buying
Vendors	Usually they roam on the roads or sit down for selling.	Not any	plastic items, small jewelry, clothes	Usually carry along with them	Not any	Buying, selling

Table 2: Spatial Attributes Tulsibaug

Type of Shop	Description	Architectural Character	Selling items	Display	Aesthetics	Activity happening
Permanent	The shops are typical ones with window shopping and the type changes depending on the selling item. Usually a ground or G+1 structure	The shops have a typical rcc structure in rectangular plan with a single entrance and racks placed linearly for display. Some of them are G+1 structure while some have a few seatings for customers. Spread across the whole area	Utensils, clothes, plastic items, jewellery, footwears, eateries, grocery, Pooja items,	The items are either displayed on a rack or just stacked upon one another and kept at the entrances or hung from the ceiling on the main door. In the case of clothing the clothes are displayed on mannequins.	Bright lighting, in some cases just the arrangement of selling items has been itself attractive.	Buying, selling, Some just come to sit and chat
Temporary (NMC)	The shops were first temporary structures and came under encroachment but eventually acquired permission from NMC.	The shop is a plinth level structure in timber and roofing of patra. The shop layout is 2x2.5M. Each shop has a main double leaf door covering its front face. With the provision of a forefront where the rest of the items are displayed as the space within the shop.	Footwear, Jewellery, beauty items, orchestra items (one line of shops is only the orchestra bands)	The items are usually displayed on small racks or displayed with stacked arrangement on the forefront or in some places hanged from the ceiling.	Display items itself. Their arrangement itself attracts the buyers.	Buying, selling,
Temporary (Temple)	The shops were first temporary structures and came under encroachment but eventually acquired permission from NMC.	The shop sizes vary, but has an average area of 5sq. m.	Pooja items, plastic items, clothes, grocery, paan shop, flower shop, hardware,	The items are displayed on the forefront with stacked arrangement or hanged in the roof.	The bright colors of the items are on display with varying textures.	Buying, selling, chatting, eating
Encroachment	The illegal stalls are set up	These are temporary arrangements done, like a kiosk, stalls	Seasonal clothes	A simple arrangement of tables arranged linearly across the road fringe. With roofing of sheets when necessary.	The backdrop white cloth along the trees have clothes displayed on it.	Buying, selling, chatting, eating
Kiosk	Varying in sizes and display again depends on the selling item	A platform /top raised to a certain height with the help of bamboo posts and covered with plastic sheets as roofing.	Plastic items, small jewellery, vegetables, fruits, flowers	Usually displayed on the platform or hanged across the roof.	The display of selling items itself.	Buying, selling, chatting, eating
Hawkers	They have no place fixed and usually	A cart	Fruits, vegetable,	Displayed in the cart	Not any	Buying, selling,

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	own a cart for selling purpose.		plastic items, small jewellery, clothes			chatting, eating
Vendors	Usually they roam on the roads or sit down for selling.	Not any	Fruits, vegetable, plastic items, small jewellery, cloth	Usually carry on themselves or just have a cloth on which items are displayed	Not any	Buying, selling, chatting, eating

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Construction Technology in Hilly Areas: Western Ghats

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Abstract : Architecture on hills offers advantages like views and cool breeze. Hilly regions have variations in topography, geology, altitude and climate. Unpredictable geological and climatic conditions make construction conditions unfavourable. Various factors are considered like landslide-prone areas, slope, existing subsurface water and study of geological maps before constructing on a sloping site. Construction techniques play an important role in helping the structure sustain. Vernacular construction techniques include use of timber, mud, stone, etc. Contemporary construction techniques include use of green building materials like steel-framed construction, cement-wood boards, etc. This research paper deals with construction techniques which will help sustain the structure.

Keywords –Sloping sites, Topography, Geology, Landslide, Vernacular architecture, Contemporary construction techniques.

I. INTRODUCTION:

Hills are landforms that rise above the surrounding terrain. Hills are formed through geological activity such as faulting or erosion. Earlier settlements were built on hills, to avoid floods, densely forested areas, for defense and good views. Lack of picturesque views, fresh air and accessible flat lands in the cities, people have finally started to resort to hilly regions. With increasing population and construction demands, construction in hilly regions, on sloping sites have taken place.

Challenges faced during construction in hilly areas:

Hilly regions have wide variations in topography, geology, altitude, geomorphology, material resources and climate. Unpredictable geological situations, precarious climatic variation, hydrogeological conditions, deep gorges, rivers, high winds, high altitude, landslides and mud flows make construction conditions unfavourable.

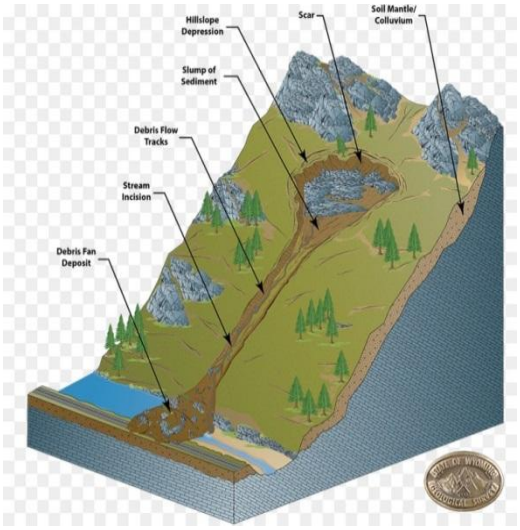

Fig 1.Landslide

Building consideration for construction in hilly regions:

1) Site Selection:

1.1Check for Landslide-prone areas: Landslides are most prevalent disaster in hilly regions, which are caused by gravity acting on weakened rocks, debris, etc. which constitute a sloping area of land. A landslide hazard map shows the areas susceptible to landslides.

1.2Check for Slope and sequence of rock structures: Study of sequence of rock structures beneath help analyze the stability of land, and whether the land is suitable for construction or not.

1.3Check for existing subsurface water: The presence of subsurface water in an area may lead to the formation of cavities therefore inviting landslides.

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2) Comprehensive Planning:

2.1 Topographical data: It involves study of geological maps, analysis of geomorphological features, previous and present land use, previous slope failure and landslides, underground services, etc.

2.2 Site Investigation: For construction on a hill-site, site investigation should be executed in two stages. First stage consists of boreholes and geophysical survey which includesdepth of soft soil, hard stratum and bedrock.Soil samplesshould be collected from boreholes for laboratory tests, which help in designing slopes, foundations and retainingwalls.In addition, the ground water profile should also be examined.

3) Design of Slopes:

Designing of slopes plays an important role while constructing on a sloping site. Improper design creates environmental impact leading to slope failures.Therefore, for slope design, detailed information about soil properties,geology of the site, groundwater regime is necessary.The structure design should fit the natural contour and reduce cut and fill of earthworks.

4) Sustainable development:

For sustainable development, construction technique should be developed with locally available and easily workable materials like timber, stone, mud, etc. that have good climaticresistance and have less impact on environment of hill settlement, and, green building materials like cement wood boards, aerated concrete panels, gypsum plasterboards, etc.

I. MATERIAL AND METHODOLOGY:

1)Case study of weekend home in Sahyadri hills:

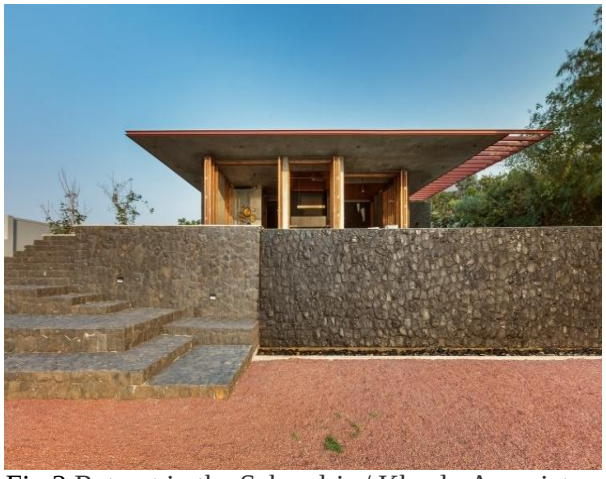

Fig 2.Retreat in the Sahyadris / Khosla Associates

The weekend home is built with the help oflocally available material of Deccan Plateau: black basalt stone. The stone is used as a random dry pack cladding along the entire extent of the exterior walls, on a few internal accent walls and for retaining walls. Doors are made of sustainable Accoya wood.Angular shaped skylights are provided for natural lighting. Retaining wall created at the periphery and a ramp alongside it to arrive at the entrance 3''-6" below.[vii]

2) **Case study of Hotel Dalhousie in Himachal Pradesh:**

Fig 3.Study of Building Structures & Construction Techniques in Hilly Regions: Hotel Dalhousie

Construction technology used: Kath-Khuni. Kath-Khuni technique has the characteristics to be, sustainable, aesthetically pleasing and seismically sound. Materials such as stone, wood and slate are used. The walls and retaining walls are made of stone and wood which are stacked up alternately. Wood

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from deodar tree is used for flooring, partitions, door and window frames. Slate,a material which is cut into thin sheets from the heavy metamorphic rocks, is used for roofing.Slate is a sunlight reflective material, heat absorbent, frost resistant and moisture barrier as it is contains high quartz content.

3)Green building materials for sustainable design in hilly areas:

3.1 Steel construction: Light steel-frame building consists of structural wall frames and roof trusses made from cold-formed galvanized or Zinc Aluminum structural steel sections. Less wastage, low transportation and storage costs reduced time of construction offers cost savings up to 15%.[v] Steel can be reused and does not rot or sag over time.

3.2Cement-wood-boards: These are made from cement and wood (eucalyptus and casuarinas). Due to special manufacturing process, the panel gains the durability andstrength of cement and easy workability of wood. These sustainable boards are weather resistant, termite resistant,fire resistant and provides good sound insulation. They can be used for wardrobes, false ceilings, partitions, etc.

3.3Sandwich panels: These panels are pure dry fixing system comprising two thick boards (fiber reinforced cement sheets).These are light weight, durable, water and termite proof, provides thermal insulation and fire resistance. This factory made panels have semicircular tongue and groove jointing system which provides rapid installation. False ceilings, wall paneling, structural glazing, etc. are some of its applications.

3.4Aerated concrete panels: These are made from a mixture of fine fly ash, with cement, gypsum and lime as binding agents, aluminum powder and water acting as foaming agent, and can be used in high rise claddings.

3.5Gypsum plasterboards: Gypsum plasterboard for walls is also called dry wall which implies no water usage. They can be used for walls, lift shafts, stairwells, etc.in residential, schools, hospitals, etc.

3.6Roofing and cladding: Corrugated tiles are made from bitumen combined with resin and single layer of organic fibers. A coating of zinc-aluminum provides corrosion resistance. These sheets are ideal for roofing and cladding.[v]

4) Type of construction according to slope:

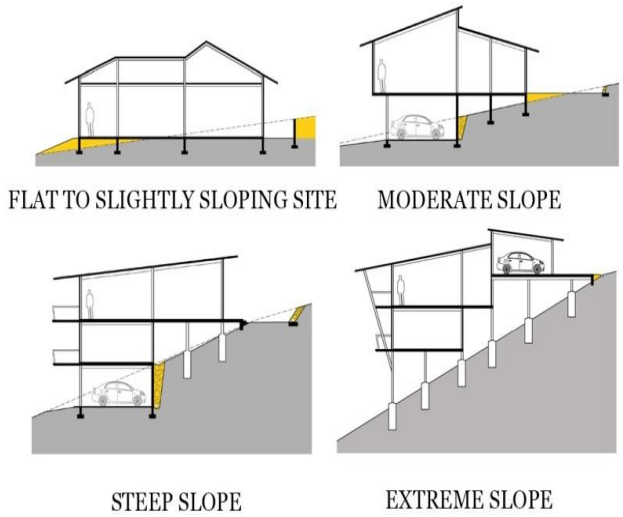

Fig 5. Matching building design to suit the degree of slope

Slope	Type of construction
Flat to slightly sloping sites(site slope upto 7%)	Single slab on ground construction
Moderate slope(slope between 7-20%)	stepping two or more slabs or using part slab/part post or beam construction
Extreme slope(slope more than 33%)	suspended or pole construction techniques
Steep slope(slope between 20-33%)	post and beam construction should be used which steps with the site.

Table 1. Matching building design to suit the degree of slope

5)Example of good hillside construction practice:

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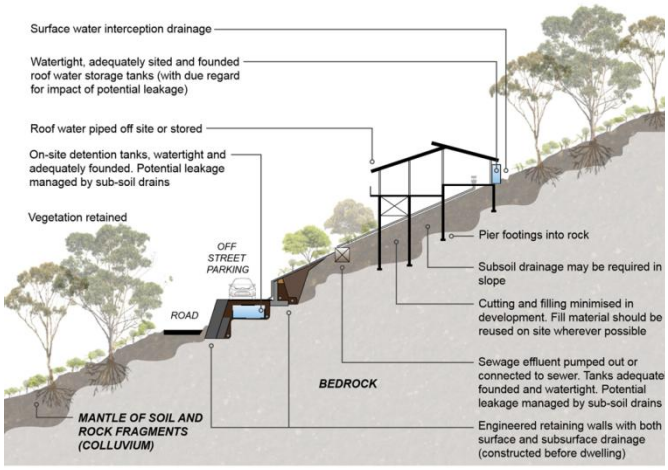

Fig 5. Guidelines for building on sloping sites

II. RESULTS:

1) Weekend home in Sahyadri hills:

- Locally available material black basalt used in construction of walls and retaining walls.
- Accoya wood used for doors which is a timber modified through a process called acetylation which enables it to resist rot, and durable up to 50years.[xi]
- Construction done considering natural topography of the site, creating negligible impact on the environment.

2) Hotel Dalhousie in Himachal Pradesh:

- Kath khuni construction technique used which consists of use of stone, wood and slate.
- Outer layer involves laying of random rubble masonry of granite stone stacked up alternately with deodar wood. Wood (good in compression and tension) is interlocked in the corners with other wooden members. This technique provides good seismic and thermal response.
- Slate, which is asunlight reflective material,is used for roofing. It is heat absorbent, frost resistant and moisture barrier as it is contains high quartz content.

3) Green building materials:

- Steel construction: Lightweight steel-framing systems are reusable, offer similar environmental performance to that of conventional double-brick construction technique and eliminate wet masonry work on site.
- Cement-wood-boards: Due to unique manufacturing process, these boards are fire resistant, weather resistant and have good insulation properties.
- Sandwich panels: These panels are an alternative to masonry walls. Being fire, weather and termite resistant, these panels also offer rapid installationwith minimal disruption of work, due to its light weight.
- Aerated concrete panels:These can be used for high rise claddings totackle masonry difficulties such as, plastering,curingandbrick by brick construction.
- Gypsum plasterboards: These boards offerhigh level performance in terms ofmoisture resistance, acoustic and thermal insulation, and fire rating.
- Roofing and cladding: Corrugated sheets are designed to give aesthetic look, while at the same time being extremely light weight. Thus, it helps reduce transportation cost.

III. CONCLUSION:

With increasing population and construction demands, construction on sloping sites has taken place. Considering the factors affecting natural topography of the site, it is important to build structures using vernacular construction techniques and contemporary construction techniques which include use of green building materials that have negligible impact on the environment.

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To Study the Symbolism of Mount Meru and its representation in the Architecture of the Angkor Wat Temple

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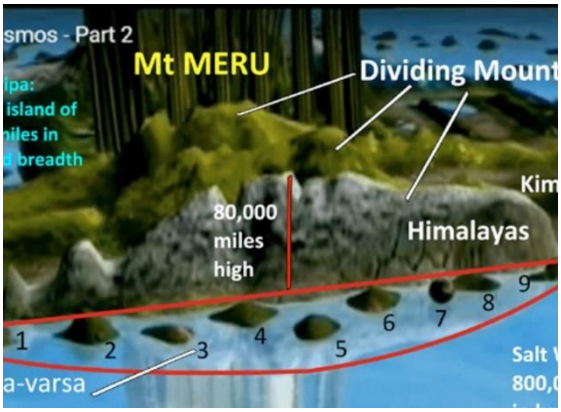
Abstract: ***Art speaks about the metaphorical meanings in context to the shapes, patterns, ornamentations and planning implemented in creating it. This nature of it is symbolism. In Hindu religious architecture the shapes and patterns depict the archetypal manifestation of nature and its attributes therefore contributing in religious significance depicted through the means of the construction of the structure. Mount Meru is believed to be the centre of the universe it is a representation of the central axis theory of the sacred Hindu Cosmos. Angkor Wat Temple located in Cambodia symbolises the peaks of Mount Meru all of its original religious motifs are derived from the Hindu Cosmos and Hinduism . This research paper speaks about the study and interpretation of the symbolism of ancient Hindu Mount Meru and its representation in the architecture of the Angkor Wat Temple. It also aims to study the significance of the Angkor Wat Temple and the relation between the temple and Mount Meru. The paper aims to draw a comparison between the symbolism of the two with the interlays in the historical and cultural time periods and also understand why it is necessary to do so, to scrutinize and draw inference of the existing data on the topic.***

Keywords - Hindu Cosmos, Central Axis Theory, Mount Meru and Hindu symbolism, Angkor Wat Temple, Mount Meru and Angkor Wat Temple comparison, Conclusion.

INTRODUCTION

Mount Meru is believed to be the highest point of the universe in ancient Hindu texts. It is also regarded as the earth's navel, the point at which the creation began in other words '*the centre of theuniverse.***'** The mountain is said to be separating the heaven and earth.



(**Image A- Mount Meru and the depiction of cosmos.)**

It is commonly said that the mountain is the centre of the universe its symmetry is vertical and horizontal, surrounded by the waters of life which is surrounded by seven concentric seas each diminishing in size from the centre if we see this technically it is the entire landmass of the earth surrounded by the mountains and sea.**(Image A)**

Mount meru is believed to be the part of the sacred Hindu cosmos, Hinduism believes that universe is created, destroyed and recreated in an endless series of repetitive cycles where Brahma is the creator, Vishnu the sustainer and Shiva the destroyer. This holy trinity as referred to combines to form '*Parmeshwar Purusha,'***(Image B)**the supreme being who is the manifested form of the whole of infinity. It is a philosophy of Hinduism that the human being is said to contain within itself the entire cosmos *'Aham Bhramosmi'* which reinforces the idea of part in whole and whole in part. It has been stated that the ancient Hindu cosmos is inspired from the human anatomy. To maintain harmony all man-made objects and structures were enjoined to be fashioned with the same measurements and principles with which the cosmos is made and thus the underlying order and symmetries of the cosmos manifest themselves in the designs and representations made by man. Thus, stating the Hindu philosophy of the whole cosmic

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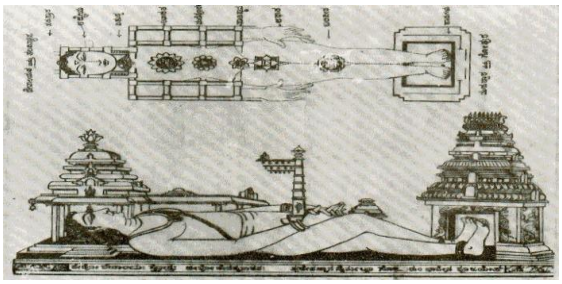
principle replicates itself again and again in even smaller scales.



(Image B- Parmeshwar Purusha)

Angkor wat temple located in Cambodia is a gigantic temple complex which was built by King Suryavarman II in the early 12th century in order to serve as the king's state temple and capital city, over a period of 500 years from the seventh to the twelfth century successive rulers sought to build sacred spaces that bore witness to the presence of gods and the legitimacy of the kings. Since its been constructed it has maintained religious significance for nearly 900 years all of its original religious motifs are derived from Hinduism and the temple is dedicated to the holy trinity of Hinduism Shiva, Brahma and Vishnu, the 5 central tower of Angkor Wat symbolises the peaks of Mount Meru, since Mount Meru is surrounded by the ocean with the same context the temple complex has the central shrine with enormous moats which represent the oceans at the edge of the world.

Thus, studying the significance of Mount meru and Angkor Wat individually and understanding their co-relation and significance to establish the symbolism of the mountain in the architecture of the temple.

METHODOLOGY

This research paper aims to study and interpret the concepts and religious philosophy pertaining to the Hindu Cosmos of which Mount Meru is a symbolic and also to understand the representation of the symbolism of this mountain in the architecture of the Angkor Wat Temple. To analyse and establish that Angkor Wat Temple is considered as the miniature replica of the Mount Meru and the Central Axis theory associated with the mountain

HISTORICAL BACKGROUND AND ORIGIN OF ANGKOR WAT TEMPLE

The Angkor Wat Temple was built by King Suryavarman II at the height of the political power of the Cambodian dynasty namely Khmerin between years 1113-1150.

Khmer civilisation flourished between early 9th century A.D. and mid-15th century A.D. It was founded by King Hiranya Varman in the year 1080. There has been an inscription of King Suryavarman II discovered in "Phnom Rung" located in North-Eastern Thailand which contains a detailed description of the royal family lineage and the native place of stay of the Khmers. This description also contains information about Hiranya Varman being a descendant of **'**Aditya' -the Sun God and 'Lakshmi'- the consort of Vishnu thus establishing a relation of the empire with the divine Brahmanical Hindu ideologies. Thus **'**Aditya' and'Lakshmi' were also used as suffixes to characterize the members of royal family. The most notable rulers of this dynasty were Suryavarman II and Jayavarman II.

Like his predecessors King Suryavarman II decided to build his own royal sanctuary and thus constructed The Angkor Wat Temple facing it towards the West, since it was dedicated to Lord Vishnu -the great Brahmanical God of the holy trinity as believed in Hinduism.

It was a popular belief of the Khmer civilisation that the Kings were regarded as an incarnation of deities like Shiva, Vishnu and Brahma -all to whom the well-being of the realm was confided, thus all the Kings were considered at an equal stature with God. This was regarded as the 'Cult of Devaraja' where the word Devaraja meant **'**God-King' which was centred around a **'**Sacred Lingam (Pillar)'and this pillar was a symbolic representation of 'Lord Shiva'. This would be installed in the Temple Mountain that was located in the centre of the capital and the empire.

The sanctification of Devaraja cult resulted in it becoming a ritual for the future Kings to build their own distinctive temples which would also serve as their royal sanctuary. They also made it a priority to build public reservoirs and canals along with public utility services with the focus being the security of the state and to ensure the essence of their Kingship. This ritual can be traced back to ancient Indian dynasties, where a number of them had a sacred mountain of worship and inspired by this for several centuries it became a duty of Khmer Kings to construct temples in the form of mountains which

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preserved the royal pillar that was an expression of the kings sacred ego and it was this ritual which lead to the construction of great temples in the Angkor region with Angkor Wat being the one that was designed inspired by the sacred Mount Meru.

HINDU COSMOS

Hindus believe in creator -an immanent and transcendent supreme being who has no form, no beginning and no end. This entity represents the highest truth of the universe and everything else is said to be a reflection of it. This divine entity is referred to as 'Parmeshwar Purusha', the supreme being who is the manifested form of the whole of universe. The Gods and Goddesses in the Hindu pantheon represent fewer abstract notions that are easier to connect with and grasp. However, each deity is a representative of the divine ,as in Hinduism it is believed that our bodies are the houses of the divine and deep, which means that each human being is said to contain within itself the entire cosmos 'Aham Bhramosmi'-which reinforces the idea of part in whole and whole in part, Connecting the individual soul to the world's souls which is termed as the Cosmic connection.The ancient Hindu cosmos has been inspired from Human anatomy the reason for it being the ancient philosophy of maintaining harmony between nature and man-made objects. As it is believed that the deeper association between the person and nature spirit results in a divine connection which transcends the boundary of space and time. The Hindu texts and philosophy have been derived to ease the burden associated with human existence.

CENTRAL AXIS THEORY

In Hindu Cosmos the central axis or the Axis Mundi is around which the cosmos turns. This centre serves as a communication link between Heaven and Earth. In ancient Hindu texts Hindu lifeworld is a pilgrimage which is an act to cross from one world to another and "to cross" means to transform, it is a spirit guiding force that is a sacred journey to discover the wholeness of oneself and in this journey each stage has a significance- a message and a meaning. Thus, there exists a genius locus which inter-connects the varying niches of the levels and this deeper association between man and the nature results in a divine connection which transcends beyond the boundaries of time and space and creates a world of meaning, feeling and revelation. This field where man meets divinity is regarded as "Faithscape" which is an embodiment of sacred time, rituals, places and meanings. In terms of architecture it is to be used in the form of planned human construction, the designing of the holy spot is essentially a specific transformation of human creativity which is often interpreted in the terms of signs and symbols and the hidden meaning preserved on them all. This presentation of wholeness is a representation of the cosmos which forms a cosmic geometry referring to a sacred and stereotypical dimension ofpattern/relationship, order/sequence and temporality/changes. This forms a harmonic bond between man and its surroundings. In symbolic form analogy if human body has been accepted as a representation of the universe. Thus, drawing parallels between the macrocosms (universe) and microcosmos (temple/human body) and this interlinkage is represented in the Axis Mundi or the Central Axis Theory.

MOUNT MERU AND HINDU SYMBOLISM

Mount Meru in Hindu Mythology is believed to be the highest point of the universe. In ancient Hindu texts it is regarded as the Earth's navel, the point at which the creation began- the axis of the world. It is the golden mountain that stands in the centre of the universe separating the Heaven and Earth. Its basic symbolism in Hinduism is it is a world pillar that separates Heaven and Earth. Meru has been present since the beginning of creation, many other sacred mountains surround it mainly four mountains which establish an orientation to the magic of the compass points and the divinities that preside over them. In Hindu cosmology there are successive periods in which the cosmos is articulated in four, three and seven divisions respectively. it is represented in the Puranas that the world was divided into four continents and the later Puranas mentioned that there were seven concentric ring- shaped continents. All these cosmographical dispositions make Mount Meru the centre of the horizontal plane and make it a point of reference for everything around it. But its symbolism is not only limited till here Meru is a vertical shaft which links macrocosm and microcosm, God and Men, time and timelessness. In accordance to the Hindu Puranas there are seven number of 'Lokas' or Planes which are at different

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heights of the sacred mountains and different deities reside at different levels and at the top of it lies **'**Swarga' or Heaven- the city of the Vedic God 'Indra'. Similarly, it also states that the levels of the mountains inside the earth correspond to multiple levels of hell which is a reference to the foothills of the mountains that initiates from the Earth but the whole of the summit is not limited to the surface of the Earth and goes beyond .Thus, Mount Meru is consecrated as the full vegetal energy of the Hindu religion and represents the Tree of Life in the religion, it is the manifestation of the Central axis theory of the Hindu Cosmos.

MOUNT MERU AND ANGKOR WAT TEMPLE COMPARISON

The culture of late medieval period of Cambodia (802 A.D.-1431 A.D.) discovered their expression of uniqueness through construction of marvellous sculpture and architecture. The people of Cambodia had an inherent love for the mystic and religious philosophy and this resulted in them building a series of magnificent temples for the deities they worshipped and had carved artistic images and also engraved beautiful bas-reliefs to decorate them. Thus, these temples glorified Gods and Kings.Pre-Khmer or Indo-Khmer art inspirations belonging to the 5^{th}-6^{th} century A.D. bore the closest affiliations to the Indian art styles. The Khmer period revealed an indebtedness to the inspiration from art styles of India which was more obvious in the surviving buildings of those era. Various excavations have found traces of Indian settlements in Siam and Cambodia where the works discovered were closely related to the types of sculptures created during the Gupta Dynasty that one could easily mistake them for being of Indian origin. Native chiefs of the era were attracted to the Indian culture due to the fact that it was characterized by having a specific way of life laid down by philosophical and religiousdoctrine. There can be two major possibility of the adoption of Indian religious way of life. The first being either Indians imposed their form of political and religious organisation on a native society of Cambodia, which taking inspiration from it created a political organisation of Indian pattern. The second being either an Indian origin became the ruler of a native society of Cambodia or a native chief may have summoned upon the help of a Brahmanical priest to set up a monarchy of Indian type.

The establishment of Khmer autonomy began in the late 8^{th} century A.D and early 9^{th} century A.D. 'King Indra Varman' was the progenitor of the Khmer art. he is believed to have been studied the monistic Vedanta philosophy of The great 'Shankaracharya' from a brahmin and was married to 'Indra Devi' who claimed her descent from India. She was the daughter of an Indian Brahman named 'Agastya.' This resulted in creation of sculptures and architecture styles that were heavily influenced by Hindu religious philosophy.During the Khmer period most of the important and typical elevations were in the form of the summit of stepped pyramid. This form of the architectural constructions mainly temples which also served as royal sanctuaries had been stimulated from the cult of the Temple Mountain built after the imagined shape of either'Mount Kailasa'or 'Mount Meru'.This was an importation of an old Indian concept of 'Pratibimba', making of either sacred mountains or unseen celestial regions in the form of architectural constructions.Angkor Wat Temple is one of the largest religious complexes in the world which of all the Khmer monuments has been best preserved. It has a legend associated with it that it was built by Indra-Lord of Heaven. It is a logical culmination of the temple mountain whose evolution has followed through preceding centuries. It was constructed by King Suryavarman II and was originally a Vaishnava shrine which was dedicated to lord Vishnu and the temple was constructed facing towards west. It occupied the centre of the capital and served as the burial sanctuary of the king that was considered at an equal stature with Lord Vishnu. Considering the symbolic aspect of the main entrance of the temple facing towards the west direction in Hinduism the idols of the gods that are worshipped are placed in the West direction. Also considering the funerary aspect of facing of the temple towards the West is the symbolic theme of it being the direction of the dead. It is also acquainted with the traditions of the ancient Angkor and present-day Cambodia of building the tomb. Thus, thistemple is a classic example of both the temple mountain and the funerary temple. It probably contains the ashes of the dead king. The design of Angkor Wat is focussed on three rising concentric galleries at the heart of the

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temple and a vast amount of space circling the galleries. Around it is a rectangular moat, which is a water filled border that isolates the grounds of the monument. The central sanctuary is 138 metres high which stands on a square terrace 33m high and 225 metres square. At the corners rise four towers connected by galleries and communicating with central shrine by covered passages and around this is a wall of galleries with towers at its four corners. Beyond this is an encloser measuring 850 by 1000 metres and surrounded by a wall of laterite and sand-stone. The whole was originally surrounded by a moat of 200 metres wide enclosing a total area of nearly a square mile. The sun rises in the east and sets in the west, thus on the basis of the Sun's movements the Earth's two major geophysical axes are based and the Khmer architects aligned their temples to accord with these axes. Numerous ancient Hindu texts state that the temple architecture must be in harmony with the universe. At the Angkor Wat the floor of the central sanctuary was raised 23 metre above the ground level, the tower symbolising union of King and the Divine. The moat around Angkor Wat is 200 m wide but extremely shallow and forms a sacred perimeter of water around the temple which separates the temple from the secular world. The laterite and sand-stone wall has been cut into large single entrances on the East, North and South and by a total of five entrances on the West. The moat that has a bridge which is used for the access to the temple is symbolic to the bridge of life, as mentioned in Hindu texts which is a separation between life and death and the realm of humans and celestial beings. The architectural focus of Angkor Wat is the central tower which isconnected to the gallery around it by roofed and pillared corridors on the East, North and South. It is rectangular in shape, the second and third terraced being setback to the east on the opposite side to the main entrance, thus lengthening the architectural perspectives along which the eyes travel to the cluster of terminal towers. Each terrace is surrounded by a gallery interrupted at intervals by pavilions, corner towers, decorated doorway, stairways and axial pavilions. The stairways leading from this courtyard to the second terrace are covered. Each platform is higher than the one below it so that the terraces avoid the appearance of being huddled one on top of the other. With Angkor Wat the temple mountain reaches its apex, the concentric galleries on each terrace, vaulted stairways and corridors and galleries of bas-reliefs. All depict the whole of Khmer art and its stylistic inspiration from the Mount Meru which is the centre of the Universe and the constant element of the Hindu cosmos.

CONCLUSION

Angkor Wat temple is an insightful accumulation of the religious philosophy of Hinduism the co-relation of the temple construction with Mount Meru speaks about the evolution of the architecture of the period on the basis of religious psychology. We can see the construction of the central tower which has several stages and eachsuccessive stage results in the increase in height which is similar to the concept of Mount Meru and the consecutive planes with the residing of different deities.**(Image C)** The concept of Horizontal and Vertical axis that was followed in the temple which is the moat that surrounded the temple with a bridge on it connecting it to the city horizontally whereas the central tower that vertically connected the temple to the planets and sky above, which mimics the mythical reference of Mount Meru a central axis around which the Cosmos itself revolves.

Sectional Perspective of Angkor Wat

Image C)

ACKNOWLDEGEMENT

I would like to express my sincere gratitude to Prof. Ar. Nishigandha Sakhardande for her invaluable guidance and encouragement. It was her keen and relentless indulgence that helped me reach the conclusion of my research.

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Design of Built Forms of Wind Responsive Skyscrapers through Dynamic Interactions

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Abstract: Population density is constantly increasing world-wide and India being projected as one of the world's most populous countries brings out the major issue of shortage of land for future generations. Therefore, there is a need for us to go for more verticality in structures for providing necessary spaces in limited land areas. Skyscrapers are now an indispensable resource and with it comes its design. The design of a building or a built form always governs a few parameters, both for aesthetics and the structure. For a skyscraper, the function of Wind, is a crucial factor to be considered as we are moving up in the atmosphere with greater wind pressures. Wind characteristics change with every region and every season, according to the topography, physiology, geography etc. Every built form acts or reacts to these characteristics in its own unique fashion. A built form is the result of the plan, the façade and the openings on the façade. A sphere will react to the wind like no cube will, a cube will act in a manner a pyramid never will. Every solid mass (building) either acts as a barrier, or facilitates the air movement in the required direction as per the form. Wind has been the most important aspect that needs attention while making new age structures of mega million projects reaching sky. The paper discusses various ways how wind and Architecture can together accommodate through proper design approach. It provides statistical data on wind characteristics at varying heights for different shapes and forms of buildings in Mumbai region and also discusses what design approaches, used in skyscrapers across the world, can be similar or dissimilar to those in Indian context. Computational fluid dynamics shows wind flow behavior for different geometrical configuration to draw attributes of the best form or shape.

Key words – Wind, Wind effect, Geometrical form, shape, flow, Skyscraper

INTRODUCTION

The Wind is air in motion relative to the surface of the earth. It varies with time and space. Due to unpredictable nature of wind, it is necessary to design the structure by considering the critical effect of the wind on the it. The motion of wind is always governed by the state of its surrounding conditions. The wind forces depend upon terrain and topography of location well as the nature of the wind, size, and shape of the structure and dynamic properties of the structure. As the wind encounters a structure, it exerts positive pressure on the windward face.

Every physical conformation of a building will react to wind flow lines in distinctive manners. Some surfaces, planes or points would help deviate the flow lines or would converge them. Deviation in wind flow away from the building surface will always cater to reducing the velocity and therein the pressure on the building, which any design should aim at. Hence, fluid mechanics play an important part. It would be safe to say that a building standing tall in the atmosphere will experience the same kind of wind motion like that of a bird flying high in the sky. Just how an aerofoil shape was invented to cut through the wind passage for aeroplanes, taking influence from a bird. There can be a number of shapes and forms of buildings which work against wind.

The two very basic approaches of designing can be a static approach or a dynamic approach. Dynamic approach counters the static approach, assuming the buildings to be exceptionally tall, slender or vibration prone. These are methods generally used when the width to height ratio is 1:5 or above. The dynamic interaction between motion of the building and gusting of the wind increases effective wind loading. (Nirmal, 2017)

The paper will focus on the current designs for skyscrapers and effect of wind dynamics on them which are observed by placing 3D building models in simulation software having real-time wind conditions of Mumbai.

LITERATURE REVIEW

With the perfect and over the conventional correlation approach between Architecture and Engineering, has resulted in creating the landmark in the world. It is very important to understand phenomena of wind over the building form to counteract the wind pressure on the structure. Further, the design of tall buildings is not limited to wind sensitive design but rather using wind to the advantage of building.

The wind behavior can be classified into various phenomena. "Cross-wind" actions usually govern in design of very tall buildings; especially interference effects magnify these effects. Interference from buildings located in close proximity to the proposed building can cause large increases in cross-wind responses. The designer should not only consider the existing conditions but make allowance for future changes in the surrounding area during the design life of the structure. There are several different phenomena giving rise to dynamic response of structures in wind. These include buffeting, vortex shedding, galloping and flutter. Slender structures are likely to be sensitive to dynamic response in line with the wind direction as a consequence of turbulence buffeting. Transverse or cross-wind response is more likely to arise from vortex

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shedding or galloping but may also result from excitation by turbulence buffeting. Flutter is a coupled motion, often being a combination of bending and torsion, and can result in instability. For building structures flutter and galloping are generally not an issue. (J. & B., 2007)

The wind response is largely determined by building shapes. Buildings with rounded forms, rather than rectangular forms with flat surfaces, offer less wind resistance (Figure 1). Tall buildings that are short in horizontal dimensions are more critical for overturn and possibly for the total horizontal deflection at their tops (Figure 2). Open-sided buildings or buildings with forms that cup the wind tend to catch the wind, resulting in more wind force than that assumed for the general design pressures.(Figure 3)

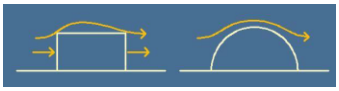

Figure 1 Wind action on built forms

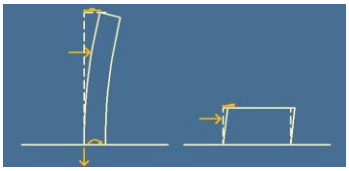

Figure 2 Wind action on different height of buildings

Figure 3 Wind action on semi-open built forms

Source: International Research Journal of Engineering and Technology (IRJET)

The plan form of a building affects the airflow around and through it. It could either aid or hinder the natural flow of wind. Physical obstacles in the path of airflow create pressure differences. This causes a new airflow pattern. Air tends to flow from high pressure areas. Knowing the direction of air movement, the plan form can be determined also as to create high pressure and low pressure areas. Building openings connecting the high pressure areas to low pressure areas would cause effective natural ventilation. (Nirmal, 2017)

Figure 4 Wind Action on various building plan forms

Source: International Research Journal of Engineering and Technology (IRJET)

Aerodynamic shaping at the concept stage of the building could significantly reduce the wind loads. The wind can be "disturbed" by changing the building shape along the height such as tapering or twisting thus reducing the synchronization and correlation of fluctuating excitations. (P.Mendis)

Some modifications on cross-sectional shape such as slotted, chamfered rounded corners, and corner cuts on a rectangular building can have significant effects on both along wind and across wind responses of the building to wind (KWOK, 1995) as in Taipei 101. Corner modifications in Taipei 101 provide 25% reduction in base moment when compared to the original square section (IRWIN, 2006) Chamfers of the order of 10% of the building width, makes 40% reduction in the along wind response, and 30% reduction in the across wind response when compared to the rectangular cross sectional shape without corner cuts. Excessive rounding of corners of the cross section, approaching a circular shape in the cross section, and cylindrical form in the building, significantly improve the response against wind. In the study of Davenport (1971), peak deflection of the model in circular cross-section was about half of the one with square cross section where the building models were representative of roughly 70 storey structures. Addition of openings completely through the building, particularly near the top, is another very useful way of improving the aerodynamic response of that structure against wind by reducing the effect of vortex shedding forces which cause across wind motion. (GÜNEL, 2007)

METHODOLOGY

TYPE OF RESEARCH: Qualitative and Quantitative Research

- To perform virtual wind tunnel tests through simulation on form of buildings for studying its behaviour towards wind flow.
- To study Live and Book Case Studies to understand problems, Mistakes and Solutions.
- To have a comparative analysis between different skyscrapers in Mumbai region and draw conclusions for optimum design solutions.

HYPOTHESIS: The form for the building will taper from its lowest floor to its highest floor for all built forms.

CASE STUDIES

Book Case study 1 : Burj Khalifa, Dubai

Architects: Skidmore, Owings and Merrill (S.O.M.)

Facility: Mixed use, basically Residential.

Features: 521 m, desert rose shaped plan.

Size: 37,00,000 m2

LOCATION:

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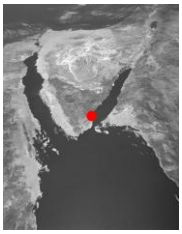
Coordinates: 25°11′49.7″N 55°16′26.8″E



Source: http://faculty.arch.tamu.edu/media/cms_page_media/4433/burjdubai.pdf

TERRAIN: COASTAL

PREVAILING WIND DIRECTION: The building has essentially 6 wind directions. 3 of these are when the wind directly blows into a wing. The other 3 directions are when the wind blows in between two wings. These wind directions were borne in mind when orienting the tower to the most strong wind directions for Dubai: north west, south and east. (Figure 5)

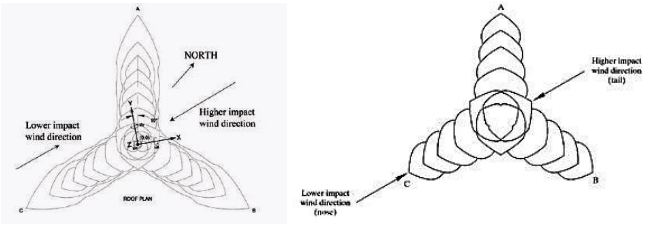


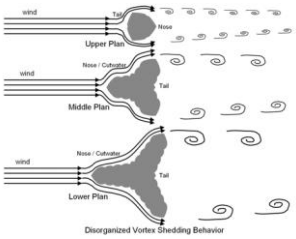
Figure 5 Wind direction in plan

Source:http://faculty.arch.tamu.edu/media/cms_page_media/4433/burjdubai.pdf

TOWER FORM: The floor plan of the Tower consists of a tri-axial, Y-shaped plan, formed by having three separate wings connected to a central core. As the Tower rises in height, one wing at each tier "sets back" in a spiraling pattern, further emphasizing its height. The result is 24 different primary floor plates (plus some less major variations), creating a stepping geometry that presents multiple building widths over the height of the building, providing an environment that "confuses the wind"—the wind vortices never get organized, because at each new tier the wind encounters a different building shape. Starting from a slender top, the building spreads out as the gravity and wind forces accumulate. As a result, even though the global forces are large, the forces in the individual members are not.

Several revisions to the building were made. Some were related to the geometry of the Tower: the size and shape of the wings were the setbacks changed throughout the process, as were their locations: the original massing had the setbacks occurring in a spiralling counter-clockwise pattern, which was revised to be in a clockwise direction. Taken together, these measures had a significant impact in encouraging disorganized vortex shedding over the height of the Tower. Another revision was related to the orientation of the building.

The Tower has six important wind directions, all parallel to the major axes of the wings—three directions where wind is blowing into the "nose" of each wing, and three directions where wind is blowing into the "tail" of each wing at the center of the building (Figure 6). The orientation of the Tower was then selected to better accommodate the most frequent strong wind directions for Dubai: northwest, south, and east.



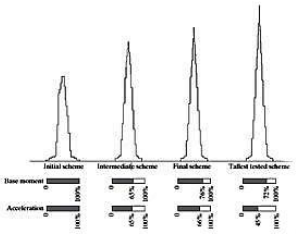


Figure 6 Tower Wind Behavior **Figure 7 Improved wind behavior**

Source: http://www.civil.ist.utl.pt/~cristina/EBAP/FolhasEdifAltos/burj-dubai/160.pdf

Book Case study 2 : Taipei 101, Taiwan

Architects: C Y Lee & Partners

Facility: Commercial Office tower

Features: 508 m, Square Plan with Static form

Size: 3,57,719 m2

LOCATION: Taiwan

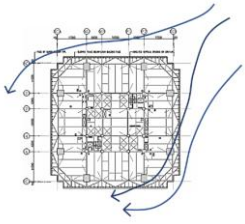
Coordinates: 25°2′1″N 121°33′54″E

Here a typhoon with 100 year return period brings winds of 43.3 m/sec (97 mph) averaged over 10 minutes at a height of 10 m (33 ft). This is similar to a three-second gust of 67 m/sec (150 mph).

Source: google earth

TERRAIN: COASTAL

PREVAILING WIND DIRECTION: North East to South West



Source: http://ctbuh.org/papers

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TOWER FORM: The W-shaped corners minimises the wind load on the structure. Building Vertical Shaping: The repeating modules were inspired by the joints of indigenous bamboo and the tiers of pagodas; each module has a narrower base and a wider top as if a flower opening to the sky. Each module has eight floors, and eight modules form the majority of the tower's height. In the Chinese spoken in Taiwan, 'eight' is a homonym with 'wealth,' making it a very appropriate feature for a financial center. A ninth module that tops the main shaft and supports an architectural spire has a smaller footprint but matching wall slopes. Below the repetitive flared modules, a 25 story base shaped as a truncated pyramid provides improved overturning resistance and lateral stiffness (Figure 8).

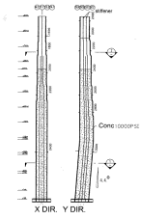


Figure 8 Source: http://ctbuh.org/papers

Plan Shaping for Wind: The challenge was a high wind environment. Tall, slender chimneys and skyscrapers experience alternating crosswind forces due to vortex shedding: wind passing the object separates from side faces in alternating whirlpools. When vortex formation set by wind speed and building dimensions coincides with building period, large forces can result. It can excite a skyscraper with crosswind forces much greater than those normally used for design. During a wind tunnel visit by C.Y. and the authors, RWDI demonstrated that a square tower with sharp corners creates large crosswind excitation. Rounded and chamfered (45o) corners reduced lateral response, but a 'saw tooth' or 'double notch' corner with 2.5 m (8.2 ft) notches achieved a dramatic reduction. See Figure 9. Architect Lee understood the significance of this shape and incorporated it into the upper module corners from that point on. See Figure 10.

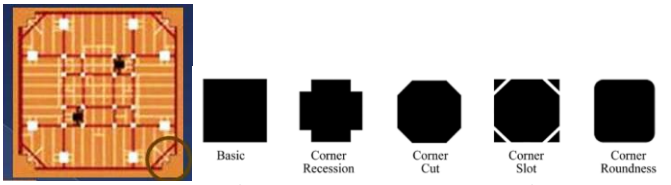


Figure 9 Corner Modification Source: The Role Of Aerodynamic Modifications In The Form Of Tall Buildings Against Wind Excitation (H. Emre Ilgin And M. Halis Günel)

a) b)

Figure 10 a) The Taipei 101 profile shows a truncated pyramidal base topped by eight, 8-story flaring building modules, a narrower equipment/observation deck module and a steel-spined spire. b) A close-up of the tower corner clearly shows the 'sawtooth' treatment above Floor 25 for wind vortex reduction. Source: http://ctbuh.org/papers

Book Case study 3 : The Gherkin, London

Architects: Foster and Partners

Facility: Commercial Skyscraper

Features: 180 m, Circular Plan with Bullet shaped elevation

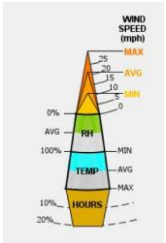
Size: 47,950 m2

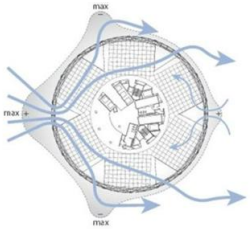
LOCATION:

Coordinates: 51°30′52″N 00°04′49″W

TERRAIN: Plain rough terrain

PREVAILING WIND DIRECTION:





Source: Foster + Partners

TOWER FORM: The overall cylindrical shape allows for the wind to move around the building. It breaks the hierarchy of solid rectangular boxes in the vicinity. Offers minimal resistance to wind, improving the environment for people on the ground and reducing the load on the building. The slim base reduces the reflections and increases daylight penetration. The bullet shaped building responds to specific demands of small site area. The design provides column free floor space, light, views, and incorporates many sustainable building design features. Atria between the radiating fingers of each floor link together vertically to form a series of informal break out spaces. These loads are all absorbed through the glass façade and eventually transferred to the diagrid. The pressurized air from the wind passes into the building through a natural ventilation system, which is incorporated through a double skin. There are open shafts built in between each floor that act as ventilation for the building and they require no energy for use. The shafts pull warm air out of the building during the summer and use

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passive heat from the sun to bring heat into the building during the winter. These open shafts also allow available sunlight to penetrate deep into the building to cut down on light costs. It has been said that 30 St. Mary Axe uses only half of the energy that a similarly-sized tower would use.

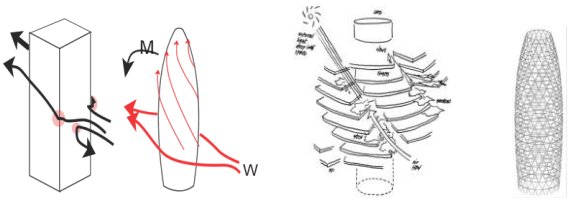


Figure 11 Wind interaction with form Source: Foster + Partners

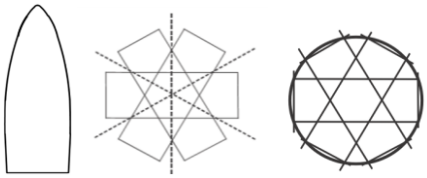


Figure 12 Massing, symmetry and geometry Source: Foster + Partners

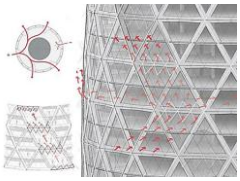


Figure 13 Wind flow lines trail the spiralling grooves around the aerofoil geometry Source: Foster + Partners

ANALYSIS OF CASE STUDIES

From the above three case studies it is for said that the design of a geometrical form requisite wind dynamics. A flow line will always be associated with the major or minor modifications in the shape, may be in the plan form or in the section form. Understanding the parameters like Location. Terrain, Prevailing wind conditions and the Tower form (in plan and in section) are necessary to gain a few ideas while planning or designing a skyscraper. Different locations have different effect of winds on the built form.

DATA COLLECTION AND ANALYSIS

In case of the Indian sub-continent, considering the Mumbai region, which has an ever increasing potential for construction of skyscrapers, the following analysis has been done. The wind-rose diagram of Mumbai given below shows the wind direction to be from South-West to North-East.

Figure 14 Wind Rose Diagram of Mumbai

Basic Wind Speed of Mumbai = 39m/s

In table 1 given below, the graphs showing the relationship between the wind pressure and height have been calculated by the formula,

Vz = Vb x K1 x K2 x K3 x K4

Where,

Vz = Design wind speed at height z

Vb = Basic wind speed (Mumbai)

K1 = Probability Factor (risk coefficient)

K2 = Terrain Roughness and Height Factor

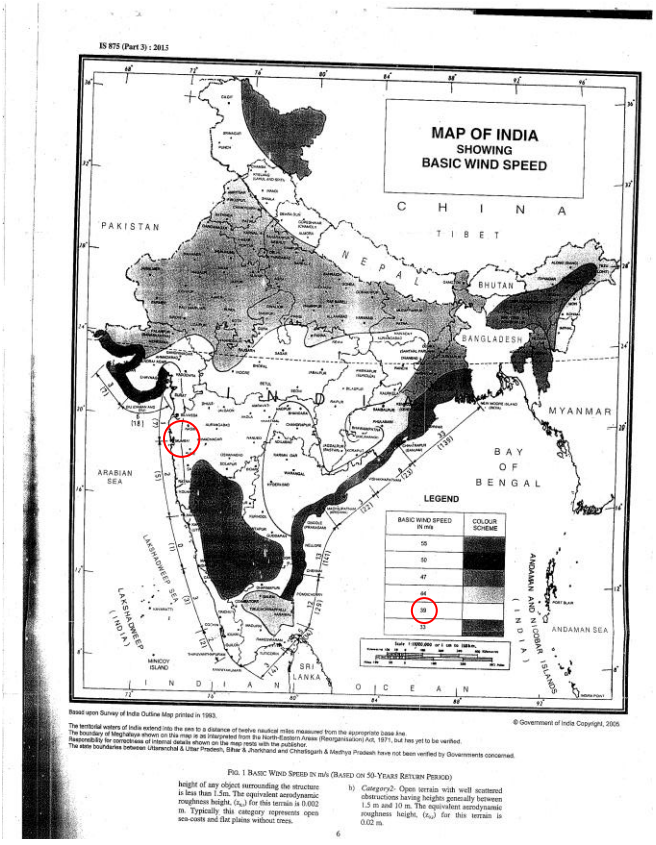
K3 = Topography factor

K4 = Importance factor for the cyclonic region

Wind Pressure

Pz = 0.6 Vz^2

IMPLEMENTATION OF STANDARDS (NBC/DC)



Source: Design Loads (Other than Earthquake) for buildings and structures- code of practice

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6.3 Design Wind Speed (V_z)

The basic wind speed (V_b) for any site shall be obtained from Fig. 1 and shall be modified to include the following effects to get design wind speed, V_z at any height z, for the chosen structure:

a) Risk level,
b) Terrain roughness and height of structure,
c) Local topography, and
d) Importance factor for the cyclonic region.

It can be mathematically expressed as follows:

$$V_z = V_b k_1 k_2 k_3 k_4$$

where

V_z = design wind speed at height z, in m/s;
k_1 = probability factor (risk coefficient) (*see* 6.3.1);
k_2 = terrain roughness and height factor (*see* 6.3.2);
k_3 = topography factor (*see* 6.3.3); and
k_4 = importance factor for the cyclonic region (*see* 6.3.4).

This is the criterion for measurement of regional basic wind speeds and represents airfields, open park lands and undeveloped sparsely built-up outskirts of towns and suburbs. Open land adjacent to sea coast may also be classified as Category 2 due to roughness of large sea waves at high winds.

c) *Category 3* — Terrain with numerous closely spaced obstructions having the size of buildings/structures up to 10 m in height with or without a few isolated tall structures. The equivalent aerodynamic roughness height, ($z_{0.3}$) for this terrain is 0.2 m.

This category represents well wooded areas, and shrubs, towns and industrial areas full or partially developed.

It is likely that the, next higher category than this will not exist in most design situations

Table 1 Risk Coefficients for Different Classes of Structures in Different Wind Speed Zones
(*Clause* 6.3.1)

SI No.	Class of Structure	Mean Probable Design Life of Structure in Years	k_1 Factor for Basic Wind Speed m/s					
			33	39	44	47	50	55
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
i)	All general buildings and structures	50	1.0	1.0	1.0	1.0	1.0	1.0
ii)	Temporary sheds, structures such as those used during construction operations (for example, formwork and false work), structures during construction stages and boundary walls	5	0.82	0.76	0.73	0.71	0.70	0.67
iii)	Buildings and structures presenting a low degree of hazard to life and property in the event of failure, such as isolated towers in wooded areas, farm buildings other than residential buildings	25	0.94	0.92	0.91	0.90	0.90	0.89
iv)	Important buildings and structures such as hospitals communication buildings/towers, power plant structures	100	1.05	1.06	1.07	1.07	1.08	1.08

Source: Design Loads (Other than Earthquake) for buildings and structures- code of practice

6.3.3 *Topography (k_3 Factor)*

The basic wind speed V_b given in Fig. 1 takes into account the general level of site above sea level. This does not allow for local topographic features such as hills, valleys, cliffs, escarpments, or ridges which can significantly affect wind speed in their vicinity. The effect of topography is to accelerate wind near the summits of hills or crests of cliffs, escarpments or ridges and decelerate the wind in valleys or near the foot of cliffs, steep escarpments, or ridges.

6.3.3.1 The effect of topography shall be significant at a site when the upwind slope (θ) is more than about 3°, and below that, the value of k_3 may be taken to be equal to 1.0. The value of k_3 is confined in the range of 1.0 to 1.36 for slopes more than 3°. A method of evaluating the value of k_3 for values more than 1.0 is given in Annex C. It may be noted that the value of k_3 varies with height above ground level, at a maximum near the ground, and reducing to 1.0 at higher levels.

Table 2 gives multiplying factors (k_2) by which the basic wind speed given in Fig. 1 shall be multiplied to obtain the wind speed at different heights, in each terrain category.

Table 2 Factors to Obtain Design Wind Speed Variation with Height in Different Terrains
(*Clause* 6.3.2.2)

SI No.	Height z	Terrain and Height Multiplier (k_2)			
	m	Terrain Category 1	Terrain Category 2	Terrain Category 3	Terrain Category 4
(1)	(2)	(3)	(4)	(5)	(6)
i)	10	1.05	1.00	0.91	0.80
ii)	15	1.09	1.05	0.97	0.80
iii)	20	1.12	1.07	1.01	0.80
iv)	30	1.15	1.12	1.06	0.97
v)	50	1.20	1.17	1.12	1.10
vi)	100	1.26	1.24	1.20	1.20
vii)	150	1.30	1.28	1.24	1.24
viii)	200	1.32	1.30	1.27	1.27
ix)	250	1.34	1.32	1.29	1.28
x)	300	1.35	1.34	1.31	1.30
xi)	350	1.35	1.35	1.32	1.31
xii)	400	1.35	1.35	1.34	1.32
xiii)	450	1.35	1.35	1.35	1.33
xiv)	500	1.35	1.35	1.35	1.34

NOTE — For intermediate values of height z in a given terrain category, use linear interpolation.

6.3.2.3 *Terrain categories in relation to the direction of wind*

The terrain category used in the design of a structure may vary depending on the direction of wind under consideration. Where sufficient meteorological information is available, the basic wind speed may be varied for specific wind direction.

6.3.2.4 *Changes in terrain categories*

The velocity profile for a given terrain category does not develop to full height immediately with the commencement of that terrain category but develop

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Source: Design Loads (Other than Earthquake) for buildings and structures- code of practice

The Wind flow lines for the five buildings have been derived from the observations through virtual wind tunnel test by simulation.

3.2.1 Live Case study 1

IMPERIAL TOWERS

Architects: Hafeez Contractor

Facility: Residential Skyscraper

Floor count: 2 x 60

3.2.2 Live Case study 2

PALAIS ROYALE

Architects: Talati Panthaky Associates

Facility: Residential Skyscraper

Floor Count: 88 floors

3.2.3 Live Case study 3

NAMASTE TOWER

Architects: WS Atkins Plc

Facility: Mixed-Use Skyscraper

Floor Count: 63 floors

3.2.4 Live Case study 4

PLANET GODREJ

COMPARATIVE ANALYSIS OF CASE STUDIES

Table 1 Comparative analysis studying various parameters for design

Architects: DP Architects

Facility: Residential Skyscraper

Floor Count: 51 floors

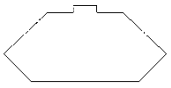
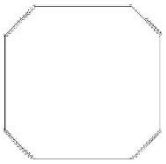
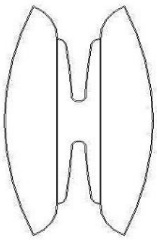
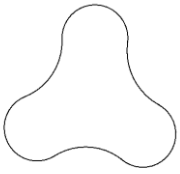
3.2.5 Live Case study 5

WORLD ONE

Architects: Pei Cobb Freed & Partners

Facility: Residential Skyscraper

Floor Count: 117 floors

PARAMET-ERS	IMPERIAL TOWERS	PALAIS ROYALE	NAMASTE TOWER	PLANET GODREJ	WORLD ONE
Geometric Form in Plan	 A squeezed hexagonal shaped plan.	 An octagonal shaped plan with 4 diagonal sides shorter than the rest 4. Also has a balanced geometry.	 An organic form, consisting of two concave surfaces at a short distance acting like capillary.	A slight curve which is concave in nature but is an open form.	 An organic form, developing from a basic triangle, spreads in 3 different directions acute to each other.

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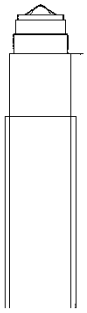
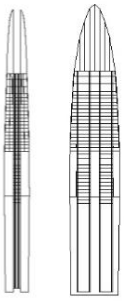
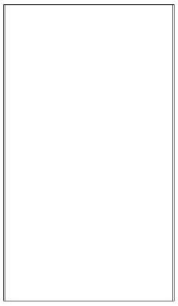
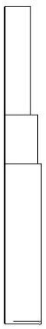
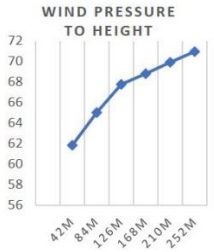
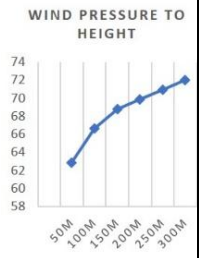
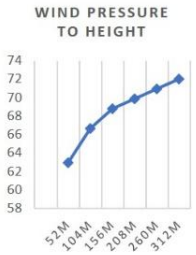
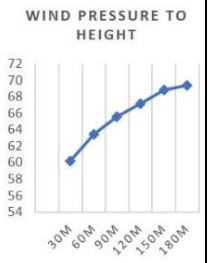
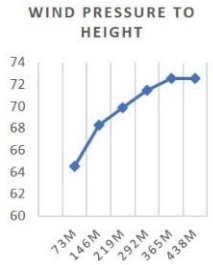
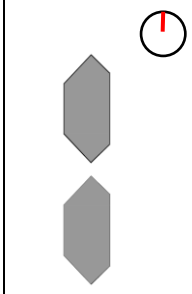
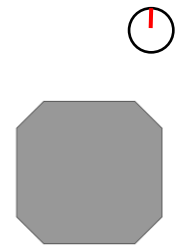
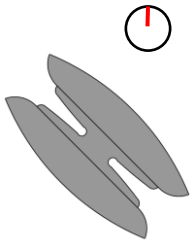
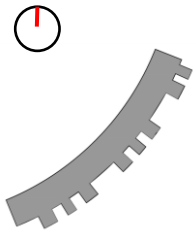
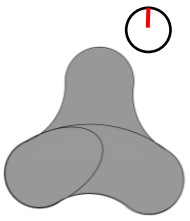
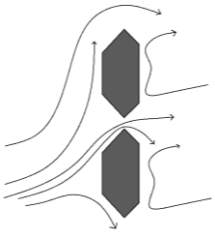
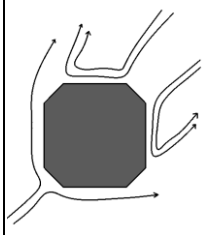
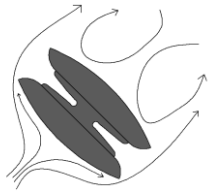
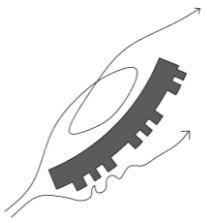
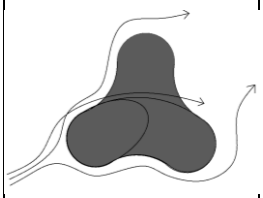
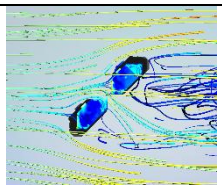
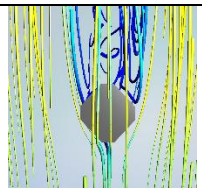
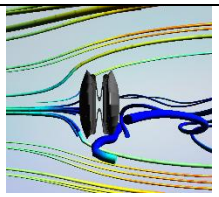
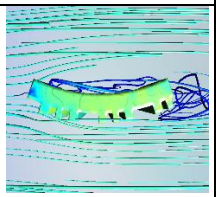
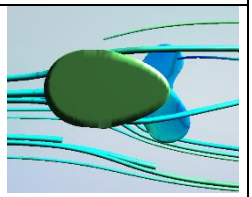
Geometric Form in Section	 Observed setbacks in section. Reducing nature as we move upwards in height.	A regular rectangular shape in section with no setbacks or tapering towards top. Is slender in section.	 An aerofoil shape. Width of a floor first increases slightly then descreases gradually towards the top.	 Rectangular in section.	 Rectangular section in a plane having setbacks.
Total height	254 M (833 ft.)	320M (965 ft.)	316 M (1037 ft.)	181 M (594 ft.)	442 M (1450 ft.)
Wind pressure at various heights					
Orientation					
Effect of Wind Dynamics					
Simulation Plan					

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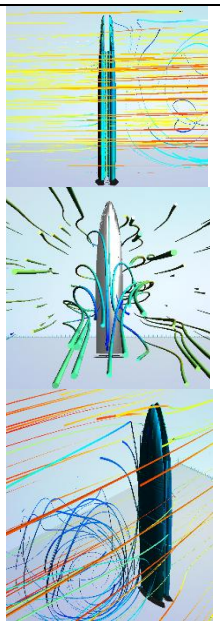
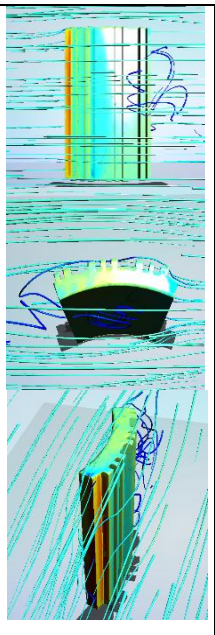
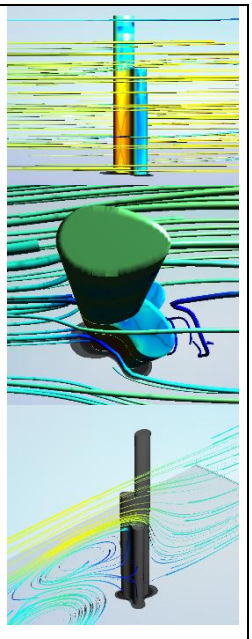
Elevation View					

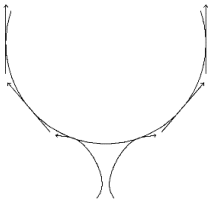


Figure 15 Tangential Flow Lines

CONCLUSION

With these examples already in place it is believed that Architecture is not limited to designing spaces but go hand in hand with different fields of engineering. The 'tapering' effect is utilized by creating smaller surface areas at higher levels and reducing the upper level plans, and thus mitigating the wind load. The more sculptured a building's top, the better it can minimize the along wind and across wind responses. While reducing the plan areas at the upper level by 'varying the shape' of the building along its height, minimizes the wind forces by causing the wind to behave differently, preventing it from becoming organized, as in case of the Burj Dubai Tower. Aerodynamically favorable forms are preferred. Some modifications on cross-sectional shape such as slotted, chamfered rounded corners, and corner cuts on a rectangular building, can have significant effects on both along wind and across wind responses of the building to wind, as in Taipei 101.

A curved shape of the building in plan, when the approaching wind direction is towards the concave side of the building, will give a thrust which is tangent to the surface and hence comes in less contact with it allowing the flow lines to deviate. Material of the façade also plays an important role in such cases.

Through the graphs in the table given above it is inferred that the height to wind pressure relationship forms a parabolic curve i.e. as the height of the building increases the wind pressure increases but with a decreasing rate. It is known that, Pressure = Force/Area which implies, pressure is inversely proportional to area. Therefore, it can be said that along with the decrease in plan area of a building for greater heights, a reduction in the height of each floor as when moving upwards gradually, the overall surface area in contact with the wind pressure will decrease hence, reducing wind loads.

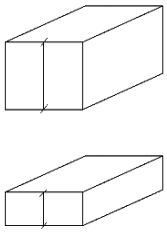


Figure 16 Height reductions

Every building mass under the influence of wind shows high wind pressure surface at the leeward side and a low wind pressure surface at the windward side in the simulation. Reduction in the area or nulling it out at the leeward surface, can cut down on the higher wind loads.

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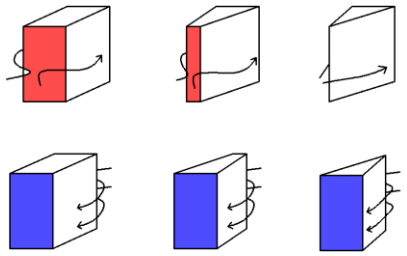

Figure 17 Reduction in negative wind pressure

A hexagonal shaped plan has the least workability towards wind dynamics which can be observed through the case of Palais Royale. Also, in case of Imperial Towers two buildings placed at a short distance from one another create a narrow passage for the wind to pass in between them, thereby increasing the velocity of the wind at critical junctions.

In case of Planet Godrej, a loop formation is observed at the inner side of the concave surface. We know, as the acceleration of a particle increases, the radius in which it moves increases hence, for smaller acceleration, radius needs to be small. Minimalization of the radius can be achieved by increasing the concavity of the form. The grooves or offsets are positive assets of wind resistance. They trap the wind flow and deviate them in the required direction. A triangle and a curve respond to wind optimally. The geometric form of the World One tower is significant which combines both.

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I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. Shreyas Paranjape for his valuable guidance, inspiration and encouragement. His keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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Role of Courtyard as a Model for Micro Climate Modifier in Hot and Dry Climate

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Abstract : Factors like global warming, pollution and consumption of fossil energy have encouraged the need of sustainable development. Increasing rate of global warming, led to the increase in demand for passive cooling techniques. Courtyard is the one of the most significant feature used in buildings for passive cooling. Courtyard being originated from hot and dry region plays a very important role in maintaining the thermal comfort and microclimate of the building. It is an open space surrounded by cluster of rooms. This paper attempts to explain literature study of the role of courtyard in maintaining the micro climate of a structure in hot and dry region. The main objective of the research is to understand the effects of courtyard geometry on the changing nature of the micro climate of a building in hot and dry region. Further can also be established guidelines for efficient courtyard design in different types of buildings.

Keywords:**Courtyard, micro climate, orientation, geometry, passive cooling technique, thermal comfort, hot and dry region.**

1. INTRODUCTION

Due to the increase in debates on climate change and sustainability in different regions, sustainable and green building constructions have been on the rise. Building design forms must not ignore atmosphere contemplations. An elective way to deal with the manner in which the buildings are designed is expected to enhance the environmental performance of buildings and limit their expense of running it, which could incorporate power and water utilization.

Courtyard is a universal design element which has been tried for several times of years all around the world.The use of courtyard as an integrated means of architecture in different building around the world has been dated back to centuries ago.Courtyardis a building element that is originated from the hot and dry region. It is basically an enclosed area surrounded by a building or walls and opens to the sky [fig.01].

Figure 01: Basic courtyard sketch

Courtyards are common architectural patterns throughout many periods of history and in many regions. They are referred as a micro climate modifier, which may improve thermal comfort conditions in the enclosed as well as the attached built volume. It is an architectural design element commonly applied in tropical buildings for its social, environmental and therapeutic potentials.It is influenced by social, economic, cultural and environmental conditions.Most households have employed the courtyard for different purposes and activities. The courtyard serves as a means to provide natural light, cool air, privacy as well as security to the surrounding spaces within the building.The courtyard system comes in different shapes and sizes depend on the size of the building and the region. It could be square shape, I-shape, rectangular shape, circular shape or amorphous etc. Courtyards as the open spaces of houses play the most critical and effective role in absorbing solar energy, so controlling sunshade -due to thermal comfort necessity- is really important in architectural system of buildings.Proportions, placement directions, materials and courtyard form play the major role indetermining the solar energy amount on various surfaces of courtyard and providing visual and thermal comfort for residents.The courtyard building has been recognized as the representative building of the hot dry regions and a valuable answer to harsh climate. Solar radiation, as one of the most influential parameters of the hot and dry climate, can have an influence on the design.

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1.1 HOT AND DRY CLIMATE

Hot and dry climates are typically found between 15° and 35° north and south of the equator. In these locations, stable descending air and high pressure aloft create hot, arid, conditions with intense sunshine. Hot and dry climates are generally hot, sunny and dry year-round. Maximum daytime summer temperature goes as high as 45 degree centigrade and relative humidity as low up to 20 %.In this region, the wind is usually local. Whirlwinds, especially in the afternoons are associated with sand and dust. Sand and dust is another reason for employing courtyard building form in such areas; because it protects the courtyard building from whirlwinds.

2. METHODOLOGY

The conduct of the research paper is employed on the basis of two methodologies:

1) Unobtrusive: It includes library study on the concept of sustainable architecture, hot and dry climate and courtyards as passive cooling techniques, type of courtyard.

2) Literature case study: Three different buildings of hot and dry climate zones of world are selected for the case study. This study is carried out to identify the effects of orientation, proportion and geometry in each case. Selection process of cases was based on the following criteria:

a) Climate selection: The study was carried out for hot and dry climate zoneswhere there is largely unbroken sunshine for the whole year due to the stable descending air and high pressure aloft.

b) City selection: Two cities namely Rajasthan (India) and Negev (Israel) are selected from the hot desert climate regions. These regions witnesses strong whirlwinds with sand and dust.

Finally, all descriptive study both literature and library are integrated to propose a physical-environmental design model for courtyards, as a passive cooling strategy for future sustainable buildings in hot and dry climate. The model will be beneficial in the designing of different type of building in the similar climatic condition.

3. LITERATURE REVIEW

The literature study reviews the basic functions of courtyard and the sources of heat gain into the building.

3.1 SOURCES OF HEAT GAIN

Major heat input is subjected to the occupant's metabolic activity and from the use of artificial lighting and other appliances resulting in internal heat gain. The heat gain is also depends on building type. Solar radiation is another major source of heat gain. The incidence of solar radiation [fig.03] on external surface varies with time, location and site condition; however, its effect indoors strongly depends on the building design, orientation and the way spaces are used in the building. The courtyard geometry is related to the solar path and since the sun is the main source of heat and the solar radiation, being dependent on the altitude and latitude it is important to study. The basis of climate responsive design is to make use of such energies to maintain the thermal comfort inside the building, when the outdoor temperature is out of comfort level.

3.2 COURTYARD FUNCTIONS

Courtyard is the traditional pattern in hot and dry zones, where most of the openings face a well dimensioned interior open courtyard. This type not only allows protection against the sun but also privacy and protection against dusty winds and sandstorms.Literature study on courtyard in hot and dry climate suggests the various types of evaluation which proves that the orientation [fig.02] and the proportion are the two important factors for the change in the micro climate, as the orientation and proportion are directly or indirectly related to the heat gain and solar radiation of the building.A courtyard does not have a fixed plan. Usually they are rectangular or square, it can also be circular or curvilinear. In addition, the design form of courtyard can be fully enclosed (four sided), semienclosed (three sided) or in some cases even two sided.The design form of the courtyard plays a vital role as microclimate modifier to the environment.

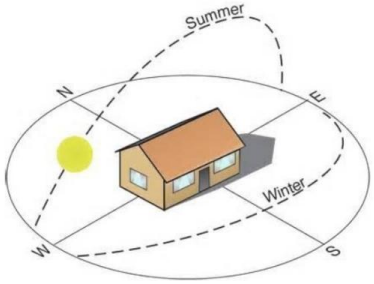

Figure 02: Orientation of the building according to sun path.

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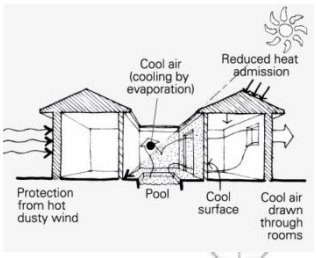
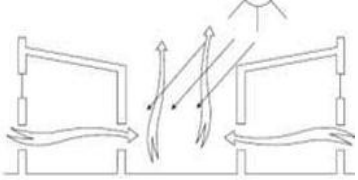


Figure 03: Working of Courtyard.



4. CASESTUDY

4.1 COURTYARD HOUSE BY AR. SANJAY PURI, RAJASTHAN, INDIA.

The design of the courtyard house is in correspondence to the hot and dry climate of the Rajasthan where strong dust winds and sandstorms are common. There are series of courtyard [fig.05] in the house but two of them are main courtyard [fig.04]. The two courts are linked by open corridors.

Figure 04: Site plan with one of the recessed space shading that area.

Sanjay Puri has said **"The layout of the Courtyard House is similar to the traditional "bhunga" houses of the Rajasthan villages where each room is an entity by itself."**All the functional spaces are radiating from the courtyard. The breaks are recessed which create shadow effect and cool down the living spaces in summers. The courtyards are oriented towards the north south direction so as to reduce the solar radiations on the elongated surfaces [fig.04]. These two main courtyards are completely enclosed on all four sides but the other small courtyards are semi enclosed, orienting towards the north direction and are highly recessed. These recessed spaces make houses much cooler inside than the outdoor environment [fig.06].

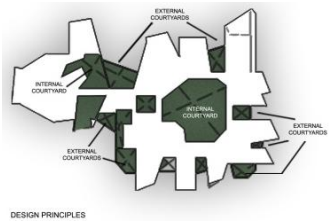


Figure 05: Placement ofcourtyards in the building

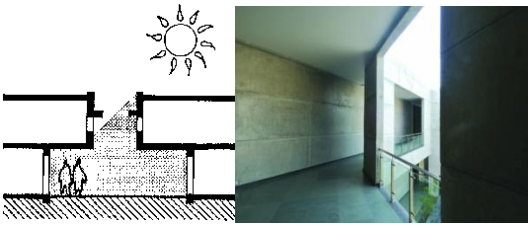


Figure 06: Effect of recessed corridors connecting different courtyards.

4.2 THE SEDE BOQER CAMPUS, NEGEV, ISRAEL.

This study took place at the Sede Boqer Campus, situated on the highlands (30.8^{o}N latitude, 500m altitude) the environmental conditions of the area includes frequent dust and sand storms, intense solar radiation and a very hot and dry wind blowing from neighboring deserts, usually carrying large quantities of dust, which result in the conditions above or below the comfort zone. Prevailing wind directions range from north to northwest.

Two courtyards that are chosen for the study are the part of complex of dormitories of the campus. They are intended to provide a comfortable open space for the occupants. The courtyards measure 5.5m x 21m in plan and are enclosed on three sides by continuous connected building whose height alternates between 2.6m to 3.1m. The open sides of the two courtyards are oriented towards different directions: one faces due south while the other faces west [fig.07].

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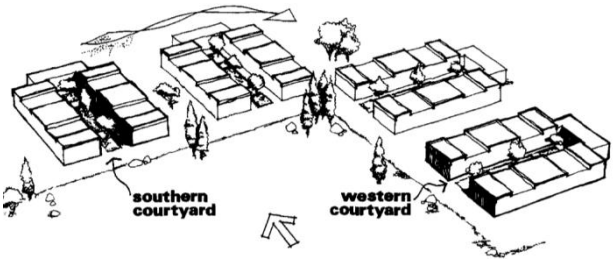

Figure 07: Lavout of the courtvards

The temperature in the courtyards is monitor during the hot periods of the season. The data summarized below are based on the measurement periods. In the afternoon hours the temperature recorded in the west facing courtyard is higher by 2-4^{o} C than the south facing courtyard. The variation in the thermal behavior observed in the two courtyards may be clearly related to the effects of geometry: the difference in orientation creates a certain lack of symmetry in relation to both solar exposure of the courtyards during the day and wind exposure throughout day and night.This greater contribution of direct solar radiation appears to be a significant factor in the accelerated heating of the west courtyard.The lack of shading [fig.08] is in itself a significant factor in determining thermal comfort, due to the increased exposure of inhabitants to direct sun. During the afternoon time strong winds were observed from the west-northwest. These winds caused accelerated exhaust of the hot air which was enclave in the western courtyard, but did not affect the southern one. Thus the attenuation of wind flow in the narrow direction of the courtyard is clearlyobserved.

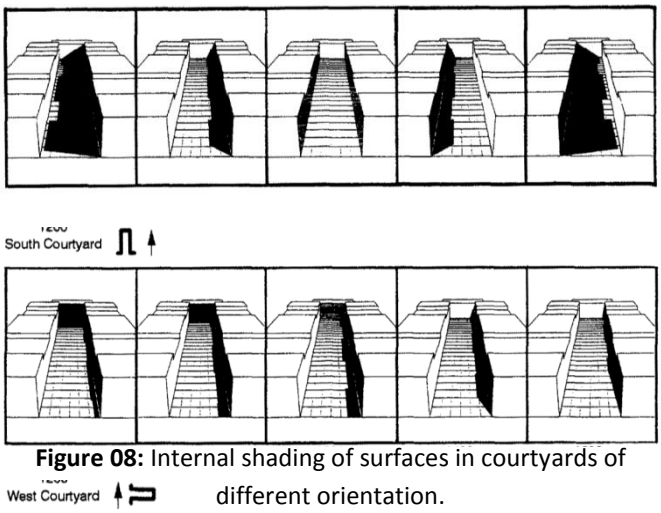

Figure 08: Internal shading of surfaces in courtyards of different orientation.

5. ANALYSIS

The case studies carried out in different areas of the world with different types of building tells that the in both the cases the microclimate is affected by the orientation of the courtyards. In the courtyard house of the Rajasthan the geometry of the courtyards are unusual than the other forms like square or rectangle which are so designed that the connecting passages between the courtyards are recessed which allows the creation of shadow inside the building resulting in the decrease in the temperature. On the other hand in the case of Sede Boqer campus the geometry of the two semi-enclosed spaces influence their thermal behavior to a decisive extent. The difference in the indoor and outdoor temperature of the building is observed to be very less. The creation of microclimatic conditions poorer than those outside the attached courtyard may prove to be of negative influence on the thermal behavior of the enclosing built volume. From the above case studies it is observed that the type of the courtyard is also an important factor along with the orientation and geometry of the courtyard.

5.1 MICROCLIMATE MODIFIER

Above case studies help in knowing the role of courtyards as micro climate modifier. Courtyards are useful in maintaining the thermal comfort inside the building only when the building is designed keeping in mind the orientation, type and geometry of the courtyard. It reduces the temperature by 3-4^{o}C inside the building in summer. In this way it helps in maintaining the microclimate of the building.

6. CONCLUSION

This paper describes a research effort that contributes towards understanding the characters of courtyard designs. The amount of solar rays received on the courtyard building surfaces has a great influence on the produced heat in courtyard buildings.Courtyard in buildings have almost the same design criteria in all the climatic zones but the appropriate form, dimensions and proportions are dependent on the climatic characteristics of each zone. Air movement and day lighting performances in the courtyard buildings are dependent on its design variants such as; form, size, area, orientation, shading devices, vegetation etc. All these factors contribute to the courtyard's role in maintaining the microclimate of the building.

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Understanding Change and Continuity in House Form: A Case of Sirohi

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Abstract: The interplay of culture–climate and architecture has been a theme most widely accepted and researched by scholars time and again. Rajasthan, for its rich architectural heritage owing to its culture and tradition, in a particularly hot and dry climate has been most appropriate to examine this relationship. However, despite having rich architectural heritage Sirohi has remained quite unknown hence this paper tries to fill this gap by the study of houseform at Sirohi. The Study aims to comprehend the influence of cultural aspects, layers of change and continuity,on the architecture of this town.The Scope of the paper has been limited to three houses of a community.

Keywords: Architecture of hot and dry climate, settlements of Sirohi, change and continuity, house, culture, organization.

INTRODUCTION

The built form in traditional architecture is a product of culture, social beliefs, time, material and climate contributing to a sense of rootedness. The traditional architecture reflects this very concept across all scales i.e. - house, cluster, and city. A city at any time period is in a stage where something happens continuously. It can be seen as a manifestation of these layers at any period of time. Thus in the continual process of time, the city can be understood by examining the factors which lead to continuity and change.Traditional houses, those which are specific to a region and culture, and built with local ingenuity, criticallyprovide a sense of belonging and cultural identity. The house is a microcosm that satisfies not only our biological but also our "social and spiritual needs" (Jackson1952).

Hot and arid climate, along with the cultural patterns of Rajasthan has generated a particular kind of builtform in this region. The buildings are introverted and the courtyard is the most central space of the house and holds the surrounding spaces it is like a nucleus towardswhich all other things gravitate; its strength lies in its capacity to provide protection against climate.Though the larger *Havelis* have more ground area the scale of the courtyard is magnificently maintained. Rajasthan has remained famous for its rich architectural heritage reflecting its culture and tradition in, particularly hot and dry climates. Various cities of Rajasthan like Jaipur, Jodhpur, Jaisalmer, Udaipur, etc. have been studied. Sirohi despite having very traditional architecture it has not got due attention by the scholars.

House form and lifestyle of settlements in Rajasthan and India are undergoing a transition from traditional to modern. In recent timesSirohi has started expanding its old territory with new approaches. Also in the old part of town, many of the houses started to demolish to reconstruct. The present article focuses on the observed changes in architecture, typology of house-form and lifestyle, with a case of Sirohi. It brings together the multiple layers which are interlinked and part of community life; these layers can be identified as cultural beliefs, privacy, and status of women. These social systems are far more important than any physical restraint and have the greatest differentiating effect on the form of vernacular housing (Rapoport 1969). Thus Sirohi is the most pertinent case to study its traditional house form and identify the factors of continuity and change from the earliest to the present context.

AIM

The research aims to examine the factors of the formation of a house from the earliest point to the present, identify the continuing and changing factors with understanding the influence of change.

OBJECTIVES

- To document the traditional architecture of Sirohi.
- To analyse the organization of houses and understand the traditional pattern of house form in relation to habitants.
- To identify the tangible and intangible factors that sustain, modify and change house form.

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METHODOLOGY

The research has relied on primary and secondary sources for data collection and understanding of the different phenomenon. The initial research consists of library research from books, articles, thesis for understanding the aspect of culture and to know the history of Sirohi, Rajasthan. As a means to collect the data of the city, many historians, scholars and writers in the area were interviewed. The second stage is of documenting the chosen case studies which include measure draw, photo documentation, and informal interviews. The third stage includes the analysis of case studies to identify the factors in the formation of house form, examine the continuing, changing factors and influence of change.

CRITERIA FOR SELECTION OF CASE STUDIES

Sirohi town grown over 500 years has a much wider range of house forms, selection of case studies is based on-

- The age of house form to be from oldest to the newest.
- The location of house form in the settlement to be from closest to the palace to the gate of the town.
- House form to be from different communities to understand the organization and relation of community to house form and being of the same typological type.

SIROHI – History and It's Organisation

Sirohi, situated under Sirnava range was established in 1405 AD by Deora dynastythatbelonged to the Chauhan Rajputs. Name Sirohi comes from being situated under the Sirnava range. Thetown was located at the centre of the hill but due to the water stream coming from hill, the location of the town changed to the western edge of the hill in 1425 AD by Maharaja Sesmal which is the present town of Sirohi. Town shares boundary with Marwad in north and west, Palanpur in south and Mewad in East.The palace of town is situated on the topmost part on thenorthern part of thehill which is visible from a far distance. The oldest part of the Palace was built by Maharaja Akharaj. The present palace is the addition in the oldest part which was made in different time periods by successors of the Royal family. Close to the palace is a cluster of Jain temples known as Derasari which was made in 1577AD.

Town has two gates one at the north edge of town and others in the south. There are two primary roads, one starting from south gate to north gate and other bisects this from centre which connects to palace known as Palace road. These two primary roads are branched by secondary roads which further goes to tertiary. On the primary road from North gate till the Palace road is the main market which accommodates all the occupation of different communities residing in the town.The settlement is a mix of many indigenous communities that have evolved over a period of time. House form and its settlement pattern of each community have similarities and distinctions which can be seen clearly. At all the stages of growing social and cultural factors have been the primary forces of influence Castes residing in the town are Brahmin, Rajput, Jain, Mahajan, Charan, Mali, Darji, Sonar, Luhar, Suthar, Kumbhar, Nai, Dhobi, Gosai, Rabari and many more. All individual secondary and tertiary streets are of these different castes.

TRADITIONAL ARCHITECTURE OF SIROHI

The traditional architecture of any place is reflected in its physical and cultural aspects, the factors of Sirohi in the formation of house form are as follows.

- Culture–Sirohi being a mix of many indigenous communities all of them follow the same pattern of belief on a larger scale with the addition of religious belief at each community level.Men are responsible for earning while women are associated with household activities. Each family being in 3 parts parent, children, and grandchildren interaction within the family with each other is much free and normal except the wife of the son, who can't talk to father of son directly and also interaction is very little. Females of the house usually use to cover their faces by sari when there is any male elder to them or any guest in the house. All the community holds a great belief and respect for God and Grain.
- Climate – Sirohi lies at 308m above sea level. The climate here is considered to be a steppe climate. Steppe is a dry, grassy plain. Regions have distinct seasonal temperature changes, with cold winters and warm summer.
- Material – The locally available materials in Sirohi are Stone, Wood and Achakal bricks which are locally made.

ORGANIZATION OF THE HOUSE

Spatial distribution at First Floor Level

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Spatial distribution at Ground Floor Level

0	Phela_ entrance
1	Por_ living room
A	Washroom
2	Haar_ chokdi- washing area, staircase, passage
B	Rasoighar_ kitchen
3	Aori for women_ room
4	MandirAori , Patar
C	AnajAori_ storeroom for grains
5	Chowk_ terrace
6	Aori_ bedroom
D	Kateri_ balcony

The traditional houses are essentially two storied – ground and first floor. The ground is organized with functional spaces divided into 4 parts and above has flexible, multipurpose activity spaces. All the houses have one entrance from the street and are linear in form.Staring with a sequence of the house from the ground.

Phela – The entrance of the house is the connection between house and street. It has raised a platform and staircase to enter the house. The raised platform is used by habitants and the outsiders for interaction with other houses nearby

Por – The first room in the house also called as bethak room is used by men of the house. Elder man of the house uses this space to sleep at night. Guests who come to a home, men are accommodated primarily in this space.

Har – The second part of the house after por is a transition space between men and women spaces of the house. Har word comes from local term heri which means street. This space has thethe service areas like kitchen, washing area, Paniara- drinking water, staircase. The space also has a cut in the slab it generally acts as a courtyard but the size of opening being small it seems to be a cut in the slab.

Rasoighar – Kitchen which is in the second part in the har is a small space with niches in the wall for storage. It has a small cut in the slab which allows smoke to pass out.

Aori for women – The third part of the house is a room that is used by women primarily. It has also had a cut in slab smaller than the one in Har. As it is being deep in the linear house this cut is made for light. This is the maximum used space on the ground floor.

Mandir and AnajAori – The fourth and last part of the house is for the need and belief of the house and holds a much important place. This space has a Temple and storage for grains. The space is also called patar for having a big box like container that stores a major amount of things that are used on the functions and occasions in the house. The room has no light or any opening for ventilation. As it has the most valuable things in the house it is placed in the deepest partand kept dark.

Washroom – This is placed in the por. All the streets have nala which are drains so washrooms are kept in the fast part which directly connects tothis drain.

Chowk – This is located on the above floor which spreads on the second and third parts of the house. It is the biggest part of the house. It doesn't have any specific function to it but is flexible enough to have any function or activity happen. It is also the most private place in the house visually and physically. Space also connects to lower floor by having two cuts on the floor of Har and Aori. This is the core space of the house.

Aori– Above floor have two Aori which are bedroom on both ends of the chowk. Aori towards the street side has kateri which is balcony which connects visually to the street.

The traditional house form of Sirohi is a pure formation by its cultural factors. The ground floor is more of functional spaces with the segregation of men and women area which is also because of visual street connection to show their culture of the house. The above floor is different from below as it again merges the segregation of men and women. The floor primarily allows the flexible and free interaction of family despite showing their culture. The ground floor is therepresentation of the cultural tradition of settlement whereas above floor is the representation of the family-culture which is identical to them. Traditional culture is visible to all whereas family culture is private and core to the family itself.

CASE STUDY

Tracing the Evolution of Houseform

Three case studies are documented to examine the evolution is house form and identify the continued tradition and changes in it.

House is organized in the same traditional sequence. The ground floor is divided into 4 parts with male area first with transition second third of the female room and fourth as mandir and storage. The first floor has chowk in the centre which is accessed by a staircase. Two rooms are attached on both sides of the chowk. House is compact and short in a linear direction compare to others. Chowk is divided into 2 parts. At present one room is attached above the chowk as per requirement. Except for painting of the house, there are no major changes seen in it.

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House 1: Located at Kothari pol (1910)

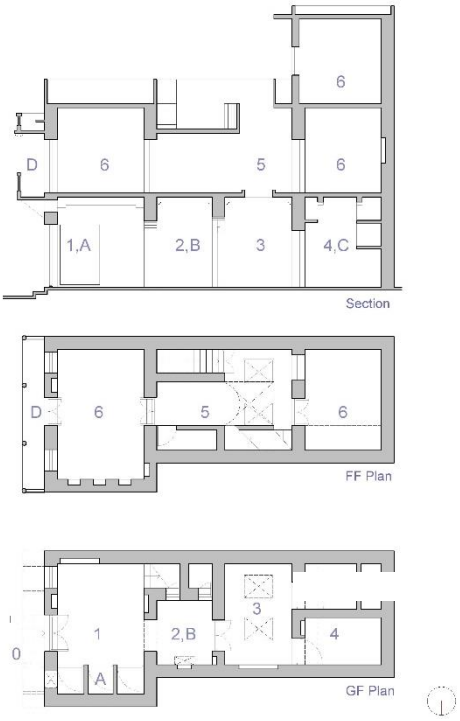

Fig. 1.1

Fig. 1.2

Fig. 1.3

House 2: Located at ChotiBrahmpuri (1975)

Fig. 2.1

House is organized in the same traditional sequence tracing from house 1. The ground floor is divided into 4 parts with male area first with transition second third of the female room and fourth as mandir and storage. The first floor has chowk in thecentre which is accessed by a staircase. Two rooms are attached on both sides of chowk. House is longest in the linear direction compare to others.Chowk is the longest part ofthe house having semi-open space. House is not used by the original owner of the house, is rented to a 'chipa; (tailor) family. House is used in the same cultural tradition by family. House used by tailor family women aori which is third part of the house is accommodated by sewing machine. Women being at homework on machine from 10 am to 6 pm. Men of the house have a shop in the market, who comes back home around 7 pm. The usage of rooms

Fig. 1.2

Fig. 1.3

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according to its cultural way is seen clearly when all the members of house are there. There is no change in the house.

House 2: Located at ChotiBrahmpuri (1975)

Fig. 2.2

Fig. 3.1

House organization is the same according to the tradition in the division of parts on the ground floor, but the functionality of each space has changed.Ground floor divided into 4 parts, 1st has staircase and washrooms and place to remove shoes, 2nd in the living room of the house, 3rd and 4th being majorly same divided with partitions of rooms have a kitchen, storage, mandir, and room. First floor is again divided into 4 parts as in ground floor 1st being same as below as service area having washroom, washing area and drying space for clothes, 2nd is again a type of living room as below attached with a room, 3rd is made with an idea of chowk but is covered with slab and is much similar to room and 4th part is divided into two parts. There are two more rooms made on the third floor. The ground floor is primarily used, the first floor is used by children'

House 3: Located at Sengali Market (2016)

Cultural Changes and House form

The traditional culture of house formation has continued in the same sequence from house1 to house2 where the ground floor is organized with sequential functional spaces and with segregation of men and women and above floor having chowk as a core multipurpose space. Thinking of the family in the settlement was very simple and similar to having an interactive simple life in being with the cultural pattern of the society. To its solution, each house had chowk which was very simple, plain but capable of catering multiple opportunities in it and served to any member of the house. Tracing the sequence from house2 to house3 there are visible changes and continuity in the thinking of society. The ground floor has remained the same in the division of 4 partsbut only in the terms of organization. Part1 instead of being por which was the main area of male and for guests, here it became an empty space with staircase, washroom, and space to remove shoes. There is a new element of the water tank which is added in this part which changed the function of space. Thus here thinking of the services changed the space organization. Part2 here became the living room from har which was the transitional space in the house. Part3 and Part4 being majorly one with some internal walls have a kitchen, store, temple room, and a room. Thus the ground floor being culturally functional spaces and segregation with transition has become too simple division and workable space. The first floor in the house1 and 2 are entered from har on the ground floor and opened in chowk whereas here it is accessed frompart1 of the house which is service area and open again to a service area. There is kateri towards the street side but seems to be an extension of the floor as the façade of kateri changed to the railing. House 1 and 2 having chowk as a core space has been missing in house3. There are nos. of rooms made on the floor which are made with the thought of the future expansion which are of no use in present condition.

Thus, there are visible changes and continuity in thinking and resulting in the organization in traditional architecture of Sirohi. In the present time of huge density, the thinking of making house form is major of its future expansion. Resulting in its house form consists sequence of plain and empty rooms which are made functional by using

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it. The core place in the house which was chowk has lost resulting in this.

CONCLUSIONS

In a modern context where architects hold the prime role in shaping the house form, it is pertinent to look back at this traditional architecture to understand the role of core space and organization and reflect back on it.

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Effects of Urban Green Spaces on Physical Health

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ABSTRACT : Urban green spaces are an essential part of urban planning, and have a positive impact on physical health, mental health as well as helps improve one's social interaction. Not only at an individual level, but also has benefits on a societal level. Studies show that it is beneficial in terms of economy, ecology and also the people living in the locality are happier as compared to the others. This paper talks about the importance of Urban Green Spaces in order to promote a healthy lifestyle. Research tools such as field survey in order to study the spatial organization of the built and landscape elements in a park are used. Activity mapping for understanding the user interface. Interviews and questionnaire to study the impact of activities in parks on health enhancement. The expected outcome from this study would be to formulate some ground rules which could be used for the planning and the spatial organization in a park. Urban green spaces, here, refer to the public parks or public gardens, in residential areas only.

Keywords: urban green parks, spatial arrangement, physical health enhancement

INTRODUCTION-

India is a developing country, taking big steps towards urbanization. Urbanization or urban planning comprises of different parts. There is planning of commercial zones, residential zones, industrial zones, landscape, open spaces, etc. and working out the connection between these spaces. Urban green spaces are an essential part of urban planning. Urban green spaces as well as other open spaces in urban planning are as important as doing the smallest detail in a building. Looking at the growing urban cities, the proportion of green spaces compared to the built mass is very less, which is not an ideal case. Especially in today's lifestyle, where people are not much concerned about their health, it is very important to design these green spaces such that they would motivate people towards having a better and a healthy lifestyle. Urban green spaces have a positive impact on physical health, mental health as well as helps improve one's social interaction. Along with these, it has other benefits like a safer locality, fresh and clean air, etc. There has been a lot of research done on urban greens paces and its benefits. Studies show that the use of urban green spaces on a regular basis has a positive effect in order to overcome diseases such as obesity, cardiovascular diseases, diabetes and premature loss of life. Effective use of these spaces also helps maintain the metabolism of our body. Not only physical, but also mental health problems such as depression, can be overcome, as suggested by the studies. The aim of this research is to study the importance of Urban Green Spaces, that is public parks and public gardens in order to promote a healthy lifestyle. The studies will be done using various research tools such as field survey and interviews in order to study the spatial organization of the built and landscape elements in a park. Activity mapping for understanding the user interface and their response towards the parks. The impact of activities in parks, on health enhancement would be studied through interviews, questionnaires and surveys. The expected outcome from this study would be to formulate some ground rules which could be used for the planning and the spatial organization in a park. The open spaces in different zones like residential zone, industrial zone, etc. have different functions, but their impact on human minds are very powerful. Here we will be talking about the urban green spaces in residential areas. Urban green spaces, here, refer to the public parks or public gardens in residential zones only.

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AIM- To study the importance of public urban parks and gardens in order to promote a healthy lifestyle.

OBJECTIVES- 1. To study the spatial organization of the built and landscape elements in a park.2. To understand the user interface and their response towards parks.3. To study the impact of activity in parks, on health enhancement.

MATERIAL AND METHODOLOGY-

Research question- How can the urban green spaces be designed in a locality to encourage people to spend time on physical activities on a daily basis and also promote a healthy lifestyle?

The research is done using various research tools like field surveys, interviews and questionnaires and activity mapping. A qualitative research is done in order to understand the human response towards these spaces. Also, there are case studies done where two public parks in Pune – 1. Dr. Shyamprasad Mukherjee Udyaan, Erandwane and 2. Shahid Major Pradeep Tathawade Udyaan, Karve Nagar have been studied. Both the case studies have been done keeping in mind the three main objectives, which are-Objective 1 - To study the spatial organization of the built and landscape elements in a park.Physical mapping – Field survey and interviews with park management. Objective 2 - To understand the user interface and their response towards the parks.Activity mapping – Observations and interviewsObjective 3 – To study the impact of activity in parks on health enhancement. Interviews, questionnaire, survey on space and activity, health enhancement. In order to analyse the urban green spaces, the following points need to be studied-What are the various aspects that can be used to help improve physical health. - How are the green spaces utilized by different age groups, genders?- What different spaces (e.g.- seating, space for activities like yoga/floor exercises) can be provided based on the different activities that take place in a green space? Methods of data collection-1. Secondary data collection through referring books and existing research. 2. Primary data collection- Unstructured interviews,Non-participatory observation, Mailed/ Collective questionnaireScope- The study will be done for public green spaces, open for all, rather than gated communities as that would give a broader scope of the study.The age group selected for the study is 18 years and above. Limitations-The research is limited to studying only the physical health benefits.These areas selected will only be public spaces in residential zones

LITERATURE REVIEW-

(A.C.K. Lee, 2010)-The health benefits of urban green spaces: a review of the evidence

This paper talks about the physical as well as non-physical health benefits of having urban green spaces. Though the results are not very affirmative, there have been studies conducted on various aspects related to the urban green spaces. It states that there is a weak evidence for links between physical health, mental health and well-being, and urban green space. Environmental factors such as the quality and accessibility of green space affects its use for physical activity. User determinants, such as age, gender, ethnicity and the perception of safety, are also important. The paper concludes that most of the study findings show that urban green spaces are health beneficial. However, establishing a casual relationship is difficult and simplistic urban interventions may therefore fail to address the underlying determinants of urban health.

(Michelle C. Kondo, 2018)-Urban Green Space and Its Impact on Human Health

This paper talks about green spaces with an urban context. What is the impact of urban green spaces on its locality or as a society? Apart from health benefits, it also talks about the threats of having urban spaces in a locality. The evidence shows that there is a consistent negative association between urban green space exposure and mortality, heart rate and violence, and positive association with mood, attention and physical activity. It states that the results were mixed, and that there is no specific association between urban green spaces and general health, weight status, depression and stress. The study was too low to conclude upon factors like birth outcomes, blood pressure, heart rate variability, cancer, diabetes, etc. Thus, it concludes by saying that there needs to be more studies done to make generalizations and meta-analyses, of these and other health outcomes possible.

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(Andrew Chee Keng Lee, 2015)- Value of urban green spaces in promoting healthy living and wellbeing: prospects for planning.

The paper starts with talking about the already done research about the relation between urban green space and health. It states that there is a need to understand the mechanisms by which the benefits accure. It talks about focusing on the reality, rather than considering a casual relation between the user and the space. The various determinants of the use of green spaces are discussed. It talks about the mechanisms of functionality and the implications for research and practice. The paper also talks about the potential threats and the possible solutions.

(Takano, 2002)- Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces.

This paper talks about the use of urban green spaces by the older age group. The relation between the longevity of senior citizens in megacities or densely populated areas and walkable urban green spaces. By walkable green spaces they mean, the spaces that are functional or can be accessed by humans for use. The green areas in a residential area should be emphasized and developed for further more use. The study is done not considering various factors like gender, age, race or socioeconomic factor. For senior citizens, the ease of access to the green space is also an important factor.

(Jolanda Maas, 2006 July)- Green space, urbanity, and health: how strong is the relation?

The relation between green spaces, urbanity and health is that health is dependable on green spaces which are a part in urban cities. With the growing urbanization it is equally important to have a good health, for which green spaces are necessary. Green spaces have a direct impact on human minds, health and living. Green spaces are considered to be more than just a luxury while urban planning, which is not an ideal case. Every one, despite age, gender, caste, socio-economic status should be able to access the green spaces. There is a difference in the use of green space in urban and rural areas. In urban areas however, people make more benefits of the space.

CASE STUDIES –

1. Dr. Shyamprasad Mukherjee Udyaan

Figure 1. Dr. Shyamprasad Mukherjee Udyaan Entrance Gate

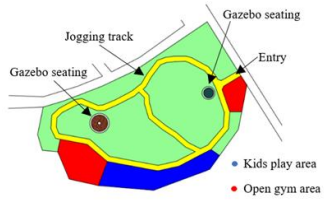

Figure 2. Schematic plan for Case Study 1

While selecting the case study, the locality of the park was observed. Being a completely residential area with some commercial shops like general stores, groceries, the majority of the people coming to the park were the local residents in the area. A sample size of 50 was selected of which 25 were males and 25 females. The division of 25 was further done on the basis of age groups-

18-25 years – 3 samples each

25-45 years – 4 samples each

46-65 years – 4 samples each

66 years and above – 4 samples each.

This was done in order to avoid biased views and results on the subject. Observations were made during parts of the day – one in the morning between 6am-8am and in the evening between 5pm-7pm.After interacting with the people visiting the park, here are some of the good points that they told about the park. 1. The park is located in a prime area and also has good access, along with parking right in front of the park. 2. There are no hawkers who sit outside the park or cause nuisance in the area. 3. The park is very well maintained on a regular basis, along with the workout instruments and the kids play area.

The results show that 80% people, out of the total surveyed, visit the park on a daily basis, 7% visit twice or thrice a week and 13% visit only

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occasionally. Out of those, 33% people approach the park by vehicle, while 43% live at a distance of 5-10 minutes walking distance from the park and 23% live at a distance of 10-20 mins walking distance from the park. 64% of the people make use of the workout instruments provided in the park. 54% people visit the park in the morning, while 70% people visit the park in the evening. The overlap of 16% shows the people visiting the park at both times.The bar diagrams below show the response to the questionnaire in percentage. The data was collected as per different age groups but for analysing the data the average of all 25 male or all 25 females is considered.

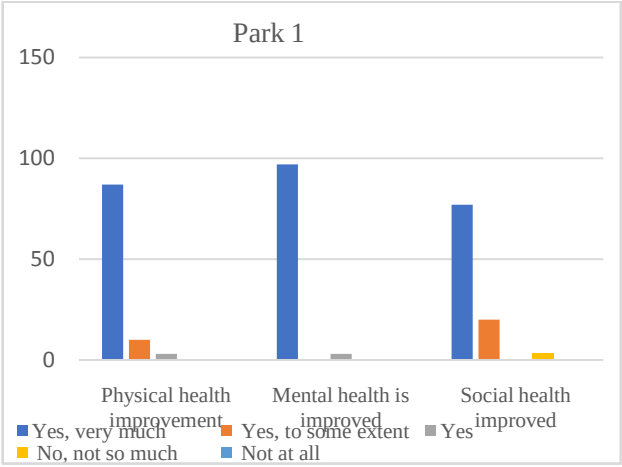

Figure 3. Bar chart showing different results for health betterment for Park 1 in percentage

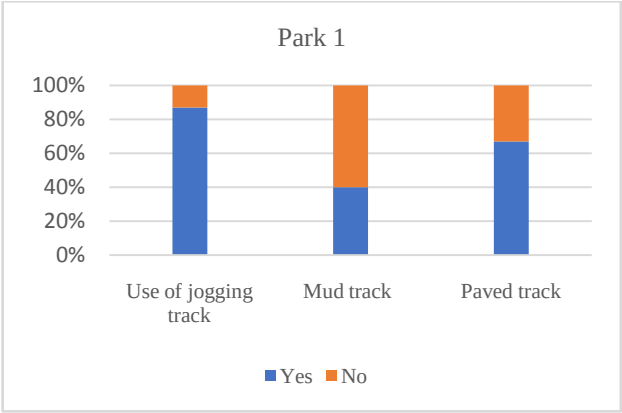

Figure 4. Bar chart showing Jogging track related data results for Park 1 in percentage

2. Shahid Major Pradeep Tathawade Udyaan –

Figure 5. Shahid Major Pradeep Tathawade Udyaan

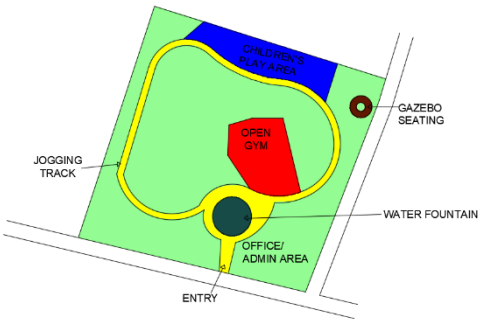

Figure 6. Schematic plan for Case Study 2

This park also is located in a residential, with some commercial shops and restaurants in the surroundings. The park is majorly accessed by the local residents in the area and also by some of the people living on Sinhgad road, which is around 5mins away from the park. The samples collected for this case study are 50 as well. Out of the 50, 25 are males and 25 are females. The division of 25 were further done on the basis of age groups –

18-25 years – 3 samples each

25-45 years – 4 samples each

46-65 years – 4 samples each

66 years and above – 4 samples each.

The footfall here as compared to the other case study is less, since the park in terms of area is smaller than Park 1. The length of the jogging track differs accordingly. Also, the number of workout instruments provided in the park are less as compared to park 1.

The results show that 80% people, out of the total surveyed, visit the park on a daily basis, 7% visit twice or thrice a week and 13% visit only occasionally. Out of those, 20% people approach the park by vehicle, while 43% live at a distance of 5-10

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minutes walking distance from the park and 37% live at a distance of 10-20 mins walking distance from the park. 43% of the people make use of the workout instruments provided in the park. 83% people visit the park in the morning, while 47% people visit the park in the evening. The overlap of 36% shows the people visiting the park at both times.

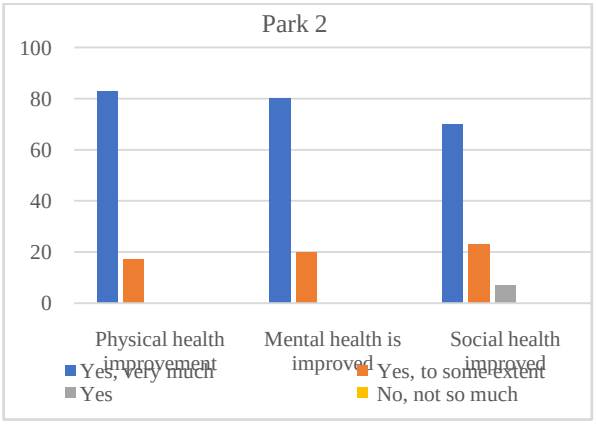

Figure 7. Bar chart showing different results for health betterment for Park 2 in percentage

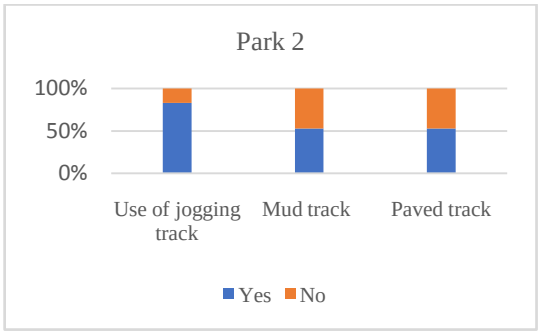

Figure 8. Bar chart showing Jogging track related data results for Park 2 in percentage

The study of both the case studies in done in the exact same method. There are some points which are common for both the parks, where as in some cases either of the two are better. But park 1 being constructed later than the park 2, has a greater number of facilities for the users. The results are more positive for case study 1 than case study 2.

RESULTS AND TABLES -

The table below shows a comparative analysis for both the case studies –

Table 1. Table showing the comparative analysis for different factors affecting physical health

POINT	CASE STUDY 1	CASE STUDY 2
Daily use of park	80	80
Improvement of physical health	87	83
Use of open gym in the park	67	43
Use of the jogging track in park	87	80
Covered / Open to sky track	0 / 100	0 / 100
Mud track / paved track	40 / 67	53 / 53
Helps improve mental health	97	80
Helps improve social interaction	77	70
Benches / Gazebo	87/40	83/33
Effect of water body	60	47
Effect of soft background music	63	40

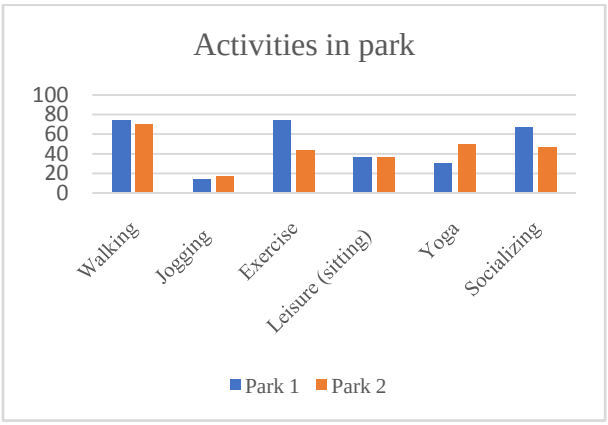

Figure 9. Bar chart showing comparison between the percentage of activities carried out in the two case studies

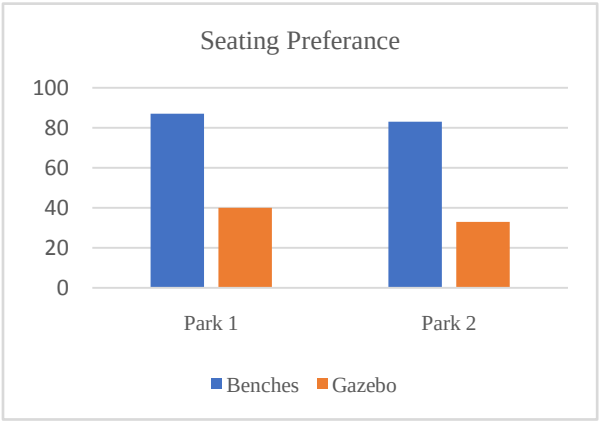

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Figure 10. Bar chart showing comparative figures for seating preference in percentage

CONCLUSION-

As the above bar diagram shows the comparative analysis of the average percentage of the various activities carried out in both the parks. In both the cases, people most commonly use the park for walking, exercising and socializing. These three factors play a major role in the well-being of a human, both in terms of physical as well as mental health. Based on the interviews and analysis done, the effects of urban green spaces on physical health can be analysed as-

- The park should be designed considering the universal design guidelines.
- The provision of workout instruments in parks is very advantageous. People make use of these instruments willingly if they are maintained on a regular basis.
- The jogging and the walking track are used by almost everyone. Some people prefer a normal Mud track while some prefer a paved track. This difference is majorly affected by the gender and the age factor. But while planning, it is always advisable to provide both types of tracks.
- The track should preferably be straight, with not too many curves and turns. It should be evenly levelled.
- While taking the interviews, some people suggested to have a semi open or shaded jogging track, for especially during the rainy season. Hence, if possible, the track can be so designed that a part of the track is covered, maybe by a semi-arch, or giving pergolas throughout.
- Open to sky seating is preferred by people than closed/ covered seating. Thus, benches provided in the park can be of materials like wood or plastic rather than concrete benches. The height of the benches should not be too low (below 450mm, as observed).
- If Gazebos are to be built, they should not be very small. They can be rectangular or circular in shape. The gazebo observed in the Case study 1 was sufficient enough for the footfall of that park. It has the radius of around 3M along with 16 benches with a capacity of 3. The space left in the middle was sufficient to cater indoor yoga practice sessions. Hence this size can be considered as a reference.
- The presence of water body has a positive effect on the mind.
- Music is the best soothing therapy; hence soft background music is always a good option.
- Overall, the park should be well lit, there should be no dark corners or shadow areas left.
- The trees to be planted in the garden can be flowering trees, as it gives a better impact and is a visual pleasure for our minds.

Thus, by the general observations, it is clear that urban green spaces are beneficial for our physical health, and not only physical health but also mental health, social life, ecology and economy.

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I would hereby like to thank all the faculty members, Dr. Banani Banerjee, Dr. Priyamvada Chitale, Ar. Anita Kavathekar and Ar. Ashwini Shitole, who have guided me so well. I am grateful for the knowledge that they have shared with me throughout the process.

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vi. Urban residential environments and senior citizens’ longevity in megacity areas: the importance of walkable green spaces [6]

vii. Value of urban green spaces in promoting healthy living and wellbeing: prospects for planning [7]

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Application of Semantics and Semiotics in Understanding Design Philosophy of Ar. Charles Correa Within Context of Indian Architecture

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ABSTRACT : In order to communicate, a formal or otherwiselinguistic system is adapted. The language can be understood only when the sender and receivershare a common system of symbols and signs. Similarly,Architectural languagehas semantics and semiotics that have the ability to convey meaning through spaces visually.Architect Charles Correa's ideology was shaped due to Socio-Cultural-Economic context as well as the climate of Indian sub-continentforming an Architectural vocabulary which was very specific to Indian context.This research paper attempts to explore and understand the mediums used by Architect Charles Correa to convey meaning in Indian Architecture through Visual Analysis.

Keywords
Architectural Language, Semantics, Semiotics, Form and Character, Communication in Architecture, Symbols and Signs, Indian Architecture, Works of Architect Charles Correa.

Introduction

Communication is a social activity through which the information can be transferred by the sender and interpreted by the receiver after decoding. According to George Miller the science of communication contains a set of signs and symbols that have meaning embedded in them which are perceived by someone who has the ability to decipher, understand and interpret those signs and symbols.(George, 1951)

A Language is a structured system of communication which involves spoken, written / verbal and non-verbal. These languages also include the signs, symbols and scripts which makes communication feasible. Signs and symbols are not only studied in a language but rather it has its place rooted in rituals culture, image and art.(Tavsan, 2018) This can be classified in two broad divisions: Verbal communication and Non-verbal communication.

Communication ability of some signs and symbols can be perceived much stronger than the others due to the logical conditioning of mind which is known as perception. Thus, the communication function is subjected to human interpretation which results into implicit meanings.(Gawlikowska, 2013)

Architecture is a visual form, falling into non-verbal category of communication that can be understood as language with grammar and vocabulary as Architectural Language. For understanding the architectural language and the semantic and semiotic model consisting of symbols and signs shall be used. These signs and symbols themselves might not have a meaning individually but together with context are able to generate expressions.

Indian Architecture and Ar. Charles Correa-Over 150 years of architecture in India remained under the British influence. After the independence it was necessary for Indian fraternity to cast an impression over the world by projecting culture, heritage, modernity, vividity in its design so as to emboss the existence of great nation. Therefore, after the independence, Indian architecture immediately parted from European classical styles and rushed into modernism. This modern architectural period proved to help the scenario. Charles Correa, B.V. Doshi, Raj Rewal were the one to develop the technology, design to make something which contributed towards building the great Indian society. (Foundation, 2016)

Ar. Charles Correa used to think about the climate conditions, comfort levels and with the support of escalating and improvising technology Correa formed his most iconic structure in the heart of Mumbai 'Kanchenjunga Apartments'. This apartment building with duplex, internal staircase, courtyards, was a lavish structure satisfying the increasing population and without compromising requirements. Ar. Charles Correa also did not just think in terms of Physical or Social Context, rather his works depict the Context of Time which they were a part of. Hence Correa says, "*Architects should think of the various attempts made in the history, critically analyze the facts and elements and then should improvise on them as needed*." (Correa, 2000)

Ar. Charles Correa's aim was to develop an architectural style specific to India's climate which became a milestone, benchmark and also his signature.

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Research Background And Methodology

Semantics and Semiotics -The expressions of communication in Architecture which are semantic and semiotic message systemshave the ability to convey meaning through space and is limited to human perception and understanding.These two elements govern how one communicates and perceives architecture. Semiotics and Semantics is parallel to the study of meaning-making or interpretation of signs. This includes study of signs, analogy, metaphor, symbolism and signification.
Formal Discursive Communicative methods of architecture are described as semantic which results in development of Form. Drawn shapes play a critical role not only in representing a design concept but also in allowing the designer to reinterpret them to develop new ideas.(Schwarzfischer, 2011)

Non-Formal Non-Discursive Communication is described as semiotic, the phenomena of grammar and limitations of spatial communication is referred as character. The non-discursive communication of architecture is more linked with real world situations and experiences. It uses context to communicate to arouse emotional response, it is therefore a medium used to transmit easy-to-decode messages through architectural forms.(Gawlikowska, 2013; Khan, 1984)

The space has the ability to communicate through Form, Space, Order, Character and Atmosphere but ability to recognize the code by its receiver.(Penn, 2003)

Communication -According to the existing theories in literature of Communication through Semiotics can be majorly classified into three main types:

Syntax - A sign is anything that communicates a meaning, that is not the sign itself, to the interpreter. All the languages rely on the process of semiosis that have the ability to relate the signs and their meanings. Signs can communicate through any of the senses, visual, auditory, tactile, or taste. (Leach, 2005)

Semantics - A swiss thinker Ferdinand de Saussure introduced these terms as the relationship between signs and what their actual meanings are conveyed. The signifier is the image which acts as a reference for something whereas the signified is what the message conveyed is about.(Saussure, 1959),(Juodinyte-Kuznetsova, 2011).

Pragmatics - Then French semiotician Roland Barthesin his theory “Semantics for Beginners” says, Denotation is the primary or literal meaning of a word which when separated from the from the feeling it evokes (Explicit meanings), On the other hand Connotation are the ideas or the feelings which are associated with the denotations (Implicit meanings). (Barthes, 1999)

This paper tries to deal with all the three aspects of semiosis i.e.- syntax, semantic and pragmatic parts of architecture.

To understand the basic theory of the languages-communication, Semantics-semiotics, Literature papers reviewed, established significance as well as a need in the Indian Context. The primary case examples chosen for visit were Bharat Bhavan - Bhopal, IUCAA – Pune which provided a better understanding in terms of Visual Observation and Analysis.The established precedents in the Semantics and Semiotics language model provide the base for the further derivations made.(Ramzy, 2013)Structured Interviews were also conducted with the architects who have worked with Ar. Charles Correa to analyze the design ideology, philosophy and methodology. Content Analysis of writings by Charles Correa along with transcribed Articles - *“Transfer and transformations”, “Blessings of the sky”* along with the Movies- “Volume Zero” and “Into the Unknown”.

Analysis, Results and Tables

The Visual Analysis was conducted for the following structures to Identify and document the visual components responsible for Form and Character generation.

Bharat Bhavan, Bhopal

Under the leadership of Jawaharlal Nehru (India’s first prime minister), India saw the formation of various new architectural buildings with cultural institutions. A new draft stating the need for cultural revival and sustaining India’s intangible and tangible heritage was formed. The intent was to give a platform for practitioners of this traditional art form and educate others about these in an accessible urban area.(Correa, 2000)

This is how the vision of ‘India House’ or ‘Bharat Bhavan’ was born, envisioned to be built in each of the 21 states (in 1970). It was imagined to be a cultural center that spoke this vision through a series of galleries and exhibition/performance spaces(Foundation, 2016)

The first commission of this vision went to Architect Charles Correa where he was endowed with the responsibility to design the first-ever Bharat Bhavan, in Bhopal (Madhya Pradesh).

Bharat bhavan consists of series of sunken courtyards and terraces which are facing towards the lake and thus the whole building morphology is embedded into the terrain. When one enters through main entrance, the only element seen is the skyline of Bhopal across the main lake which

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emphasizes the fact that there is no need for this kind of structure to stand out Architecturally.Rather it can even be equally convincing with subtle and subdued form suitable for such activities. As steps brings down into the series of interconnected sunken courts one finds himself surrounded by the various activities. The materials which are used for the project tend to be the local stone (Red Sandstone and Dholpur Stone) that is used as a cladding on the regular Reinforced Concrete works which itself was way ahead of time. The various wood works seen are a result of Local Craftsmanship and the Local wood available. The Reinforced concrete lintels are a replication of traditional Indian wood works used I the formation of lintels and sill. (Frampton, 1996),(Correa, 2000).

Figure 1: Images of Bharat Bhavan through various courts, Steps and terraces, Construction Details.

TABLE 1 –BHARAT BHAVAN

SNo.	Signifier	Signified	Connotation/ Denotation	Meaning
Activities				
1	Focus on Cultural Facilities and Tribal Arts Center as well as Museums.	Cultural Significance	Denotation	Importance given to Culture tradition and the Arts and Crafts inscribed into the very land.
2	Entry to Courtyard	No formal Reception, Corridors.	Connotation	Total Independence in Activities and Arts.
Form and Geometry				
1	Access from the top and stepping down into the courtyards.	Easily approachable to common man.	Connotation	As one proceeds through the sunken courtyards various connections in a casual arrangement states a gesture of welcoming.
2	No Built Spaces seen from the Entrance.	Backdrop is the Skyline of Bhopal	Denotation	The idea is not highlighting the building itself rather to emphasize on the context and the culture which it has.
3	Grid	Uniformity	Connotation	Repetition of module and structural stability.
4	Courtyards	Planned Informal but introvert spaces	Connotation	Search of identity within oneself.
5	Conical Dome	Heavenly light	Connotation	Seeking guidance from the super power.
6	Absence of windows	Casual Movement and interconnectivity	Connotation Denotation	The same way with which all arts are connected
Materials				
1	Local Red Sand Stone and Dholpur Stone.	Connection with the context.	Connotation	Local material gives an identity which follows context and connects with the people.
2	Reinforced Cement Concrete	Innovation in Construction Technology	Connotation	During the 1980's the construction technology had just started development in R.C.C.
Construction Technology				
1	Ledge and battened doors	Simplicity	Denotation	Local Craftsmanship and Traditions
2	Ferrocement Conical Dome	Innovation in Form	Denotation	Highlighting the upcoming technology on the basis of current culture and traditions.
3	RCC band at Lintel level	No Cladding, exposed structural.	Connotation	Reminder of traditional wooden architectural construction.

IUCAA, Pune

In 1988 with the Prof. Govind Swarup and Dr. Jayant Narlikar a committee was formed which proposed State of the art Astronomy and Astrophysics laboratory within the Savitri-bai Phule Pune University Campus. **The Inter-University Centre for Astronomy and Astrophysics (**IUCAA) consists of an Educational Area with Research Library and other Equipment and apparatus labs. The Devyani Court consists of stepped sit out spaces depicting the boundaries of universe which are expanding infinitely with the focus in the center containing two binary stars (black holes merging into one). The Roche Court consists of idols of 4 great scientists Aryabhata, Albert Einstein, Issac Newton, Galileo Galilei which depicts the presence of their knowledge through the ages and has passed on for further research. The Seirpinski court connects the residential areas with the main courtyards which is the graphical representation of the Fractal patterns. The Primary philosophy behind the Courtyards was to bring in the vast universe and to provide space for the building to breathe. The Design initiated with drafting the initial

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content of the courtyards or so called "the zero spaces" with a purpose and then providing the built massing which caters to the purpose on a more fundamental level.(Frampton, 1996)(Correa, 2000)

Figure 2:Images of Various Elements of IUCAA, Pune

TABLE 2 - IUCAA

SNo.	Signifier	Signified	Connotation/ Denotation	Meaning
Activities				
1	Functioning Research Facility for India Under SPPU	Significance given to Astronomy and Astrophysics.	Denotation	Importance given to making a search for the unknown, gesture to accept challenges and finding the truth.
2	Entry to the structure	Patterns on the wall pointing towards sky.	Connotation	The pattern represents steps which eventually form an arrow which points and leads towards sky.
Form and Geometry				
1	Access from the top and stepping down into the courtyards.	Easily approachable to common man.	Connotation	As one proceeds through the sunken courtyards various connections in a casual arrangement states a gesture of welcoming.
2	Built wall on the Entrance.	Hierarchy in Material	Denotation	The whole idea convinces to point out the sky which is mysterious in various ways.
3	Grid	Uniformity	Connotation	Repetition of module and structural stability.
4	Courtyards	Enclosure in four walls and exposure to infinite sky.	Connotation	Identifying the ground and what we are but still curious to experience the "beyond".
5	Relationship of Built steps with unbuilt and intangible nature.	Blackholes and the Event Horizon resulting into Binary star configuration.	Connotation	Man trying to explore and discover new theories about perception.
6	Patterns in flooring insmaller courtyard (Residential Area).	Fractal Geometric Pattern (Seirpinski Triangle)	Connotation Denotation	Architectural response given to scientific theory which suggests infinite nature and space.
7	Postures of Scientist Aryabhata, Isaac Newton, Albert Einstein, Galileo Galilei.	Signifying the contribution given by them in the field of astrophysics.	Denotation	The current research and discovery which are being done are being taken forward by the scientists.
Materials				
1	Basalt Stone, Kadapa Stone, Polished black Granite.	Connection with the context.	Connotation	Local materials are used in various walls to denote typical Signs and Elements. Ashlar Masonry is used to form the base the claddings are done by Kadapa stone and the Sky is denoted by Black Granite.

Conclusion

Architectural works beyond their Utilitarian purpose contains cultural emotional and social expressions which an architect tries to articulate through their works. Through this paper it is evidently seen how these architectural vocabulary and languages that can be seen through their works which is the foundation for expression of ideology and philosophy.

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Satellite cities – An Inclusive Approach for a Sustainable City

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Abstract: India's rapid urbanization has given rise to densely packed metropolitan area which face problems like - long hours of intercity travel, urban sprawl, pollution and wastage of productive time resulting in increased levels of stress. This research is focused on development of sustainable Satellite Cities as a futuristic solution catering to sustainable development and growth of existing urban centres in India. Pune, Ahmedabad, and their satellite towns are researched on the parameters like transit, environmental impact, land use policy, inclusiveness and quality of life to develop a matrix which will serve as a guide for visionary satellite towns.

Keywords: *Satellite cities, Sustainable cities, Inclusive cities, Indian cities*

INTRODUCTION

India is undergoing rapid urbanization and growth which has resulted in a dense and congested urban fabric. This speedy and uncontrolled growth has given rise to numerous problems which create bottlenecks in the growth of the city. There are three ways in which a city grows - (i) Horizontal development – Causes longer travel times and traffic chaos (ii) Vertical development - Causes surge in land prices and stresses the infrastructure and (iii) Development of Satellite Cities – Establishment of a new city in close proximity of a parent city which has an independent governing body. In the past several decades, satellite cities have played a major role in decongesting metropolitan areas. There are growing appeals for development of these new satellite towns which are away from the urban chaos but within close proximity of the parent city.

Vertical Growth Horizontal Growth
Developing Satellite Cities

Image showing different ways in which a city grows. Image source – author.

HISTORY

Conceptualized by Sir Ebenezer Howard, garden cities were self-sufficient, concentric clusters which had open spaces, green belts, parks and radial boulevards. Once the garden city reached the optimum population, another city would be developed nearby. Sir Ebenezer Howard thought of several of these concentric clusters as satellites for bigger urban centres. The first garden city created was created in 1905, Letchworth as the satellite to London. Letchworth promised its residents a clear distinction between factories and homes, quiet neighbourhoods and a lot of open spaces, all of which London fell short of. In short, Letchworth promised a better quality of life. Low taxes for factories, lower prices of land to build homes and lower rents attracted a lot of investment into Letchworth. These magnets resulted in influx of population which shot up the land prices and the city could not remain affordable for the worker class and became the abode of the wealthy people, defying its economic and social visions.

GLOBAL SCENARIO OF SATELLITE CITIES

Satellite cities accommodate the population influx which comes into the into the parent city by providing housing and basic amenities. It provides the parent city with labour and work force. These new towns promise a better quality of life for all. Since satellite cities came up only in the beginning of the 20th Century, its only now, that we can observe its effects in terms of environmental, social and economic impacts. Satellite cities have come up all around the world surrounding megacities creating large metropolitan regions. Today, satellite cities are easily envisioned but most of them fail at solving the problems, rather add to them or create new ones. Satellite cities are supposed to be independent centres in terms of providing jobs and homes. Due to the imbalance, the intra city travel between the satellite city and the parent city has given rise to long hours of travel, increased fuel consumption and pollution.

CURRENT SCENARIO OF SATELLITE CITIES IN INDIA

India is not far behind the world when it comes to establishing new satellite cities. Big cities like Delhi, Mumbai, Chennai, Bangalore, Pune and Ahmedabad have

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multiple satellite cities to cater to the urban pull these cities have. Satellite cities pop up with new magnets but fail to balance out the strengths with opportunities. The metropolitan areas are expanding horizontally and are eating up open spaces in and around the city at an astounding rate. As prescribed by the World Health Organization, every person living in the city should have access to 9 square meters of open spaces within 800 meters from the residence. Most Indian cities fail to achieve the bare minimum and cities are giving away the open spaces meant for recreation to develop concrete jungles.

CASE OF PUNE

Pimpri Chinchwad, North-east of Pune, was set up as an industrial town and a satellite to Pune city. After setting up Pimpri Chinchwad, people from Pune started traveling to Pimpri Chinchwad on a daily basis for their jobs. Being away from Pune but within close proximity, the new land attracted investment and boosted economic growth in the area. This increased job opportunities in the area which were lacking in Pune. There was no formal Public transport which existed.

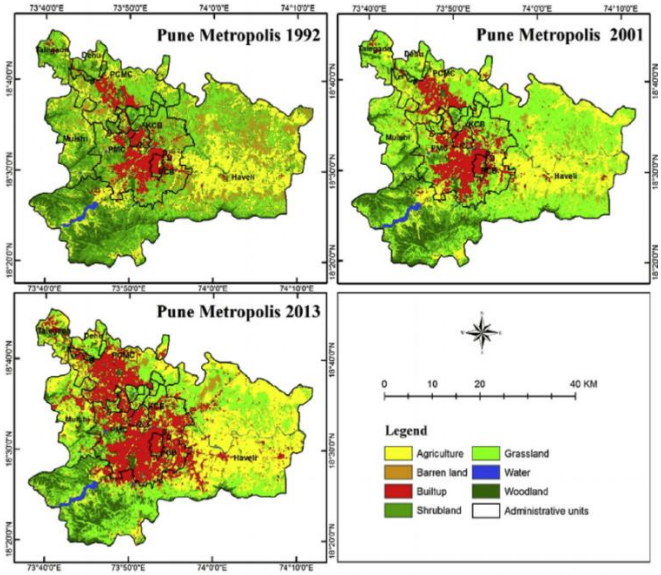

Image showing growth and sprawl of Pune, Hinjewadi and Pimpri-Chinchwad City. Image Source (Kantakumar, 2016)

Hinjewadi, North-west of Pune, was set up as an IT Park which housed multinational IT Companies. Lakhs of people travel daily from Pune to Hinjewadi for work. After understanding the need for housing in the vicinity, gated communities and high end apartments popped up in Hinjewadi, catering to IT professionals. There was no housing that was developed which would include low income groups or economical weaker sections who act as workforce and household help. Hence, many of the apartments remain unsold due to lack of maids and household help.

With the rapid urbanization, the open space left per capita is just 1.4 square meters as against 9 square meters as prescribed by the World Health Organization.

CASE OF AHMEDABAD

Gandhinagar, North-east of Ahmedabad, was set up as the new administrative capital for the state of Gujarat 30 km from the former capital city of Ahmedabad. Gandhinagar houses the administrative buildings in the city centre surrounded by housing blocks in the periphery. One of the policies that Gandhinagar adopted was to house only the government legislative and administrative buildings in Gandhinagar. Realising the mistake, Gandhinagar is now coming up with the new development plan which includes residential zones and industrial zoned on the periphery of the government blocks.

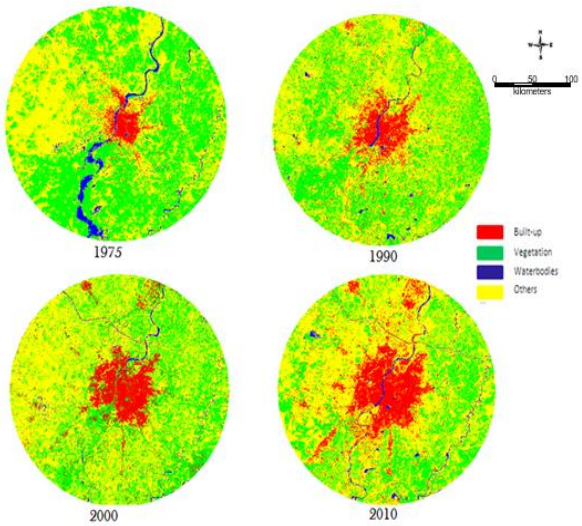

Image showing growth and sprawl of Ahmedabad, Gandhinagar and Sanand City. Image Source
http://wgbis.ces.iisc.ernet.in/energy/water/paper/Monitoring-Spatial-Patterns/results-discussion.html

Sanand, South-east of Ahmedabad, set up a TATA nano plant which boosted local economy and gave a sudden boost to urbanization process. This led to a huge influx of people into the town, which increased the demand for housing hence, increasing the land value. Both the activities led to Intra city travel to and from Ahmedabad.

With the rapid urbanization, the open space left per capita in Ahmedabad is just 0.37 square meters as

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against 9 square meters as prescribed by the World Health Organization.

ANALYSIS
CASE OF PUNE

Lack of public transport led to an increase in private vehicle ownership and increased vehicular movement between Pune, Pimpri-Chinchwad and Hinjewadi. City records show that as of 2016-17, Pune has 2.3 million two-wheelers and seven-hundred thousand four-wheelers. A worrying fact: Pune, with 1,260 vehicles per km, ranks second in terms of vehicle density among Indian cities. This has resulted in extreme levels of pollution and traffic jams.

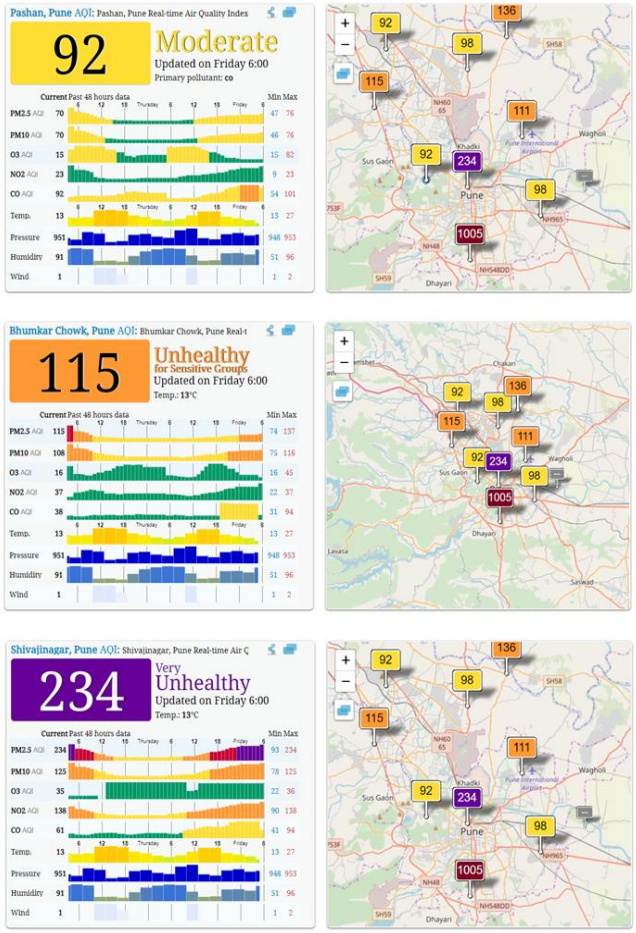

Image showing deteriorated air quality in Pune city. Image Source https://aqicn.org/city/pune/

Hence, city administrators realised that pre-emptive measures for urban mobility is the need of the hour. In the case of Pimpri-Chinchwad, Pune's twin city, due to the lack of effective intra and inter-city public transport systems, there was a steep rise in private vehicle ownership. Which, if not rectified, would have stalled the immense progress it made. In a combined effort, Pune Municipal Corporation, Pimpri-Chinchwad Municipal Corporation, and Pune Mahanagar Parivahan Mahamandal Limited turned their focus on the bus rapid transit (BRT) system. The rapid transit network, which was duly reviewed by the India Programme, was called the Rainbow BRT. It effectively utilised Pune's bus fleet and network, while also improving Pimpri-Chinchwad's connectivity to its twin city. (ITDP - https://www.itdp.in/)

Lack of open space per capita led to the degradation in quality of life forcing children to stay indoors and rely on electronic devices which take a toll om their mental and physical health. This has also created unsafe neighbourhoods to walk in for senior citizen.

CASE OF AHMEDABAD

Due to its land use policy for administrative and legislative buildings only, Gandhinagar city experienced lack of activity and increased crime in evening after the office hours. Gandhinagar District in Gujarat stands 89th in all crime records in 2013. 126th in no of murders, 122nd in no of rapes, 108th in no of robberies, 186th in no of thefts, 43rd in no of dacoities, 156th in no of kidnappings, 212th in no of riots. Gandhinagar has highest crime rate of 498.15 compared to National crime rate 218.67 in 2013. (NeighbourhoodInfo)

Even after developing one of the best BRT Systems, Janmarg, Ahmedabad dose not cater to the last mile connectivity in fringe areas, resulting in rise in the number of private two wheeler ownership in the outskirts of the city. According to transport department, 2.9 lakh vehicles got registered in Ahmedabad in 2017, in which 2.09 lakh were two wheelers and 57,661 were four wheelers. The figures are in stark contrast when the number of two wheeler registrations were only 1663 in the year 1999. (Times of India, Jan 22, 2018)

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PROBLEM	CAUSE	SOLUTION
Rise in private vehicle ownership	Bad/ nonexistent public transport infrastructure	Good public transport with last mile connectivity
Rise in level of pollution	Rise in inter – city travel with private vehicles	Good jobs-home ratio in a city
Increased Stress levels	Long hours of travel	Walkable neighbourhoods
Increase in crime rates	Deserted neighbourhoods	Mixed use land policy with eyes on street concept
Negative impacts on mental and physical health	Lack of open spaces for all	Strong policies in land use pattern with protected green and open spaces.
Lack of opportunities for LIG and EWS	Gated community development	Equal opportunity for all sections of society and creation of new job opportunities

Table 1 . Analysis of problems faced by satellite cities and Parent cities.
Source - author

CONCLUSION

Peoples' safety, transport, good jobs-home ratio, social equity, mixed land use policy and plenty of open spaces should be the baseline criteria to establish any new satellite city. These base criteria can help planners and developers to extend urban areas in a successful, sensitive and sustainable manner.

ACKNOWLEDGEMENTS

I would like to thank my guide and co-author, Ar. Meghana Patel for her continuous support throughout the process.

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Leisure Spaces in Highrise Residential Complex : Status of Swimming Pool

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Abstract :Todays scenario of happy and comfortable living standards leads to attractive residential projects by developers with multiple activities like, health and entertainment activities, in India. While these innovative inclusions in terms of amenities are mostly relegated to luxury residential projects, one feature that is commonly included in most residential projects is a swimming pool.This research paper aims to address the existing swimming pool spaces and their condition with respect to its maintainance provided in a residential projects in Pune, city. However, there has been much debate about the necessity of a swimming pool, it's maintenance and its utility to its residents.Specifically It's soughts to find out the condition mapping of existing swimming pool in the high rise residential complex.May be under or over utilise and lead to more or less usage after sometime. Applying the methodology of studying literature related to swimming pool, direct observations, site visits of the residential complex, people experience, management and other authority.

Keywords : Maintenance, Ambience, Privacy, pool, Quality, Status

1.Introduction:

Swimming pools, at least man-made watering holes for bathing and swimming, go back at least as far as 2600 B.C.E. The first elaborate construction are probably The Great Baths of Mohenjodaro, an ancient and elaborate bathing site in Pakistan made from bricks and covered in plaster, with terraced decks that wouldn't look out of place in a modern pool landscape. Mohenjodaro probably wasn't used for general lap swimming, however. Scholars believe it was used in religious ceremonies (Bellis, Mary. "The History of Swimming Pools." ThoughtCo, Jan. 29, 2020, thoughtco.com/history-of-swimming-pools-1991658.)

1.1 History and background

More man-made pools surfaced throughout the ancient world. In Rome and Greece, swimming was part of the education of elementary age boys and the Romans built the first swimming pools (separate from bathing pools).

Figure 1 swimming pool in2600 B.C..E

Figure 2 Swimming Pool First century BC in Rome.

The first heated swimming pool was built by Gaius Maecenas of Rome in the first century BC. Gaius Maecenas was a rich Roman lord and considered one of the first patrons of arts—he supported the famous poets Horace, Virgil, and Propertius,making it possible for them to live and write without fear of poverty.

1.2 Evolution:

However, swimming pools did not become popular until the middle of the 19th century. By 1837, six indoor pools with diving boards were built in London, England. After the modern Olympic Games began in 1896 and swimming races were among the original events, the popularity of swimming pools began to spread

According to the book Contested Waters: A Social History of Swimming in America, the Cabot Street Bath in Boston was the first swimming pool in the U.S. It opened in 1868 and served a neighborhood where most of the homes did not have baths.

In the 20th century, a number of leaps in science and technology took swimming pools to a new level. Among the developments, chlorination and filtration systems that delivered clean water into the pool. Prior to these developments, the only way to clean a pool was to remove and replace all the water.

This paper aims at finding out the status of swimming pool as a Leisure space inhighrise residential complex:

2. Objective to study**:**

i. Various technical and legal aspects related to Swimming pool

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ii. Recent conditions of swimming pooland immediate around spaces.
iii. Factors affecting the smooth working of pool
iv. User'sperception age and gender wise study of activities.
v. To study Original planning aspects and their execution.
vi. Schedule of maintenance

3.Scope: Though there are many factors influencing the nonusage process of swimming pool my analysis is limited only to the elements.

4.Limitations**:**This research is limited to record the users percep[tion of swimming pool use which is constructed on groundand used by apartments users having 11to 20 floors in Pune city only.

5.Literature review :

The research interest of this work is the status of swimming pool in highrise residential complex. In this section, we present the studies whose subject, objectof study, and methodology are close to our currentresearch related to in-between space, social interaction,spatial configuration, and space syntax.Social use of residents.

Mike Wheat Technical Director Norcros Adhesives, UK says that, The choice of construction methods and the specification of materials associated with the build up of tiled finishes to swimming pools and ancillary areas is wide and varied, however, the goals to be achieved for a successful facility are;

i. Safety in use
ii. Durability of performance of finishes
iii. Technical performance of a specialist facility
iv. Aesthetic performance

It can be argued that the tile grout can either playa part or can influence all four of these factors. To achieve the required standard of appearance it is essential to ensure that the quality of the workmanship and associated materials match those required standards.

Nothing detracts more from the appearance of the tiling finish than poor setting out, bad alignment, tile lipping etc. Quality installation begins with ensuring that the surface preparation and condition of the background are as recommended. The use of the correct tools, especially notched trowels, when applying the adhesive will influence the surface trueness of the tiling and the selection of the most appropriate adhesive to suit the combination of substrate, tile and service conditions is important. Equally, the adoption of the correct fixing method, especially on floors, will often playa part in the final appearance of the grouted joints. Voids in the bedding beneath tiles lead to the grout slumping in the joints, which, in turn, creates a reservoir for dirt accumulation, a situation made worse by a badly tooled, uneven grout surface. Further aspects of attaining a good standard of workmanship include setting out, cutting, alignment of joints and trueness of the finished plane of tiling. They(Mike Wheat Technical Director Norcros Adhesives, UK) have all seen how shoddy grouting and poor quality joint finishes can spoil the appearance of even the most attractive of tiles. It is recalled that many years ago, Derek Johnson, the then Chairman of H&R Johnson Tiles, was always complaining that poor grouts and grouting ruined his beautifully crafted tiles - and he was usually right.(Mike Wheat Technical Director Norcros Adhesives, UK)

Col RakeshPassi (retd), secretary, The Poona Club say that the Swimming pools using borewell water still operationalWhile the Pune Municipal Corporation (PMC) has issued notices asking all the swimming pools to halt operations, much to the delight of swimmers many professionally-run pools across the city and the pools at private clubs are still operational as they use borewell water for the purpose.The pool managers say they are not violating any civic order as they are not using water from PMC supply. "At our pool , we have two borewells that supply water to the pool. We have a good filter system and hence do not even require to dry and refill pool water. However, if we are required to close down the pool, we might seize the opportunity for a comprehensive maintenance. As of now, we have not taken any decision in that regard," said Col RakeshPassi (retd), secretary, The Poona Club.

At Tilak Tank in Deccan Gymkhana, an employee said that the pool services have not been affected as they use borewell water for the purpose.(Col RakeshPassi (retd), secretary, The Poona Club)

MeherIrani, swimming pool operations manager, Poona ParsiGymkhana, said that it's a myth that swimming pools require a lot of water. "Many pools today have good filter system. The same water is filtered and circulated. The only water required is for shower and there too we use borewell water. So even if the the civic body cuts off water supply completely, it wont affect us in the least," said Irani.

Kavita Sharma, director, Swimming and Life Saving Training Centres, The Rashtriya Life Saving Society (India), said of the 400 swimming pools in the city, only 50-60 are professionally operated with their own filter and chlorination plants.

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"The rest are private/society pools which refill water frequently. It is these pools that waste more water," she said.

In a letter to the municipal commissioner, Sharma has pointed out that if the pools are closed, the operators will not be able to cover the cost of electricity and maintenance. She has pegged the loss at estimated Rs 50-60lakh.

"The operators will not be able to pay salaries to lifeguards and coaches. Who will be responsible for this?" she asked, adding, the pools should be penalised only if they are using water from the PMC supply.

6.Material and Methodology:

Various legal and technical aspect of swimming pool: Pools pose a risk of drowning, which may be significant for swimmers who are inexperienced, suffer from seizures, or are susceptible to a heart or respiratory condition. Lifeguards are employed at most pools to execute water rescues and administer first aid as needed in order to reduce this risk.

Diving in shallow areas of a pool may also lead to significant head and neck injuries; diving, especially head-first diving, should be done in the deepest point of the pool, minimally 2.4 m (7 ft 10 in), but desirably 3.7 m (12 ft), deeper if the distance between the water and the board is great.

Pools also present a risk of death due to drowning, particularly in young children. In regions where residential pools are common, drowning is a major cause of childhood death. As a precaution, many jurisdictions require that residential pools be enclosed with fencing to restrict unauthorized access. Many products exist, such as removable baby fences. The evidence for floating alarms and window/door alarms to reduce the risk of drowning is poor.[34] Some pools are equipped with computer-aided drownin prevention or other forms of electronic safety and security systems.

The by laws of swimming pool offer a formal structure to the construction, management, maintenance and safety of swimming pools. These byelaws offer information covering the following:

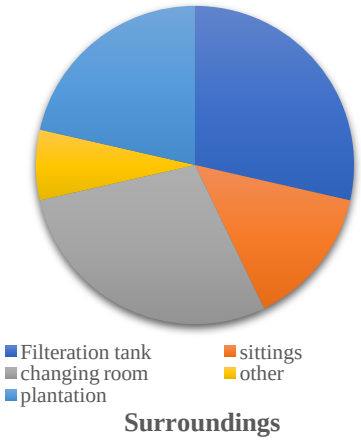
i. Applying for permission to construct and operate a swimming pool
ii. Swimming pool inspections by the authorities
iii. Modification of existing swimming pools, structuring the swimming pool, fittings and accessories
iv. Water treatment system
v. Personnel including pool manager, lifeguards
vi. Safety features and rescue equipment
vii. Water quality
viii. Operation and maintenance
ix. Operational timings
x. Regulations for swimming pool users

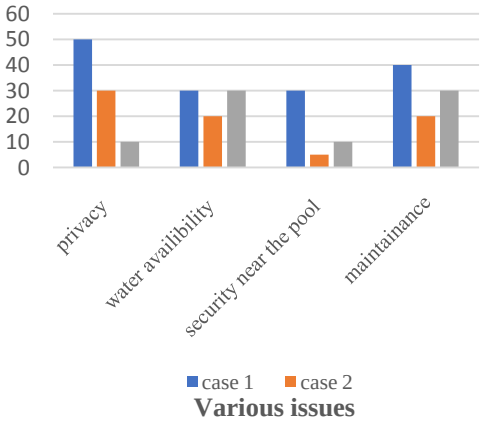
What about existing swimming pools?

For existing swimming pools, owners must carry out modifications mandated in these byelaws within a period of two months from the date on which they are effective. They can begin using the swimming pool only after the authorities inspect and approve it. (Technical aspects and maintaince of swimming pools.)

7: Result and Table :

i. Case 1 : Ujwal Paradise, Dhayri, Pune
ii. Case 2 : Suncity , Anandnagar, Pune
iii. Case 3 : Rohan Kritika , Navshamaruti , Pune.





8.Conclusions:

The status and use of swimming pool is dependent upon various factors like maintainance, water availaibility,

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privacy , policies of athourity. Highest priority was given to privacy for use purpose for all age groups and genders. Other subsiquitny issues redarding smooth working of pool is the responsibility of athourity and responsible use by users. The smooth functioning maintance issues were negible where one time maintaince was paid. Public awareness about decipline and responsible use has to be taken care of.

9.Acknowledgments

The author would like to acknowledge Dr.RajendraKoli, Ar.ShilpaIngawale, Mr. TusharHanmgar, Miss KartikiKelkar, MrSaranglathe and Miss MuktaiGaikwadfor their contribution to this work.

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Nature of modern life around transit hub in India

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Abstract: This paper discusses the current condition of areas around transit hub (railway station, bus stand and metro station) in India and design principles to solve the problems identified. The current conditions means the study of psychology of people around/ using the hub, the development of commerce, the lifestyle of people residing, the street patterns and circulation of different modes of transport systems. The problems were identified by different means of communication like surveys, interviewing local people, architects and urban designers. The design principle which are developed with reference to case studies of cities like Mumbai, Ahmedabad , Paris and by basic architectural design standards and should be used as guidelines for better development of the country.

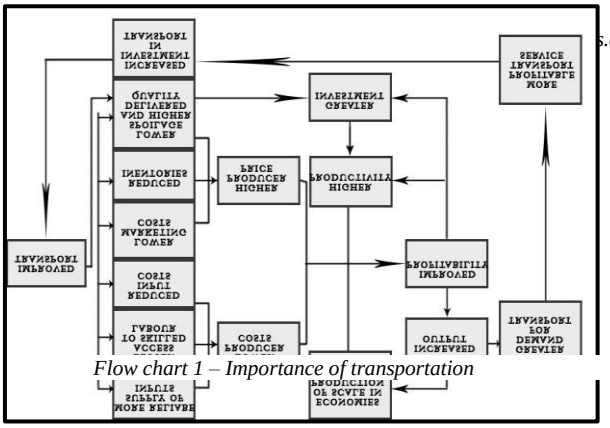
Keywords: **Transit hub, Nature, Modern life.**

I. Introduction

Transportation is driving force behind overall development. To support a wide variety of activities ranging from commuting, tourism, supplying energy needs, to distributing partsand final goods, societies (Citizens)have become dependent on their transport system. Developing transport systems which is related to dimensions such as nodes, locations, networks and interactions has been a continuous challenge to satisfy mobility needs, to support economic development. All spatial flows, with the exception of pedestrian trips and personal vehiculars, involve movements between terminals. Also the facilities in and around the terminal/hub makes the area a destination itself and can provide a ripple effect that encourages investment in area, generates new revenue streams, boosts wider prosperity and improve quality of life around transit hubs.

Transportation: "Movement of individuals, information and merchandise from one place to another with help of some mode is called transportation." They are mainly dependent on the commercial activity from which operational attributes such as transportation costs, capacity, efficiency and speed are derived.Transportation is an economic activity different from the others, it trades space with time and thus money. The fundamental purpose of transportation is geographic in nature, because it provides movements between different locations.

Importance of transportation:



Flow chart 1 – Importance of transportation

The above flow chart (1) explains the importance and output of improved transportation facilities. Economic benefits: Better production in both agriculture a industrial sectors, reduction in cost of production, reduction in scarcity, growth in foreign trade, specialization of labour and mobilization of resources, promotion of tourism.Social Benefits: More Employment Opportunities, Education Expansion, Social and Cultural Spirit, Higher Standard of Living, Relationship between Villages and Cities.

Modes of transport:

The means by which people and freight achieve mobility are transport modes. They fall three basic types– land (road, rail and pipelines), water (shipping) and air (table 1)Any facility where passengers and freight are assembled or dispersed is called a terminal. Terminals are points of interchange involving the same mode of transport or a point of interchange between different modes of transportation. Sometimes large transport terminals become the locational hub to their location since they become only points of transit between different segments of the transport system or the status of gateway in that area.

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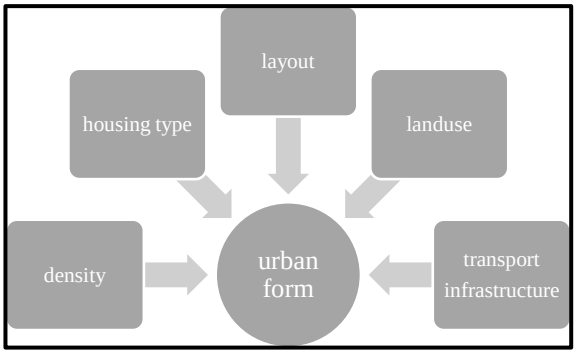
II. Literature

Transportation and urban form: Urban form is the study of human immigration and process of their creation and revolution. Due to the country's adoption of a mixed economy, which gave rise to the development of the private sector and acceleration to urbanization.

Role of transportation in urbanization: Transportation points develop or destroy the cities. Well-organised, cheap and economical transport facilities are of the first importance in the economic and social life of our cities and towns. Transportation system shapes metropolitan form and the form of metropolis shapes the transportation system. Thus, transportation, both intercity and intra city, is of prime concern of both urban and transport planners.

Elements of urbanization:



Flow chart 2 Elements of urbanization

Density: It gives the measure of number of people living in an area. By knowing the density we can figure out the culture of the area. Housing type: Buildings are the most pronounced elements of urban design - they shape and articulate space by forming the street walls of the city. The characteristics of housing in urban settlements can have an important bearing on everyday living: it hasbeen noted that residents living in low– density dwellings with large gardens will have distinct experience of urban environment fromhigh—rise apartment dwellers.

Layout: Layout describes the configuration of elements of streets, public spaces, blocks and buildings. Layout is important influencer. Public spaces make high quality of life in the city possible. Example the grand avenue "the Champs– Elysees in Paris to small intimate pedestrian streets.

Transport infrastructure: Transport systems connect the parts of cities and help shape them, and enable movement throughout the city. The quality and character of cities is defined by these various modes of transport, and that makes the cities either friendly or hostile to pedestrians.

Land use:The term land use is used to describe the different functions of the environment. Within the urban context, the dominant land use tends to be residential but a functional urban area requires industrial, retails, offices, infrastructure and other uses.

Road ways	Railways	Airways	Waterways
India encompasses of the second largest road network in the worldroad network of over 5,603,293 kilometres (3,481,725 mi) as in 2016.	Indian Railways has the largest rail network in Asia and also is the world's second largest rail network. Indian Railways transports almost 2.5 crore passengers daily	Major Indian airports provide both domestic and international flights. The Indian airport transportation network of effectively fulfils the needs of massive tourists and visitors who are arriving in the country from distant locations.	India forms one of the biggest peninsulas in the world with a coastline of more than 7,500 km. India has 13 major sea ports and about 200 non-major sea ports and intermediate ports
Cars, taxi ,van , bus, motorcycle, bicycle, rickshaw, carts	Local, suburban, monorail, metro, trams.	Passengers ,cargo	Ferry, cruise, cargo

Transportation problems: Road congestion**:** As populations increase, the average travel distances and intensity are expected to increase because of direct correlation between them.

Air pollution:The intensity of air pollution in Indian cities is judged based on CPCB's (Central Pollution Control Board) air quality classification.

Deteriorating traffic rules:Deteriorating road safety affecting transport infrastructure development. People driving habits/ manners leading to more accidents and problems like ongestions, these also includes the government transport drivers.

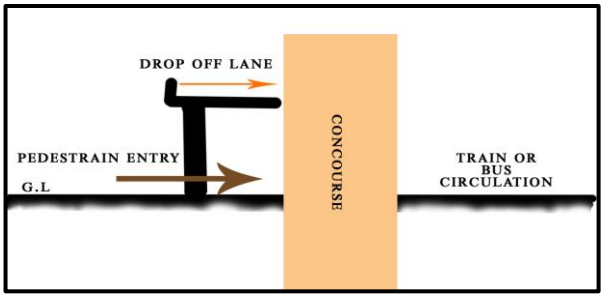


Image 1

Parking problems: The space required for a family of four (range from 85-250 sq. ft. depending on income level) is less

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than a car (typical spot = 280 sq. ft.). The shortage of parking spaces both on and off the streets in Indian cities increases the time spent searching for a parking spot and induces traffic congestion.

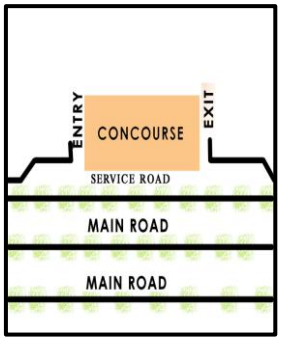

Image 2

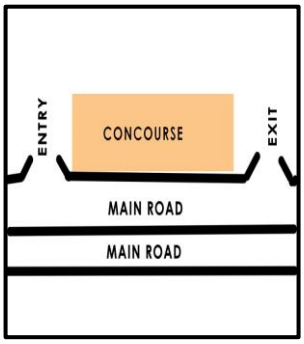

Image 3

Survey and interview results: In the survey and interviews of people of age group ranging from 18-47 years, either being a student or businessman or career hustlers having roughly income below 25,000 / 50,000 to 1lakh rupees. It is noted that most of people use public transports (trains, buses) on daily bases, these mode of transport varies according to different states. People are satisfied by current transit hub (bus stand /train station) structure, but they have problems like traffic congestion, hygiene, bad pedestrian walkways around the transit hub. Regarding the safety of people at night and daytime, many commented that it is being improved in past few years. Most of people suggestion were about the hawkers occupying space on the walkways, not giving a clear pedestrian walk and creating more confusion and about parking problems.

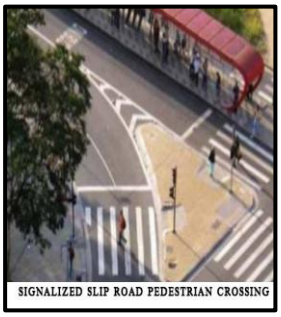

Image 4

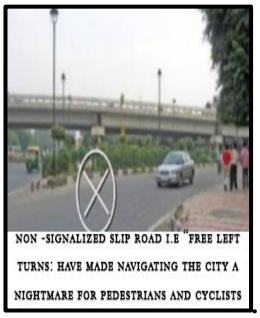

Image 5

III. Results and design principles

After interviewing various people, getting results from the survey conducted, case studies, simple observations and by applying architectural standards following are the design principles:

Image 6

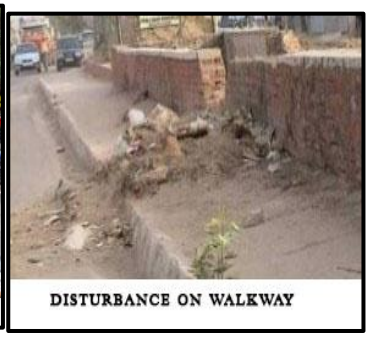

Image 7

Levels: It was observed that all the circulations (vehicular/pedestrians) everything happens on horizontal level creating more confusion and hustle for the users (Image 1). The solution for problem could be making things happen ondifferent levels (Image 2).

Entries / exits: The entries /exits of the transit hub (railways, bus stands) spills out straight on the main roads and disturbs the flow of the traffic (Image 3). The flow of traffic would be less disturbed if an entries and exits of the vehicles would be from a service lane or a by lane. (Image 4)

Image 8

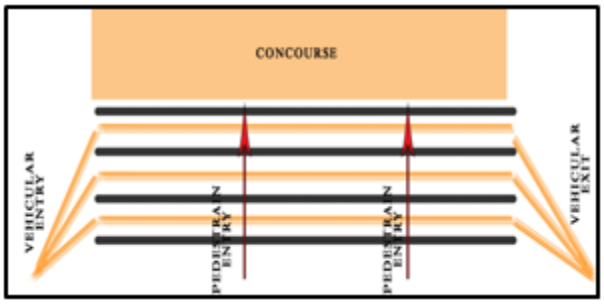

Image 9

Kerbs & slip roads: Decreasing turning radius of the slip roads increase safety of pedestrians, by shortening crossing

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distance, decreasing vehicle turning speed and makes drivers look out for pedestrians while taking turn. Slip roads in many cities are meant for the "signal free "movement of traffic and to spare the left turning traffic having to wait at traffic lights to take turn. This design feature has made crossing for pedestrians, cyclist and physically challenged people difficult to cross the road. The solution to this problem would be a signalized slip road or introduce a slightly raised crossings.

Footpaths: Footpaths should be considered as a transportation system which is connected and continuous just like roads and railways. Consistency of design elements, colour and texture help provide visual continuity and clam traffic even at crossing

Hawker's zones & frontage zones: Attractive windows and hawkers in shopping districts or entries leading upto a building create stoppages for pedestrians or users of the building. This disturbs the speed of pedestrian's traffic at the entrances of transit hub/ station. These hawkers take up about 0.5 to 1 meter additional space which must be provided in order to provide conflict free movements. In the survey, most of people answered saying these hawkers create disturbance and spoil the whole setup of the transit hub (Image 9). Actually, a design solution to this could be that, the hawkers could be placed and planned accordingly (Image 10).

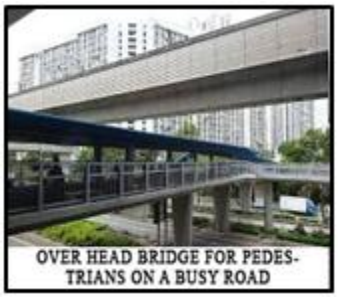

Image 10

Image 11

* Street busy, vibrant and safe .
* A variety of retail options and cheap food.
* Mixed-use and encourage walk trips in a city planned predominantly based on private vehicles.
* Generate self-employment for large number of people

Foot over bridge and traffic calming:

Foot over bridges are one of the alternative for roads where crossing distance cannot be lessen. They are to be provided only under circumstances (Image 12). Some other options for crossing could be undergroundcrossings or at grade crossings or traffic calming. Traffic calming is management of traffic through combinations of various devices and techniques, through this management technique the safety of pedestrians, residents etc is more, and it reduces vehicular speed and enhances the quality of life. The streets can be kerb less and paved with different materials to give impression of low speed or only pedestrian zones (Image 11). They can also be paved to create friction and lower the speed of vehicle. Boulevards or trees can be planted creating a physical barrier for vehicles in pedestrians dominated areas.

Image 12

Image 13

Image 14

Image 15

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Street tree planting: A transit hub becomes a heating island with all the vehicular moments and the area around has very less tree to compensate for the heat released. It is observed how badly trees and footpath are constructed (Image 13). The image 14 shows a proper way of planting trees. Following are the reasons, how planting trees is beneficial: Provides shade to pedestrians and cyclists. Reduces local ambient heat through shading the surfaces and making cool, comfortable for users to use.Absorbs pollutants and improve local air. Helps create a sense of enclosure and place making on streets for street furniture. Flowering or deciduous trees create a change seasonal urban experiences. It is observed that utility easements are placed on the footpath at side of a tree .Pedestrians corridor and utility easements must be placed separately from tree planting zones. Ideally utility should be placed in ducts or duct banks. Tree granting finished at the same level as pavement allows people to walk over them while still allowing water, air nutrients to access the roots.

Public toilets and dustbins: It is observed people use unwatched boundary walls of public spaces as public toilets and dustbins. Solution to this problem is provide

Image 15

Image 16

toilets and dustbins every 500-800 meters (5-8 minutes' walk) from each other and other destinations. Public toilets should be environmental friendly SulabhShauchalayas because: They don't smell .They consume less water and easy to clean .They can be used for techniques like biogas production etc. for generation of electricity. They provide employment.

Street lights: It is observed that the height of the street lamps is so much that it does not serves the purpose. The main intent of street light is: Safety of road users. Increase security and keep street active after dark. Provide visual night time environment .Reduce night accidents. Before placing the lights light engineer has to be consultant and necessary calculation has to be done.

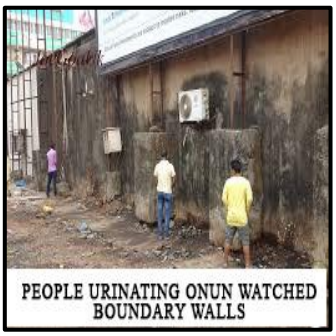

Image 17

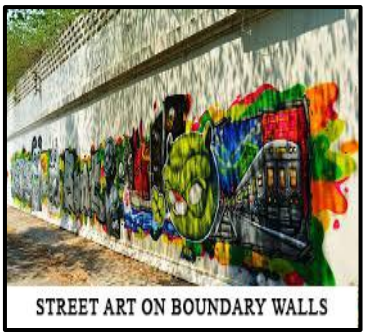

Image 18

Image 19

Boundary art: It is observed that there is no feeling of belonging, pavements are not maintained and boundary walls are abandon, therefore things like these happen.

Street furniture & signage: seating is an essential piece of street furniture which provides pedestrians and public transport users a place to rest or pause in the middle of their fast busy life.. In India many places have lack of these places the pictures taken in Mumbai shows the condition and need of such furniture. Also, to promote more public transports there

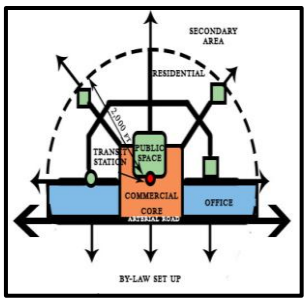

Image 20

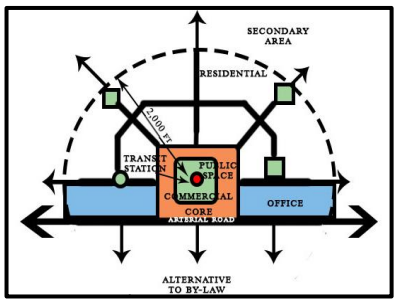

Image 21

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should be adequate maps showing the routes and boards showing timings of buses at the road side stops. Banners to be placed properly because they add a sense of place and identity to unique neighbourhood or a destinations.

Buffer zone: It is observed according to rules (image 20) transit hub are always in centre and are heating islands in that area, but an alternative (image 21)where transit hubhas a buffer of trees around it so the pollution is lessen , sound pollution is lessen and it creates an urban space which plays with physic of the people .

Conclusion

The current condition of transit hub (railway station /bus stand) and area around it in India is bad. This majorly affects the health of people phycology of people and countries infrastructure. By changing some small regular approach, it can make a big difference in improvement of the infrastructure and life of people around transit hub.

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Building Forms- An Inspiration Through Nature

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Abstract: Nature has been an inspiration and influence of many design theories. Nature-inspired designs by architects and designers have a long tradition. It is important to study nature to decipher the holistic relationship between human, buildings and nature. Following nature's trail by understanding the patterns, strategies & principles is necessary to create man-made system, structures and forms for better functioning and efficiency. Nature-inspired designs or Biomimicry have several levels. These levels include visual, abstracted, conceptual or computational designs. The main objective of this research is to understand the levels of Biomimicry. The understanding is achieved by case-study method of different levels and typologies. This is an observational type of research, where the methodology used follows qualitative analysis of selected case studies. The case studies are based on, Simulation that is the visual level of mimicking that involves literal translation or abstraction of building forms from nature. In this research paper, Lotus temple, Delhi and Guggenheim Museum, New York are studied in detail for understanding of simulation. Further cases depend on Interpretation that is the conceptual level of mimicking involving the understanding of the principles of nature i.e. geometry, structure and its functioning. The outcome of this study enhances the level of understanding of biomimicry. This could further be used to propose certain parameters for future designing of nature-inspiredbuildings

Key words – Biomimicry, Forms, Nature

INTRODUCTION

In the present age, where the world is undergoing drastic changes with the increase in population and usage of natural resources there is a dire need of a direction that leads to restorative and regenerative human systems that further leads to a sustainable world. A way forward could be by imitating to design improved and innovative solutions for architectural building form. To better understand the levels of biomimicry, it is necessary to understand various possibilities or approaches within biomimicry. The basic two strategies are top-down and bottom-up approaches, the former states the process of design looking at biology whereas the latter refers to biology influencing designs. Under these two approaches fall other categories like Simulation, interpretation, Integration, Replication and. Emulation relationship between buildings and nature. This research aims to study the aspects of nature and their inspirations

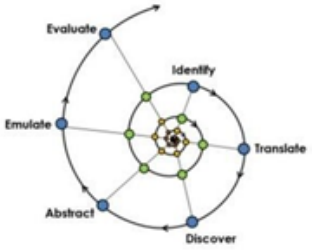

Figure – 1 Biomimicry Design Spiral (source- *Biomimicry- an analysis on contemporary biomimetic approach by SakthivelRamaswamy*

1.1 Simulation

nature to solve these complex human problems. Research on nature-inspired designs by architects and designers has a long tradition. Even before designers, indigenous cultures have mimicked nature in the process of coexisting with nature. The earliest examples being caves and leaves or trees to escape harsh natural conditions. The Greeks have been inspired by the organisms having balanced and harmonious proportions. Architects like Le Corbusier, Frank Lloyd Wright, Antoni Gaudi etc. have always used nature as a prominent source of inspiration. "Yurta" an invention in 2000 B.C. to Gaudi's master pieces in 21st century the growth has been quite revolutionary.

Biomimicry means designs inspired from nature by understanding its form, principles, function and processes. The nature-inspired designs can be classified into three major levels that are visual, conceptual and computational. It is important to study these levels to obtain or establish aholistic. This involves mimicking or copying the appearance of forms from nature to design buildings and structural forms. The form, the skin, the movement and other visual attributes becomes the source of inspiration with the designer borrowing one or more of these attributes to the design. Simulation that is the visual level of mimicking involves literally translated or abstracted building forms from nature. Most buildings out of this approach are given biomorphic character by enlarging the scale of the inspired naturalform

1.2 Interpretation

This involves understanding of the principles and functions of nature and interpretation of the same in buildings.

1.3 Integration

This approach tries to integrate the tectonics derives from

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forms in nature along with system or functions to make structures work in harmony with the surroundings.

1.4 Replication

This can also be termed as elementary biomimicry in which nature is mimicked as a cohesive whole not by a particular form, function or process. This level tries to attain the integrated functionality that is observed in nature like plants and organisms.

1.5 Emulation

This level is also termed as advanced biomimicry, which is based on modelling natural processes to the degree of self-rectification.

This research furthers talks about Simulation, Interpretation and Integration in detail. The question in this research is to understand how far these ideologies are reflected in our built environment and what the future possibilities of the same will be applicable to achieve a sustainable ecosystem.

LITERATURE REVIEW & METHODOLOGY

The literature on Bio-mimicry has fluid boundaries. A lot of research papers have been published on the same, further its possibilities depends on the topic of discussion or inquiry. In 1997, Benyus described biomimicry as being from the Greek "bios", which means life, and "mimesis", which means imitation. According to Benyus(2007) designers are mimicking the nature-inspired level as what the organisms have learned to do. Zari (2015) claimed a design that is inspired from nature may imitate the characteristics of an organism, that may be inspired by the three levels that is behaviour or the ecosystem of the organism and its surroundings. Guild (2007) "Three levels of biomimicry that may be applied to a design problem are typically given as Form, Process and ecosystem.". Pawlyn (2011) in her research paper states the first level of biomimicry is the mimicking of natural form. This type of imitating is to copy an organism for its morphological attributes like its visual shape, components, materials or how it looks. The first level is to replicate an organism's design. The second level is to imitate the natural processes. This level is to copy a biological entity's emergence or actions and processes within its environment. The third level is the imitating of the natural ecosystems. The last level is a more complicated set of processes than the first twolevels.

METHODOLOGY

This would be an observational type of research, where the methodology used would follow qualitative analysis of selected case studies. The Primary source would be book case studies & Secondary sources would be research papers andreviews.

The case studies are selected under two categories:

1) Simulation- Lotus Temple, New Delhi

2)Integration- 30 St. Mary axe (The Gherkin), London

The Parameters that would be studied in the case studies are Form, Function and Process. The outcome of this study will help to decipher a basic design theory, it will also enhance designers understanding and help them to determine which aspect of "Bio" to "Mimic" (Nurul, 2017)The field closely follows the paradigm of visual and conceptual inspirations from nature to obtain creative detail, mechanisms or shapes and structures in the Designs.

CASE STUDIES

1. Simulation

Direct mimicking or feigning the appearance of forms from nature is known as simulation. This approach helps in deriving forms, figures and metaphors by various designers and architects. Further using technology for representation of these mimicked forms from nature is used to express the designs. This level involves built forms which are literally translated or abstracted from nature**.**

1.1. Literaltranslation

In this approach nature's form and appearance are copied or mimicked literally, where in the scale would vary from the original form that is being mimicked.

1.1.1. Lotus-Temple, NewDelhi

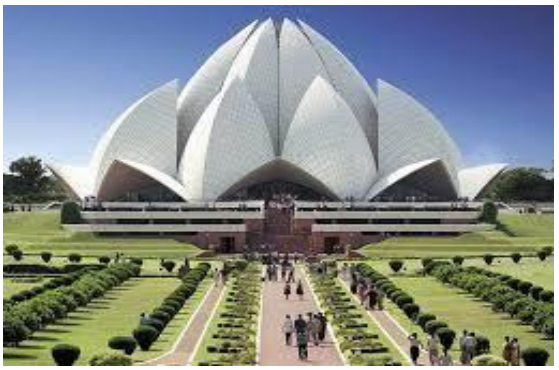

Figure – 2 Front Elevation- Lotustemple
(source- google image)

The structure is inspired by the lotus flower and is arguably one of the most visible instances of biomimicry in contemporary architecture. Lotus Temple follows the same process of mimicking nature, it is inspired from the Lotus flower. Conceptually Lotus flower symbolizes purity and holiness in the tradition. The temple gives the impression of a half-open lotus flower, afloat, surrounded by its leave. All elements are in multiple of 9 as it is said to symbolise comprehensiveness, oneness and unity

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1.1.1.1 FORM:

The Lotus temple is organized as a nine-sided circular structure that is comprised of twenty-seven "leaves" (marble- clad free-standing concrete slabs), organized in groups of three on each of the temple's ninesides.

1.1.1.2 FUNCTION:

The aforementioned "leaves" are integral to the organization of the space and are classified into three categories: entrance leaves, outer leaves, and inner leaves. The entrance leaves (nine in total), demarcate the entrance on each of the nine sides of the complex. The outer leaves serve as the roof to the ancillary spaces, complemented by the inners leaves which form the main worship space. These inner leaves approach, but do not meet at the tip of the worship space and are capped with a dramatic glass and steelskylight.

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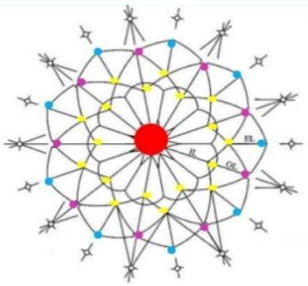

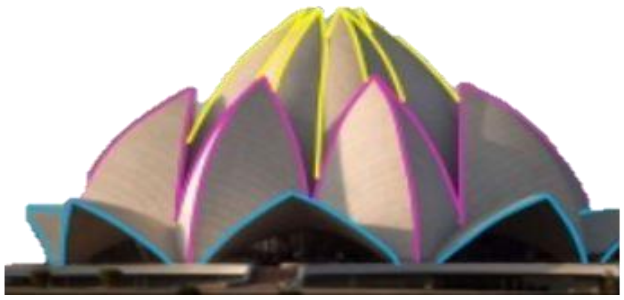

Figure – 3-Plan of Lotus Temple, 4- Elevation showing different uses of inspiration
(source- arch-daily)

2. Integration

This level involves design approaches that deals with integrating the tectonics that is mimicking the principles of nature through geometrical or structural interpretation and systems derived from nature. This is done so as to achieve self-efficient structures that work in harmony with the nature. The main aim is to achieve sustainability, a structure with low-energy consumption that would work with nature's dynamic systems.

2.2. The Gherkin (30 St. MaryAxe)

Figure – 5 Front Façade of The gherkin, 6- Elevation (source- google image)

The structure is called so due to its form resemblance to a young cucumber used for pickling. It is the first environmentally progressive high-rise structure that uses passive energy savingsystems.

The form is mimicked from a sea sponge known as, commonly called as Venus Flower Basket. It is a cylindrical sponge made of natural glass (bio silica). It grows till 6in in length with a strong exoskeleton. The tufts of glass fibres are about the thickness of a human hair and grows at the base of the sponge. The sponge has multiple layers of glass held together by an organic glue making it extremely resistant to cracking and breaking. It is arranged in a lattice or open crisscrosspattern.

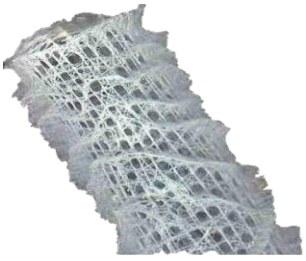

Figure – 7 Venus Flower Basket

(source- google image)

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The Gherkin mimics the shape and lattice structure of the sponge to do in air what the sponge does in water.

2.2.1 FORM:

As the Sea Sponge grows, it builds up a tracery of geometric regularity. These delicate frames are sufficient to support and protect the enclosed soft body of theorganism.

(ex. Fractals)

2.2.2. PROCESS:

The steel exoskeleton of 30 St. Mary Axe mimics the hexactinellid lattice of the Venus flower basket. It has a lattice-like, diagonally braced structure around the exterior that allows for an open floor plan without interior columns. The openness also provides a large amount of natural light penetration inside the structure.

2.2.3. FUNCTION:

The structure's air ventilation system is mimicked from the analogy of the sea sponge. The shape of the building defines the flow of wind just as the sponge helps water flow round it.

CASE STUDY	FORM	FUNCTION	PROCESS	ANALYSIS
1. Lotus Temple	Inspired through lotus flower	The leaves are divided into 3 parts separating different spaces		Simulation approach; only form is mimicked
2. The Gherkin	Inspired through Venus flower basket- Euplectella	Air ventilation system mimicked from the porous wholes of the sea sponge	Exoskeleton of the structured mimics the hexactinellid lattice of the sponge	Integrated approach where form, system and process is mimicked as that of the venus flower basket
ANALYSIS	Literal or abstraction of nature's form to achieve the structural form	By understanding the working process and system of nature and mimicking same so as to solve a problem	By understanding the morphogenesis in living organism to achieve working system of a building	Redefining the relationship between nature and buildings, to achieve and develop new sustainable technologies and structures.

Table 1- Analysis of case study

CONCLUSION

Nature inspired design approaches defined as simulation, interpretation, integration gives a way forward to achieve various built structures, achieving sustainability and efficiency. The analysis done on form, function and process gives an overview of contemporary techniques and technologies involved in the mimicking process.

Simulation approach copy the appearance and the form of natural forms to achieve a biomorphiccharacter.

Interpretation approach if done to achieve the underlying principle of nature and functioning of natural systems. Integration approach to biomimicry involves simulation as well as tectonic interpretation. Structures designed through integration achieve structural strength, functional efficiency and leads to a sustainable solution.

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Approaches of Adaptive Reuse of Heritage Structures

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Abstract: The cultural significance of India reflects in its heritage structures and architecture. Today they have started losing its essence as it is no more assigned a function, hence maintenance becomes an issue. Recently there is an increasing trend of reusing heritage structures in order to keep it lively whilst preserving the structure. Adding function to these structures is an effective way to retain the cultural significance of the structure. Adaptive Reuse enables such structures to continuously derive relevance from use and thus remain dynamically evolving. Apart from conserving the structure, its cultural significance should also sustain, which is seldom talked about in previous literature. This research focuses on different approaches of adaptive reuse and its effects. The research shall help in further studies regarding reuse of such culturally significant structures and the various approaches which can be followed.

Key words -Adaptive Reuse, Heritage, Cultural Significance, Hospitality Industry

INTRODUCTION

India is known for its diverse culture that reflects in its rich heritage. Most of our current architectural marvels have been designed long ago by our ancestors. Originally these were built to accommodate the rulers and their warriors and also a dignified shelter for the ruling family. The structures which were residences for the rulers and emperors; Forts and mansions, are today being preserved with no function to sustain. Since the grandeur and scales are not relevant to accommodate present living conditions, these significant structures should be assigned some function to keep them alive for the generations to come. Adaptive reuse has thus been practiced on heritage structures to conserve it and make them habitable and active. Yet simply assigning a function does not help in actually conserving its cultural significance – a sensitive approach towards reuse should be followed to ensure this. This study focuses on different approaches of reuse of forts and palaces to cater to the hospitality industry – Resorts and restaurants. The set parameters help in understanding how a particular space in the heritage structure is assigned different functions in different projects with the help of 3 case studies. The secondary focus of the study was about the use of materials for reuse and how it compliments with the original structure. Since hospitality industry requires various services which were not used in the olden days, a major concern in the study is about how the new services are added and treated with the traditional structure. New additions shall include toilets, hvac systems, kitchen services, lighting etc.

LITERATURE REVIEW & METHODOLOGY

"So much of our future lies in preserving our past" – Peter Westbrook. Thus reusing our historic structures in order to preserve its stories and culture becomes the most ideal method of preserving it, but while doing so we must be considerate enough to not suppress the significant character of the structure. As the time changes, the function changes and thus the requirements also change. Thus accommodating newer demands within the frame of an old structure becomes critical. So keeping this as a focus of the study , parameters were selected – reuse of structures into resorts and restaurants. The research was conducted with the help of case studies to understand the different approaches of reusing a heritage structure to serve the purpose of hospitality. The case studies selected are from 3 culturally different zones with certain significance- City Palace baradari (Jaipur) Chidambara Vilas(Chettinad), Jadhavgadh fort (Pune). These projects have a similarity – Palaces Reused to cater to hospitality industry, but the

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scales of the all 3 projects were different; for understanding different outcomes of similar functional change. Qualitative analysis of these cases has helped in understanding various approaches of reuse of heritage structures and the factors affecting it.

JADHAVGADH AS A CASE

The Jadhavgarh Fort was transformed into a heritage hotel, which would cater to leisure travelers and provide quality banquet services for large gatherings. The 30,637sqft. Fort was restored by Ar.Karan Grover in 2007. The fort resort has 57 rooms comprising of 3 suites, 38 rooms of various types, 12 royal tents and four Neem cottages spread across the fort's three wings.(Jadavgarh Fort, n.d.) The fort reflects the symbolic Maratha architecture which compliments the idea of a luxury resort. The sprawling lawns serves the perfect destination to host weddings, the pool side seatings and spa offers rejuvenation to the visitors , a one of a kind "aaimueum" exhibits exquisite artifacts and the rooms and tents offer a place to stay.The restoration is a mix of olden charm and modern-day luxury, but the exteriors have been treated to hold on to the Maratha charisma. Visitors are welcomed at the grand darbar (Fig. 1.1) which houses the information desk and reception (Fig. 1.2). Traditional Maratha seating's and the cool environment due to the stone structure creates a soothing effect upon entrance. Within the fort central courtyards act as gathering space for tourists and outdoor sitting for an inhouse restaurant. A pool and spa area (Fig 1.3) located on the first-floor terrace which is a calm silent zone with 2 huge neem trees retained during the restoration to create a cool micro climate. A restaurant named "chhajja" has indoor, outdoor and balcony seating options , where the balcony is the chhajja over the main darbar entrance (Fig. 1.4). Though the interior of the restaurants showcase a stark different look with bright yellow lighting , not so rustic furniture , tiled flooring building the ambience of a present day restaurant (Fig. 1.5).The same case follows in the rooms where the interiors(Fig 1.6) do not compliment the traditional Maratha exteriors creating diverse contrast from outdoors to indoors. The use of identical materials and finishes in the interiors would have helped in creating a holistic feel throughout the Fort.The new services could be easily identified on the characteristic Maratha backdrop- with ducts visible on a façade(Fig 1.7) to Hvac systems placed outside cottages(Fig 1.8) but toilet pipes were sensibly concealed by stone walls and creepers(Fig 1.8).The food was transported to the upper levels via trolley systems (Fig 1.10).Overall a gap was ascertained in creating a holistic appeal of a Maratha resort due to the presence of opposing "present day appeal" in specific spaces of the fort.

Figure 1.1 - The entrance Source- www.hotel.com.au

Figure 1.2 - The reception Source- Author

Figure 1.3 -Pool Source- Author

Figure 1.4 - Cafe Chhaja Source- Author

Figure 1.5-Chhaja Interior

Figure 1.6 – Rooms
Source-(Fort Jadhavgadh, n.d.)

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Figure 1.8 -HVAC system
Source – Author

Figure 1.9 - Pipelines
Source – Author

Figure 1.7 -Service duct
Source – Author

Figure 1.10 - Services
Source – Author

BARADARI , CITY PALACE JAIPUR AND CHIDAMBARA VILAS AS A CASE

Baradari Restaurant -Situated at the avenue of City Palace Jaipur an amalgamation of historic revelations and contemporary additions is a fine dine restaurant which was created as an extension to the original palace café. The restaurant is a 14,000sqft. space divided into indoor and outdoor zones. The indoors have a royal yet modern touch with the traditional Jaipur Thikri work coordinated with marble and Tiled flooring (Fig 2.1). The furniture remains subtle and blends with the structure. Toilets have abundant marble and glossy finished surfaces which affects the holistic impression of the palace (Fig 2.2). The structure was given a new expression by stripping of layers of cement and paint and repairing the exposed rubble masonry with lime mortar. The courtyard was envisaged as a binding element between the city and the museum.(Adaptive Reuse – Baradari, City Palace Jaipur by Studio Lotus, n.d.)The handcrafted marble and brass pavilion with 12 columns magnify the historic character of the palace. Some adaptations in baradari were: the administrative block, now the bar with its rugged, distressed columns. Though the building boasts of rich stone work, an inconsistency is design is identified. All columns were not identical giving it an "Flawed look".(Jaipur's City Palace gets a newly renovated cafe, 2016)

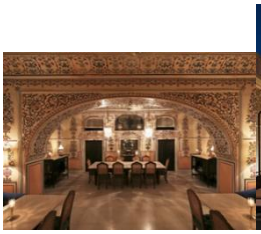
Figure 2.1 -Interior

Figure 2.2 -New additions
Source – (Adaptive Reuse – Baradari, City Palace Jaipur by Studio Lotus, n.d.)

Chidambara Vilas, Chettinad -A 110 year old palatial mansion once a residence of NattukottaiChettiars,was converted into a heritage hotel. The structure pursues a diverse style combining Indian and colonial architecture where the spatial hierarchy is conveyed through variation in décor ranging from highly adorned to simple and practical as one moves through the mansion. Local material and workmanship was used to carefully restore the mansion without disturbing its essence.(Ranee Vedamuthu1, 2014)Facade treatment of the extension (Fig 3.1) matcheswith the historic fabric by incorporating the traditional elements like parapets, stucco, columns, arches, and color scheme. Provision of attached toilets in guest bedrooms have been done carefully by providing a channel in the walls to accommodate the plumbing lines so as not to interfere in the overall appearance. Minute detailing like electrical accessories in the form of switches and switch board (Fig 3.2) have been replicated following the original details but with new material. Services like sewage treatment plant, water recycling and treatment plant and electrical room are planned in a discreet manner. Replacement of broken Aathangudi tiles on the roof and floor using Aathangudi tile masons to restore the existing pattern and color. Material restoration was done delicately by preparing local chettinadu plaster on site and applying wherever plaster had given way. The guest rooms and dining area has upheld the simple traditional appeal with the help of wood ,carvings and typical tiling patterns.(Fig 3.3) The extensions required to accommodate modern hotel requirements like guest rooms , toilets , hvac , lighting , water supply , drainage were done following the Chettinadu

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architectural style. A responsive approach is seen while adding these new spaces to maintain the historic fabric of the mansion.

Figure 3.1 -Exterior after reuse
Source -Research paper (Ranee Vedamuthu1, 2014)

Figure 3.2 -Minute detailing for reuse
Source -Research paper (Ranee Vedamuthu1, 2014)

Figure 3.3 – Rooms and dining
Source- (Chidambara Vilas, n.d.)

PARAMETERS	BARADARI,JAIPUR	JADHAVGADH,PUNE	CHETTINADU MANSION
Holistic Visual appeal	Blending modern material with traditional effortlessly.	A visible change between new and old structures.	Delicate material restoration to maintain the original character
Functions Accommodated	Fine dine Restaurant	Heritage resort and banquet	Heritage resort
Furniture , lighting and HVAC	• New simple furniture • Low energy electronically-controlled LED lighting systems • Energy efficient air-conditioning systems	• Restored old furniture and added new ones • Halogen lights used majorly • Hvac ducts visible on the rear facade	• Furniture with Chettinadu detailing. • Discreet planning of services
Overall Apeal			

Table 1.1 – Comparative Analysis

CONCLUSION

Adaptive Reuse of heritage structures into resorts has its own complexities regarding additional services and treating them such that it compliments the heritage character of the structures. This can be done is various methods depending on the major factors– The notion of the architect, availability of skilled craftsmen and traditional materials. No approach can be specifically termed as a Hence an holistic and sensitive approach ascertains beneficial results.

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude from the bottom of my heart to my mentor, ArNinadRewatkar for his valuable guidance, inspiration and encouragement. His support helped me to reach an irreproachable destination.

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To Experiment, Affordable Temporary Night Shelter For Homeless, Using Paper-Mache

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Abstract : Food, clothing, and shelter are basic human needs. However, many barely manage to fulfill the first two necessities and the third remains beyond their reach. Slums can provide an escape, yet individuals often cannot afford them. A large section of the population, therefore, lives and sleeps at public spaces, like pavements and streets, and is categorized as the homeless population. Hence, there is a need for temporary shelter which is affordable to the homeless people. In order to suffice the need for a temporary shelter, the research focuses on exploring the possibilities and drawing parallels using 'Paper Mache' as the only construction material.

Key-words- affordable, temporary-shelter, homeless, paper-mache, weather-resistant, eco-friendly.

Introduction

Every metropolitan city has both positive and negative sides. The positive being, it gives hope to the dreams of the people and exposure to various opportunities such as – a better living, reach out to all the facilities and more. The rapid growth of the city and its population, due to which the competition is getting tougher day by day, giving rise to the space crunch in the urban cities.

Many authorities, a group of environmentalists, and the government, together, are coming forward with various schemes and concepts to overcome the upcoming crisis in the future. In the current scenario, one part of the city is highly developed with all the necessary amenities, including leisure activities, while the other part of the city is filled with slums, unhygienic shelters and many without even a shelter.

The basic human needs are – food, clothing and shelter, however, many barely manage to fulfill the first two necessities, but the third remains beyond their reach. This is because people migrate from rural to urban, in need of a job and a better lifestyle, some of them manage to get what they want but the rest of the people end up working to earn at least for the survival, and then add up to the population of the homeless people.

A large section of the population, therefore, lives and sleeps at public spaces, like- footpaths, pavements, and streets, and is categorized as the homeless population. Homeless attempts to create shelters out of tin, cardboard, wood, and plastic, which becomes a temporary shelter without weather-resistant properties. Also, these types of shelters are difficult to handle, non-portable, and need lots of materials that make the product unaffordable. Slums can provide an escape, yet individuals often cannot afford them.

Thus, homelessness can be defined as a condition of people lacking housing, because they cannot afford or are unable to maintain a regular, safe, and adequate shelter. Hence, there is a need for temporary shelter which is affordable to the homeless people.

Temporary shelters are a service, for homeless people, which offers temporary residence to prevent one from exposed weather conditions and provides safety. Affordability depends upon the material chosen to build the shelter. While researching on the selection of the appropriate material for the experiment, the research came across the artifacts, sculptures and models made up of paper-mache which can be held in any shape possible along with the unbreakable strength after casting and resulting in the light-weight model.

These properties influenced the selection of the material, i.e. Paper-mache.

Hence, Paper-mache is being selected out of other materials (which cross the affordable limit) for the construction of the affordable temporary night shelter for homeless people.

In the latter experiment, the shelter modules made with the paper-mache were treated with waterproofing and fireproofing solutions to make the structure and prevent the individual from exposed weather conditions.

Literature-Review

A paper by Piyali Ghosh, Geetika Goel, Mohit Ojha, Homeless shelters in urban India: life sans dignity, 2002 [i] Talks about the cities in India that are already struggling to meet the rising demand for infrastructure development which are kept under increased pressure to accommodate continuous inflow of people from rural areas and from smaller towns and other cities.

A paper by Chandra Sabnani, The Use of an Unconventional Construction Material for Affordable Housing in India, 2017 [ii] Rapid growth in the urban area results in the creation of sections within the society with limited means, pushed into a life long struggle for survival. In such a scenario, even the basic needs are not possible to be met with.

A Paper by Dr. Julia Wardhaugh, Rural homelessness in India, 2012 [iii] Talks about Rural poverty and landlessness leads to rural-urban migration, which in turn increases the level of urban homelessness. Government responses may either be to improve rural infrastructure and thus attempt to prevent the causes of rural-urban migration, or to attempt to regulate the lives of the urban homeless population.

A paper by Gordon Solberg, Waste Paper produces Low Cost Housing, 2002 [iv] In this literature, low-cost housing by using paper with concrete has been discussed, which initiates the idea of structures made by using paper. It can be shaped in any form, is light-weighted after been cast and is cheap compared to the other materials used in the construction.

A paper by Hakan Arslan, Re-design, re-use and recycle of temporary houses, 2007[v]. Temporary houses made for homeless people should be reused, easy to cast and affordable.

A paper by Chandra Sabnani, The Use of an Unconventional Construction Material for Affordable Housing in India, 2017 [ii] The literature raised the possibilities of using unconventional materials to provide the urban poor population to overcome the affordability factor instead of using conventional materials.

In a paper by Antonio G. Valdecasas, Ana M. Correas, Carmen R. Guerrero, Jesús Juez, Understanding complex systems: lessons from Auzoux's and von Hagens's anatomical models, 2009 [vi] and Elizabet Nijhoff Asser, Lost fingers, scurfy skin and corroding veins – conservation of anatomical paper-mâché models by Dr. Auzoux, ICOM COMMITTEE FOR CONSERVATION, 2008 [vii] states that the models made up of paper-mache material has good strength, durability, easy to cast and inexpensive.

Materials and Methodology

Paper is the only material, which is easily available, reusable, lightweight and eco-friendly. Paper Mache is a mixture of paper with water and glue. Newspapers or any other old paper (avoid glossy and thick papers) are used in the making of the mixture. The main objective of the research is to study material behavior, examine the structural stability, testing against weather conditions and lastly comparing the cost of the module.

Procedure

(Note – The experiment is carried out manually and at a lower scale, i.e. 1:10, hence, the requirements of the amount of the materials are accordingly)
The following are the required materials for the execution of the experiment.

- 4-5 Newspapers,

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- 1/2kg Fevicol,
- 1Litre of Tap Water,
- Vessel/bucket, and
- Plastic formwork (according to the shape and size finalized)

Stage-1

- Take the newspapers, cut it into pieces, and keep them in a vessel/bucket filled with warm water.
- Let the paper soak and submerged into the water, for several hours or overnight.

Stage-2

- Once the pieces are soaked fully, mix it, blend it with the hands, and squeeze it through the fingers until it looks and feel similar to the oatmeal. If necessary add a bit more water and let it soak for a little longer.
- Drain (75-90)% of water while carrying out the paper mache from the bucket and keep it aside in a vessel for further mixing.
- Now add 1/4kg fevicol, which acts as a binding element, to the Paper mache and mix it well until it looks and feels similar to the dough.
- For this particular experiment, as plastic is smooth and can be easily removed, a plastic bowl is used as formwork. It can be used for n number of times as a formwork.
- Now, apply the mixture, immediately after mixing the fevicol with the paper mache, onto the formwork. This continues until it is up to the required thickness for the module.
- Keep it under the sun rays, until it dries too hard like a stone. It takes around 2 days of sunlight to dry up from the outer side. Now take the formwork off, and let it dry from the inside, under the sunlight, for 2 more days.
- The same procedure is repeated to have 2 modules in total for the experiment purpose.

fig. 1. Module before drying

Stage-3

The above procedure is carried out to create a base for further experimentation.

- Modules 1 and 2 are further treated with a polyurethane coat and white cement + URP coat, respectively.
- Module 1 is treated with a polyurethane coat, 3 times, from outside and inside of the module. While
- Module 2 is treated with the mixture of White cement + URP until it attains a thickness of 2mm. After applying the coat, leave the model for several hours/overnight to dry completely.

Test for Water-proofing

module 1 and module 2 were further kept under tap water for an hour to check for absorption.

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fig.2. Module 1 fig.3. Module 2

Test for Fire-proofing

module 1 and module 2 were further kept in the presence of fire flame via lighter to check if it catches the fire or not.

fig.4. Module 1 fig.5. Module 2

Cost of the module

The cost of the module (made up of paper-mache) is low as compared to the other materials used for making temporary shelters out of tin, cardboard, wood, and plastic. This is because the primary material for the experiment is the newspaper, which was reused and easy to find at any recyclable material collector's store. The other supporting materials were bought in bulk once and can be used several times on the number of modules possible.

Observations

The below table is the observation during the procedure of making the module

Criteria	Before Drying	After Drying
Strength	Loose and Weak	Hard and Strong
Weight	Heavy	Light
Color	White/Light in color	Dark

The below table is the observation during stage 3 and tests against weather conditions.

Criteria	Module 1	Module 2
Treated with	Polyurethane (PU)	White-cement + URP
Weight	No change	Increase in weight
Cracks	No forming of cracks	Forming of cracks
Water-Proof test	Absorbs water	Does not absorb water
Fire-Proof test	Catches fire	Does not catches fire

Result

After casting, the modules are hard enough as stone, durable, reusable, lightweight, easy to handle, and eco-friendly. It does not break even after throwing it from a height.

Module 1, i.e. treated with Polyurethane coat, does not prove to be appropriate for the building of affordable temporary night shelter using 'Paper-mache', because it soaks water in and loses the stability. Also, it catches fire easily because the polyurethane coat is plastic in nature. While, Module 2, i.e. treated with White-cement + URP coat, proves to be appropriate for the building of affordable temporary night shelter using 'Paper-mache', because it is waterproofed and does not catch fire.

Conclusion

Paper-mache can be used as a basic material to build various kind of temporary structures which is affordable to homeless people, however, it needs to be treated with White-cement + URP to make it weather resistant.

Due to its light-weight and scale, it can be transported and stacked easily.

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Impact of Building Performance on Quality of User's Life in Housing Society in Pune City: Case of Yashashree Society

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Abstract: Building Performance Evaluation (BPE) is the process of evaluating the performance of the building post construction and post occupancy. Various nations carry out BPE's based on their cultural, institutional and other parameters. In Pune city, where lifestyle is constantly changing (modernization), housing is in demand. Implementing BPE is important. User satisfaction is one of the most important parameters, since it is one of the biggest investments of one's life. Yashashree society in Pune was studied in which, 25% of residents were interviewed using questionnaire method & Likert scale. Basic attributes like accessibility, safety & security, visual comfort, thermal comfort etc. are described, which would help architects for evaluating a building's performance and may become part of city's policies.

Key words – Building Performance Evaluation, Quality of Life, User Satisfaction

INTRODUCTION

Various nations have different light qualities, climatic factors, economic conditions and most importantly different lifestyles. Due to these and various other factors, performance of various buildings in all the nations differs. A person spends most of his or her time, if not quantitatively but qualitatively in his or her house. Due to this it becomes very important that houses perform well. But a modular housing system is followed in housing complexes as catering to every end user through design is extremely difficult and non-economical. Hence, in these scenarios, performance of buildings becomes increasingly crucial.

For the same there is need for theoretical framework to help architects / designers to design spaces that are more functional and which cater to all user groups. This research paper and the questionnaire prepared would help Architects who want to perform Building Performance Evaluation.

1.1 Building Performance Evaluation (BPE) and User Satisfaction

Building Performance Evaluation (BPE) is the process of evaluating the performance of the building post construction and post occupancy to reduce the uncertainties. Building performance evaluation is carried out in various nations based on their cultural, institutional and other parameters. There are internationally approved parameters and methods for conducting BPE. But even if this data is readily available for designers, it cannot be put to practice directly. As the region changes, a majority of this data becomes irrelevant as the lifestyle and the climatic factors go through a tremendous change. Due to this there is data exchange barrier. This creates a need for region specific and user specific BPE.

1.2 Importance in Architecture

With more and more BPEs being conducted and documented, a great database can be created for reference and can improve the quality of architectural education. Architectural education should promote architecture that originates from these concepts rather than these being compliance steps that are added later on. Architecture should focus primarily on the quality of space and then the aesthetics.

1.3 Pune and modernization

Pune is the educational capital of India, with students from almost all of the countries. It is also a huge IT hub (Hinjewadi). Apart from that it is located near the industrial area of Ranjangaon. On the other hand, Pune was the biggest administrative hub during Peshwa Era and still shows some similar characters. Basically, Pune has grown to house a huge Variety of users with striking differences in their lifestyles. Since there is a drastic increase in population in Pune, Housing demand increases and people of different regions and religions migrate. Designers design housings based on general parameters, in which they even forget some basics.

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At such a place, developing buildings that cater to specific user base in the best possible manner is unavoidable. A method to create such database is through the method of Building Performance Evaluation.

LITERATURE REVIEW

A house is a basic human need, this is the place where people spend most of the time. A challenging problem which arises in this field is giving quality of life to users. Housing is the biggest investment of one's life and one must get a better quality of spaces, indoor as well as outdoor. (Eziyi Offie Ibem, 2013)

A research paper- Quality of life- Meditation on People and Architecture, talks about promoting the importance of the concept of healthy living as an indicator of quality of life among architects by adopting a more familiar language to them. For this it uses an accepted historical theoretical framework. Architects are the one who designs for people, they should know what are the basic needs of the users so as to design spaces as per user satisfaction. Architects need to know what design strategies they should use while designing qualitative indoor air. (N Boschi, 2002)

This paper aims to give some categories which would help in housing quality analysis. These would be based on items related to spatial planning, location, aesthetics, cost attributes, physical or social barriers, etc. (Strossmayer, 2017). There is a growing appeal for constant assessment of quality of housing to meet the needs of users. A common strategy used to study this is Building Performance Evaluation. Various countries have different categories and tools of analyzing housing quality and knowing user satisfaction. There seems to be a common problem where nations have derived their own parameters of assessing the quality of housing, based on their cultural values or cultural context, institutional, user lifestyles and many other bases. (Fionn Stevenson, 2017)

As the industry moves towards providing better products in terms of houses and housing complexes, BPE becomes increasingly important. Worldwide, various housing performance evaluation tools are being used over the last decade. In the paper- Categories for Housing Performance evaluation (Ankita Srivastava, 2014), they have tried and assessed the degree of relevance of the identified categories in the popular tools used worldwide. An important conclusion from this paper was that there is a need of compressive indicators for housing performance evaluation in India, which could act as a basic reference to planners and designers in the field.

METHODOLOGY

The methodology to obtain the objective of this research paper were identification of attributes that would help in analyzing user satisfaction in a building, describing the characteristics of these attributes and preparing questionnaire. Attributes once listed would be vetted through opinions obtained by the users (residents) of the building, comprising of kids, teenagers, adults and elderly. Methodology includes rating scale (Likert scale) for each question. Effectiveness of questionnaire prepared and utility of data obtained depend on the choice of correct attributes, appropriate identification and description of their characteristics and converting them into easily understandable questions. Questions thus formulated need to be unambiguous, provide clarity to all possible types of participants and be amenable to analysis and interpretation. A near correct picture of actual performance of the built facility from the user point of view will enable facility managers to address pertinent issues.

Questionnaire would be similar for all user groups because every individual would have different opinions and would respond differently. From the total residents, responses of 25% of residents was considered for the survey; which involved 3 different age groups: 5-10 years, 25-30years and 60-70 years. Weekends were used for carrying out the survey, preferably evening time. Also, some observations were made by visiting different spaces in the society and apartments.

ATTRIBUTES FOR STUDY

Attributes for BPE	Characteristics of the attributes
Accessibility	Location of staircases and lifts
	Fire-fighting equipment's
Safety and security	Safety while using internal roads
	Safety in apartment due to railings, grab bars and grills provided
Illumination	Natural light affected due to orientation of house
	Provision of light in terms of safety while transiting between spaces

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	Provision of natural lighting in corridors, basements etc.
	Appearance of spaces
	Appearance and beauty of the open spaces around the building
Ventilation	Natural ventilation affected due to orientation of house
	Chances of choking or suffocation in spaces like parking, kitchen etc.
	Provision of ventilation strategies w.r.t energy saving
	Lack of vegetation around affects indoor air
Finishes and Aesthetics	Impact of internal and external finishes on inside due to outside peak temperatures
	Impact on finishes due to heavy rains

Table 1: Attributes of Building Performance Evaluation
Source: Author

Basic attributes which were analyzed by the questionnaire were related to illumination, safely & security, accessibility and aesthetics. One of the attributes considered in Building Performance Evaluation was accessibility, accessibility to different spaces and basic needs of users. On each and every floor, location of staircases and lifts becomes crucial. Another attribute was about safety and security. Do the users feel safe in the railings, grab bars and grills provides throughout the building? Also, the internal roads provided safe. Another attribute for BPE were illumination and ventilation: qualitative and quantitative.

Also, proper illumination in different spaces like lobbies, staircase, open spaces and internal roads contribute to safety of movement. This provision also improves appearance of the space. On the other hand, ventilation also gets affected. Lack of ventilation leads to suffocation and choking. Vegetation must also be sufficient for maximum ventilation in apartments. Provision of natural light and ventilation indirectly helps in energy saving. Finishes play an important role as far as aesthetics is concerned. Provision of good quality internal and external material finishes plays a key role. It also helps in temperature control inside the structure. When the outside temperatures are at peak, the finishes must stay. In case of heavy rain, as seen recently in Pune, the provision of good quality finishes plays an important role.

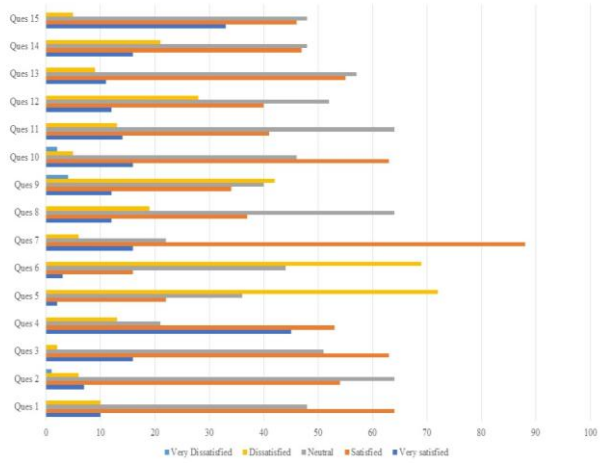

Figure 1: Graph showing responses by the residents for the conducted survey; Likert scale analysis
Source: Author

ANALYSIS OF RESPONSES

This study evaluated the performance of residential building constructed between 2010 to 2018 in Pune. The satisfaction level with accessibility within the building and safety & security in the housing was higher than any other aspects of the building, and the most important factor that determined user satisfaction was the apartment orientation: the quality and quantity of illumination and ventilation in the apartment.

Figure 2: View showing Yashashree society: considered for Building Performance Evaluation
Source: magicbricks

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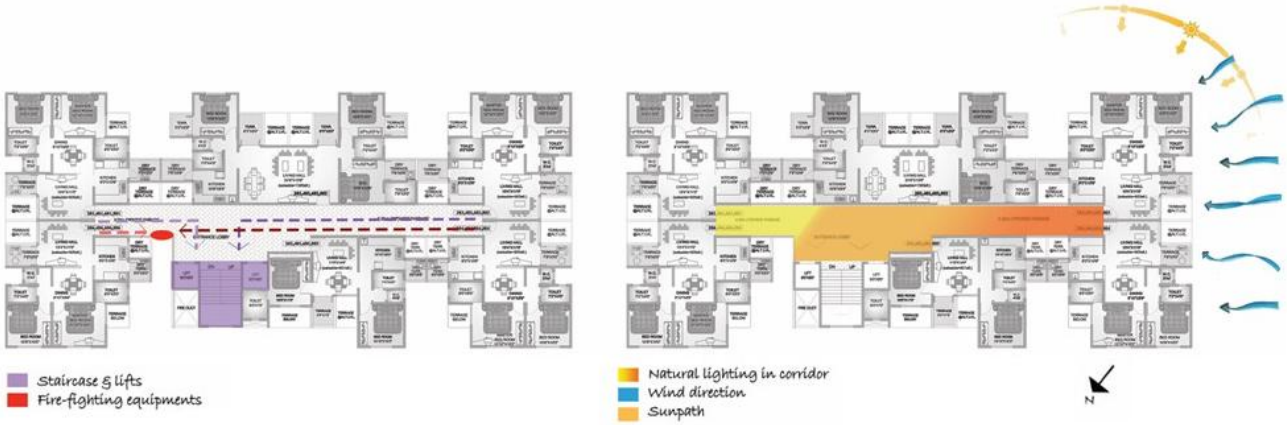

Figure 3: Plans showing basic attributes related to accessibility, illumination and ventilation
Source: Author, KNK developers

Findings from the survey show that in order to enhance the quality of life which the users have in the residential society in Pune city, and to meet the demands, expectations and needs of the occupants, several steps needs to be taken. First, there is a need to improve the quality of finishes used in apartment. Also, while designing lighting layouts and other such layouts, designer must keep in mind about movement, safety of users and aesthetics of the space. secondly, a significant improvement is required while designing and planning of housing societies to better reflect the current lifestyle of users and also address the status concerns of the target population.

The buildings evaluated happens to have long corridors, some apartments were close to them and some away. Similar happens when location of fire-fighting equipment's and daily services come into picture. In the buildings, the fire-fighting equipment's were places at a place which are closed to one apartment and away from another. This becomes critical in case of emergency. With respect to the safety and security factor, what was observed is the streets or the internal roads are very well used by people; by cars and by the pedestrian cyclists as well. Kids do play and adults do walk on these roads safely.

CONCLUSION

Generally seen, housing planning involves designing of a flat considering all spaces completely naturally lit and ventilated. But the flat on the opposite side of it doesn't get the similar benefit, as it is receiving opposite quantity and quality of light and ventilation. Thus, the concept of mirroring has this disadvantage. Architects needs to think of each and every material they provide in design in any building, that choice of material and finish would be governed by the climate and requirement of the finish. Every designer must think of while planning services like location of staircase, lifts and fire fighting elements, they must be centrally placed for ease of convenience. Provision of more plantation and equally dense vegetation is important as it affects the ventilation of indoor spaces of structure.

This research would help analyzing and modulating parameters for further designing. This would also standardize criteria for architects and developers, and may also become a part of city's policy making.

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I would like to express my deep sense of gratitude from the bottom of my heart to my mentor and faculty members for her/his valuable guidance, inspiration and encouragement. His/her support helped me to reach an irreproachable destination.

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Expression of Human Values in Architecture : Study of Institutions by Kanvinde

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Abstract: Post-independence the search for 'Indian Identity' was the single most important goal. The means to achieve it varied for most of the architects at a time when the modern architecture was becoming devoid of character. Kanvinde along with others were trying to achieve it through different means.Kanvinde expressed 'human values' by achieving the experience of architecture through form and space.Human values are of central importance to man's nature of being human. The expression of 'human values' can be traced through his architectural career. This paper through the analysis brings out expression of human values in the works of Kanvinde.

Keywords:Human values in architecture, father of campus planning in India, modern architecture in India

INTRODUCTION

"Over the years, I have come to believe that it is imperative that an architect develops sensitivity to human nature and respect for human values."(Kanvinde, 2017). When we talk about human values, we think of what is important to an individual in one's life. The human values differ from a person to person. A particular value could also be of vital importance to at least one person but unimportant to another.There are very diverse values among people. We can summarize the most features of the formation of basic values inherent from writing of many of the theorists and researchers which reveals that Values are beliefs; the beliefs that are attached to the emotions of a person.When values are related to architecture, they act as a motivational construct for people. Through the expression of people's values in architecture; it forms an ordered system of valuable priorities that characterize them as Individuals.Values guide actions, people and situations; which can be achieved by designing buildings such that the built form encourages them to explore themselves as individuals and grow in life.The most common human value that unifies people all around is the value of growth as every individual wants to have a growth in life which can be in terms of physical growth and mental growth. The expression of such values can be traced in the post-independence architecture of India when the growth of India was the ultimate goal and to help India achieve that architecture played a very important role.

The architectural history of post-independent India traces the success of the modernist architects like Laurie Baker, Charles Correa, B.V. Doshi, and Raj Rewalwho achieved an appropriate regionalist expression. The 'Indian identity' demonstrated to be the single most important goal, while the means to achieve it were different and questionable at different levels. With some distributed mentions Kanvinde is grouped into functionalist or Brutalist categories, implying that his works could not fit easily in the narratives of the period.(Sane,2017)When in the year 1945; Kanvinde returned to India, the modernism movement in architecture had already started in India. Kanvinde not only understood the principles of Modern architecture but also the cultural and social structure of Indian people which is reflected in his architecture since 1947.One constant term he stressed was 'human values' and the architects concern for activities and their human relationship. He expressed term 'human values' in architecture through form.Kanvinde expressed 'human values' through a form that go together with the idea of progress reflected in the evolution of technology.

In spite of being celebrated as an influential postmodern Indian architect,Achyut Kanvinde remains unacknowledged within history andhas conspicuouslyremained unsung in the modern

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movement of India. Most of the projects designed by him are institutional,spread across India which are not studied, though they have contributed to development of modern India. There are very fewer references or documentation of Kanvinde's works with an in-depth study and understanding of his institutional projects.

AIM

In the context of technological advancement when contemporary architecture is becoming monotonous, the expression of human values through architecture becomes even more significant. Hence, the study will develop an understanding of human values as expressed in the architectural vocabulary of AchyutKanvinde.

OBJECTIVES

- To analyze formal and organizational expression of human values through architecture
- To recognize growth as a basic human expression and its manifestation in the works of Kanvinde
- To discern the architectural vocabulary of Kanvinde

METHODOLOGY

The study relies on secondary sources like books, periodical and articles for the understanding of term human values to create the theoretical framework.Projects designed by Kanvinde were visited to gain the first-hand experience of the formalexpression and spatial qualities of the buildings. Drawings and the personal interviews (with professionals who have worked with him) have formed the bases for analysis to gain a comprehensive knowledge about the topic. Study is concluded based on the inferences drawn based on the expression of these values in his buildings.

CRITERIA FOR SELECTION OF CASE STUDIES

Kanvinde's oeuvre spans over five decades, the range and scale of these projects is vast, selection of case studies is based on

- The focus of the study is on institutional projects, as a representative case is studied.
- Since the experience of the buildings is of utmostimportance buildings located in and around Ahmedabad have been considered for this study.

DEVELOPMENT OF A PHILOSOPHY

Kanvinde in 2017 mentioned "Architecture is the crystallized physical expression of culture, projected into space.". Post-graduation from Harvard University when hereturned toIndia, he joined CSIR where he worked on the organisation in the design of Research laboratories. During his period of working with CSIR, one can clearly see the reflections of habits of design practised at Bauhaus In his early works one could see the influences of International style(Lall, 2017). Kanvinde as stated by him was surviving on his earlier knowledge gained in Harvard and that he was stagnant in his approach.Admitting this thought he started trying to search for deeper meaning and values associated with architecture. By analysing the works of known architects and writers, Kanvinde realised that an evolution of form is contributed by values and meanings associated with physical and psychological needs of the user. It was a constant search for a deeper understanding of values associated with the human environment to architecture rather than merely following clichés in the name of modern and also postmodern architecture as a pattern. (Kanvinde, 2017).

FIGURE 1.1

He tried to search for human scale and values through local materials for its efficiency associated with the region. He believed that the real strength of a building lies in how it gets recognized and accepted by people and that is what really mattered.

IDEA OF GROWTH AND ITS MANIFESTATION THROUGH MODULAR SYSTEM

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"An understanding that the true client of any work of architecture is mankind and the conviction and ability to put this belief into practice" (Broide, 1960) The basic requirement that man demands in his environment is growth; which is the common human value that unifies people all around.Each architectural conception, whatever may be its indicated use, effects many other purposes which turn into a part of reaching pattern of experience and growth.A basis for architecture relating to human values suggests that designing for a man's environment does not directly indicate the application of a rigid set of any kind of rules, but demands the opportunity for a continuous pattern of growth.Kanvinde while designing the larger campuses accentuated scale by breaking larger masses, divided into smaller units and connected them by corridors which allowed expansion and growth of human as well as the built form. The human pursue growth through the development of human persona and growth of their common shared value.

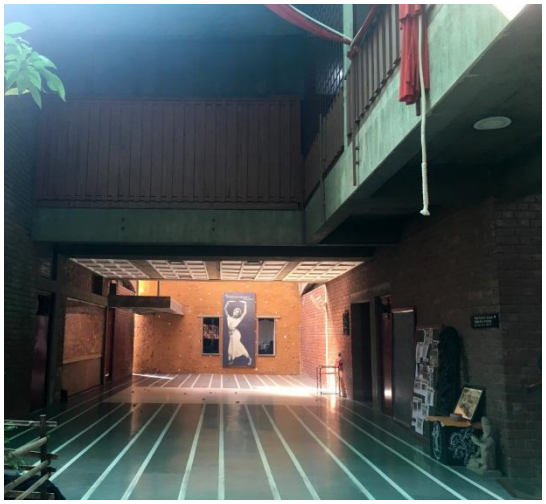

FIGURE 1.2

When we talk about growth as a human value in architecture, all the buildings are designed by keeping the usage of building in future and the need to expand the campus or building always arises. While expanding the campus, the task to keep the language same through architecture is always lingering. To achieve that ability, Kanvinde promoted the principle of modularity where the trick was to devise standard spatial and structural modules which could be attached horizontally and vertically.The method of using repetitive modules would create adirective. To overcome such an order, Kanvinde designed modules of different volumes which are twisted and connected through varied manner keeping the structural denominator same which helped in creating variations of spaces while maintain the commonalty and integrity.

EXPERIENCE THROUGH ARCHITECTURE

A. MODULAR IDEA OF GROWTH

Kanvinde used the system of modules in order to manifest growth – the very first human desire. Institute of Rural Management, at Anand is designed on a modular system which is based on a structural grid. The buildings are designed by repeating the same modules horizontally and vertically which is getting reflected in the plan of IRMA. The modules have been twisted and there is a volumetric play in the modules that adds a different experience of spaces even though they have been designed through the process of additive form. The library is arranged as four similar modules around a central atrium.Another institute located in Anand, Anandalaya School is based on orthogonal and diagonal grids; the institution is designed through L-shaped clusters which are formed by repetitive modules of classrooms, laboratories on one side and the administration, audio-visual centre on the other.

Darpana Academy in Ahmedabad is planned around an open central space which also acts as an extension of teaching space by the repetition of modules through different permutations and combinations. The form of the private residence of the director is dictated by the linear form generated on the lower levelthe following figure shows the modules used in the plan and the connections of modules through plinth.

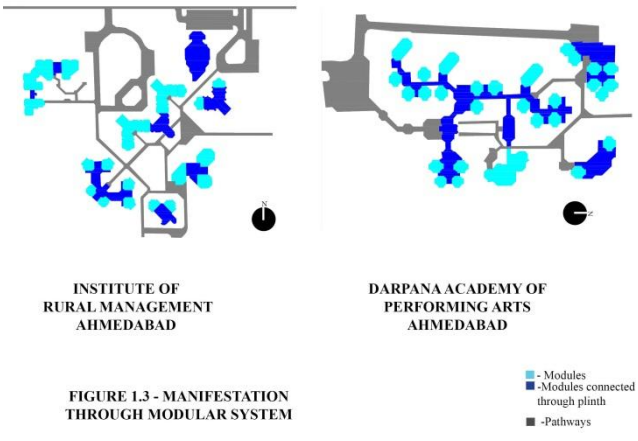

FIGURE 1.3 - MANIFESTATION THROUGH MODULAR SYSTEM

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B. SELF DIRECTION THROUGH MANIFSTATION OF ORGANISATION

IRMAcampus is planned as a system of continuous space that is linked through pedestrian routes demarked between all the buildings. The functional composition of the campus is done in a way that it divides the academic zone and non-academic zone. The academic zone is divided into three components – the teaching area which consists of lecture halls, a library, a computer centre and faculty blocks. The non-academic area comprises of administration, an auditorium and a cafeteria. Anandalaya School,campus linked through a system of covered walkways. The organization of the building that is reflected in the plan of the campus is done in a way that the flow of program can easily be decoded from the plan itself. The campus is placed around several interconnected courts. Darpana Academyis directed towards the Sabarmati River next to the academy. The academy is oriented towards the river by orienting a linear semi covered terrace towards it. The exposed brick infill walls provide sense of direction towards the more private spaces which is also reflected in the planar organisation of the academy. The following Figure shows the flow of functions and its organisation in the plan.

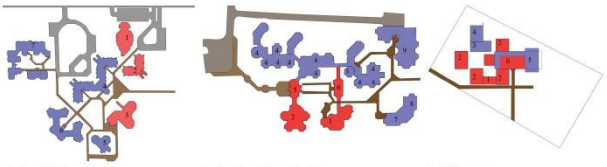
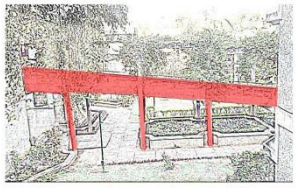


FIGURE 1.4- PLANAR ORGANISTAION

C. PEACE THROUGH ARTICULATION OF ELEMENTS

The articulation of elements of architectural language at IRMA has been done in such a way that they evoke the feeling of peace through its placement of the elements. A straight flight of steps leads from the stilted area to the entrance on the first floor. The administration and faculty blocks are connected through a bridge at the upper level. This connecting walkway creates a sense of entrance to the private buildings of the campus. While at Anandalaya, ramp is the main element of expression of the campus and it evokes a sense of peace as the ramp is sharedwith pergolas directly above it. When one walks through the ramp, peace can be experienced.Bay windows are created along the chamfered edges of the orthogonal and diagonal grids which are expression of connection of human to human.The two storey structure of Darpana Academy has the residence of the director on upper floor. The staircase to the private residence is kept such that the visitor is not attracted towards it and which served the purpose of the private entry to the residence.

INSTITUTE OF RURAL MANAGEMENT AHMEDABAD


ANANDALAYA SCHOOL ANAND

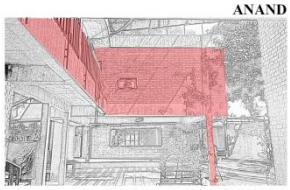

DARPANA ACADEMY OF PERFORMING ARTS AHMEDABAD

FIGURE 1.5- EXPRESSION THROUGH ELEMENTS

INFERENCES

When we talk about values, decoding human values through any physical form gets tough. The architecture is unconsciously reflected by us through ages with the human environment, human movement and human moods. As Giorgio Vasari, an Italian architect said: “Architecture to communicate like important values of the human must appear like organic body.” (Broide, 1960) Human values have a range of meaning that reflects their feelings such as comfort, security, reassurance and friendliness. Human values in architecture can be traced through the works of Kanvinde where he consciously in the later works was striving to achieve that. As talked about, the human values differ from person to person and thus this paper talks about the values that unify people almost all around. As discussed in the expression of architecture the human values that are being reflected in the area growth, peace and a self-direction which are valued personally by people from the same or different backgrounds.

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Value of Growth in architecture terms as seen through the above cases has been reflected through the modular system of Kanvinde. The modular system helps for the growth of the campus with the growth of the people on campus or institute. The growth can be easily projected through modules which can be repeated horizontally or vertically but the module differs from project to project as per the programmatic requirement. Value of self-direction in human is a value that strives them to move ahead individually as well as collectively. This value is expressed through the planar organisation of the campus and the flow of the program can be decoded in the planar organisation of the campus. The organisation helps an individual to go through the campus on one's own journey as a man has to embark on the journey of life on his own.

Value of peace in a human's life is of utmost importance as all the activities or things that he does in his lifetime including the growth of oneself is aimed towards the peace that a man desires in his life. Peace through architectural forms can be attained through the kind of in-between spaces and the elements used in the expression of the spaces. The elements such as bridges where two buildings are interconnected through that and helps in the movement of a human directly from one building to another and the placement of such a connecting bridge evokes the feeling of peace in a human. Articulation of elements connecting the outside and inside through a ramp which acts as a buffer space between the chaos outside and inside of the campus or building gives a time of transition to the human travelling through that element. This is related to humans through the time that we work hard to achieve for ourselves through the eventful day by having a halt and reflecting back on the events and that arouses a sense of peace and happiness in a human.

CONCLUSION

Through the analysis of case studies, we can conclude that today because of technological development, the importance of values and expression of human values is essential. The significance of human values and its expression in architecture can be traced through the buildings studied of Kanvinde in the paper.

ACKNOWLEDGEMENTS

I would like to take this opportunity to thank co-author and guide Prof. Naresh Chhatwani without whose encouragement and guidancewritingresearch paper would not have been possible. I would like to thank IDEA, Indus University for providing resources needed to carry out the research.

LIST OF ILLUSTRATIONS

Fig. 1.3, 1.4 Kanvinde, Sanjay. Akar - Achyut Kanvinde. Delhi: Niyogi Books, 2017.**p.**
Fig. 1.5https://www.google.com/maps/
All illustrations and photographs by author unless mentioned.

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Identifying Design Parameters for Dog Parks Using People's Perception as a Tool: Case of Pune

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Abstract: Indians have always had a strong history with animals. Today, relation between humans and animals have evolved due to restriction in open spaces. Dogs are the most widespread companions in the world. Dog parks presents an emerging class in urban context as environmental amenities. Hence, there has been a growing interest in improving inhabitancy of dogs in city. One of the reasons of this interest has been the lack of study regarding public spaces for dogs in India. The paper includes perception of people in Pune regarding public spaces for dogs through a survey method. Also, expert interviews are conducted to understand the functioning of the dog parks which in turn set the parameters for designing efficient it.

Key words – Human-animal Interaction, Companion animals, environmental amenities, Pet-friendly, open public space, dog parks.

INTRODUCTION

Human-animal interaction defines the experience of human existence. "Animals have accompanied humans for thousands of years, creating a strong interdependence between humans and other species" (de Waal, 2009). In India domestication of animals has been practiced for centuries. Over time these domestic animals became loyal companions to human beings. Today they are known as pets. "We are familiar with the interaction that we have with our companion animals, but human–animal interaction also occurs in the rural context" (Hemsworth P. G., 1997). Where a number of individuals used to pet cows, sheep, goat and lots of others in their homes. These animals had significant impact on their lives as they assist humans in several ways. Whereas today in urban context, relation between humans and animals have evolved. One of the primary reasons for this variation between human-animal relation is growth of cities. Today the world is being created for humans, keeping their foremost surroundings in mind, neglecting the major part that encircles them, 'other beings'.

"Dogs are highly adaptable and friendly, also they are the most widespread and abundant companions, occurring in most places where there is human population" (Yasemin Cindik Akinci, 2018). Today, there has been a significant rise in number of dogs living in urban areas. As per the 20th livestock census conducted by Animal Health Organization, there are 16,078 domestic dogs in Pune Municipal Corporation (PMC) while Pimpri Chinchwad Municipal Corporation (PCMC) has 16,100 (Hindustan Times, 2019).
Today, due to lack of spaces, these urban animals are kept within the four walls of the house. The question arises, if it is possible to build a space where companion dogs can adjust in city spaces? The space which can promote human-animal and animal-animal interaction. For this reason, there is a solution-oriented search for pets around the world in the form of parks and gardens. Outdoor recreation areas or grounds called "dog parks" are created for pets. "A dog park is a designated public area that's been set aside for dog guardians to legally exercise, play and socialize with their dogs off-leash in a secure environment. The park is fully enclosed or fenced and has amenities that make it clear that dogs are invited, not just permitted" (De Rosa, 2013)

LITERATURE REVIEW

1. Benefits of dog as companion

"There are numerous benefits to living with pets: decreased stress, decreased blood pressure and levels of cholesterol and triglycerides, as well as decreased feelings of loneliness" (Dog and Cat Management Board of South Australia, 2014). "Overall pet-ownership results in increased longevity, and desires for physical activity and socialization" (Centers for disease control and prevention, 2019). "In particular, pet ownership today places pets in a more important position for individuals in terms of health-therapy and social-friendship" (Yasemin Cindik Akinci, 2018). Thus, the number of pet owners in the world is increasing day by day.

2. Need for dog parks

"Human and non-human animals come into contact with each other in a variety of settings and wherever there is contact there is the opportunity for interaction to take place" (Hosey, 2008). Pets are not accepted in all environments which includes public areas, open spaces, etc. "It is emphasized that parks and open green spaces have great importance in terms of quality of life—social, economic, ecological, etc." (Öztürk, 2004). Dog parks are safe, enclosed spaces that are specially designed for dogs and people with

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similar interest to socialize as well as to meet their exercise needs.

3. Benefits of dog parks

3.1 Benefits for dogs

Dog parks provide opportunities where dogs can be physically and mentally fit. "Well exercised dogs are less likely to be aggressive and behave in a destructive or annoying way such as excessive barking" (Jessica, resq). "Exercise also helps in preventing premature ageing, improves insulin health and metabolism and pumps toxins out of body while maintaining a healthy bone density" (Cavaleri, 2014). Dog parks can provide opportunities for dogs to have frequent interaction with other dogs and people. "Dogs that are well socialized and exercised are healthier, happier and less aggressive" (Lee, 2007). Dog parks provide safe environment for dogs to play and not encounter cars, bikes and other obstacles.

3.2 Benefits for people

Dog parks can provide a common open public space where dog owners can interact with each other and form a community "It has been established that pets 'act as a lubricant or social contact' and pet owners are 'more likely to exchange favors with neighbors, to be involved in community issues and to have higher levels of social capital" (Wood, 2009). "Dog parks can provide a space where dog owners can feel connected with other human beings improving their mental and emotional health" (Planning Institute of Australia, 2013).

METHODOLOGY

The study is based on qualitative data collected through an online questionnaire on the basis of random sampling method and interview of experts. In the given time and resources, the data was collected from 61 respondents. Closed ended questionnaire was prepared to understand people perspective towards a pet. The questionnaire consisted of two parts. In first part included questions like gender, age and general views about pet friendly spaces. Further questions were based upon dog parks as a typology of open public space where questions like: reason for the visit, duration, time of the visit, etc. Second part of the questionnaire included questions based on their concerns regarding safety, aggression of dogs, etc. Literature review and interview of expert was conducted to understand the behavior and need of the dog and dog owners and propose design strategies for efficient functioning of the park.

DATA COLLECTION

1. People's perception

People perception about dogs and the spaces which could be pet friendly was tabulated through an online questionnaire. We distributed 100 questionnaires based on random sampling method and collected 61 valid questionnaires. The sex ratio was 47.5% male and 50.8% female, while the dominant age group was 18-25 years old (54.1%) followed by 25-40 years old (24.6%) and 40-60 years old (16.4%). On questioning if they like pets or not majority of them said yes which ranged to 73.8% and majority of the respondents said they would like to have a pet with a percentage of 80. 83% respondents said they are not afraid of dogs. 91% respondents are comfortable with pets in public. 70% respondent selected parks to be pet friendly. Also, more than 50% of participants don't know if pet friendly park exists.

34% participants visit parks which are dog friendly parks. The reason for visiting the park was majorly for walking and exercise (71.4%) and remaining 28.6% visited the park for dog walking. Mostly participants visited the park in the evening (52.4%) and on weekend and weekdays (66.7%).
Safety of people and dogs is perceived as a key concern in dealing with dog parks (Dog and Cat Management Board of South Australia, 2014). 75% of the sample presented their concerns regarding aggression of the dogs and safety issues in the public spaces. Research shows that injuries to people and dogs from dog bites at dog parks are rare (Arhant, 2011) however; the perception of risk remains significant and must be considered. While 88.5% of the sample responded as there should be an assigned monitor to supervise the dog parks.

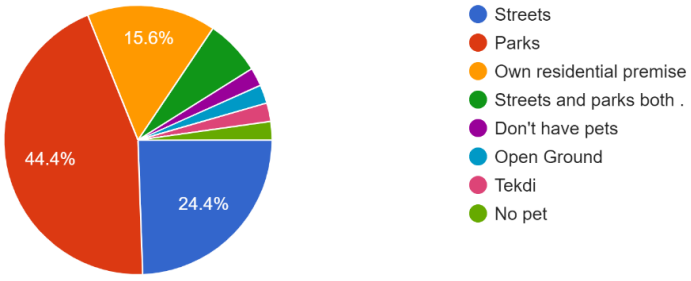

Figure 1 Respond to: where do people take/ prefer their pets to walk?

2. Planning

The data regarding the planning and designing of the parks was tabulated through literature review and interview of experts in fields related to dog care and practices. The design and planning principles considered were shape and size, seating, surface materials, signages, maintenance, dog activities, fencing, structures, water fountains, waste disposal, vegetation.

ANALYSIS

1. People perception

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The survey found that 91% of the people are comfortable with pets in the public spaces, where 70% prefer parks to be pet-friendly. As found up to 75% of people are concerned about dog's aggression. While 50.8% are concerned about smell and 80.3% are concerned regarding the safety issues.

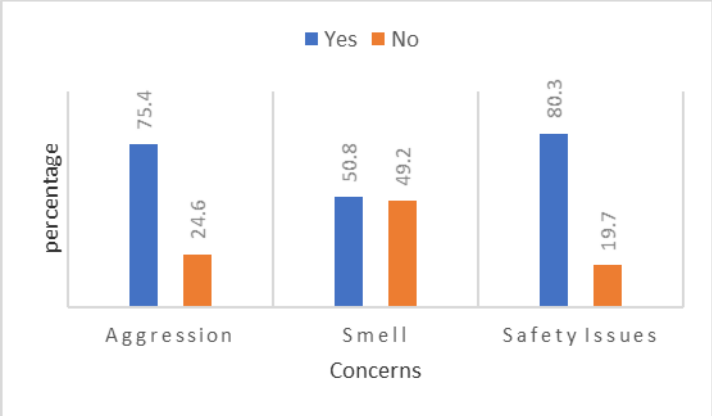

Figure 2 Analysis of survey regarding the concerns about dogs and dog parks

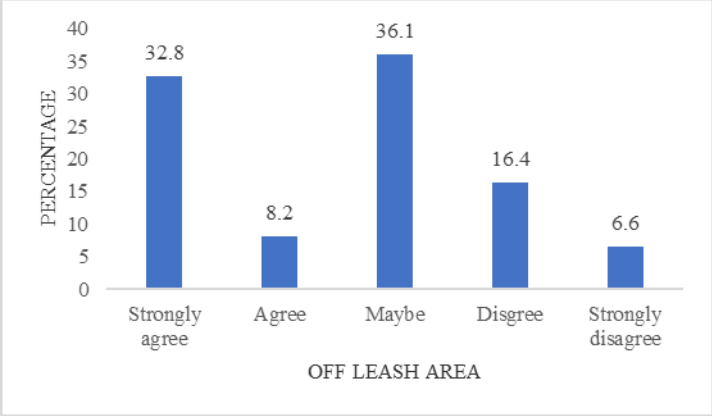

Figure 3 Responses for providing off-leash area in the park

2. Design strategies

Opinions of expert and existing literature was reviewed for proposing some design strategies for planning of dog parks.

2.1 Shape and Size:

Linear and organic (non-rectangular) shapes should be considered while designing the park. Where organic shape works better than linear creating smaller pockets for dog to take a break and get out of the traffic flow from main pathway (Jessica, Resq).

2.2 Surface material:

The choice of surface material should be done considering the hygiene and comfort. Grass should be avoided as it promotes the breeding of flees and ticks in them (Ar. Smriti Puranik). A combination of surface materials should be used to match the activity zones and corresponding intensity (Dog and Cat Management Board of South Australia, 2014).

2.3 Signages:

For management in the park signs regarding different rules and etiquettes that a person needs to follow shall be installed.

2.4 Maintenance:

88.5% of the sample responded as there should be an assigned monitor to supervise the dog parks. The involvement of park users in the daily maintenance of a dog park is a model that could be considered as this can facilitate a sense of ownership and provide a more immediate response to the issues (Dog and Cat Management Board of South Australia, 2014).

2.5 Dog activities:

There should be a variety of activity zones in park which activates their motor skills (Jessica, resq). Activity spaces or zones offer dogs a variety of opportunities including active running and quieter environments where they can sniff, play and interact with their owners, and play one-on-one with other dogs away from the high running areas (Dog and Cat Management Board of South Australia, 2014).

2.6 Waste disposal:

At appropriate locations waste bins should be located in and around park for cleaning up after dogs. Bag dispenser could be provided with a locking system to prevent unnecessary pulling out of bags.

2.7 Plantation:

Trees inside the park provide wonderful amenity as they provide natural shade and to the overall appearance of the park. It is important to ensure that plants are non-toxic and non-irritating to dogs (Ar. Smriti Puranik). Consider introducing plants with various textures to enrich the dogs experience at the park (Dog and Cat Management Board of South Australia, 2014). Also pit of the tree must be protected from dog urinating near them.

CONCLUSION

Captive animals are susceptible to stress which will cause to the decline of their health; the same way as humans does. Hence, in an urban environment, there is a need for a safe place where dog-owners can take their dog to run freely, play, and interact with other dogs. A dog park can be the solution, however, there must be proper supervision, enforced rules and etiquettes, consideration to the designing of the space, attention to the environment, concerns regarding dog health and behavior, and a plan to properly maintain the park. The design strategies proposed can be used while designing these spaces.

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Designed Outdoor Spaces for Better Educational Outcome

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Abstract : Most commonly used teaching practice today includes blackboard-centred learning bound within the four walls leading to restricted learning. Outdoor learning can be one of the approaches to make learning effortless and free the students from the routine pressure. The research is aimed towards studying the potentiality of outdoor learning as a solution to ameliorate educational outcome. The purpose of this study is to understand determinants of outdoor space facilitating improved learning experience. The study is carried out by means of amalgamation of books with literature review and case studies of schools. The research aims to provide set of guidelines that can be implemented for an apt type of space for effortless learning and applying learning in real life and making it more efficient and memorable.

Keywords – Gurukul system, Outdoor learning, Educational systems, Effortless learning.

I. Introduction

Over the period of time our education system has entirely reshaped from its roots. The history of Indian education commenced from Gurukul system – a system where the student resided in the house of their guru until the guru felt that he has imparted all that he could. Where the learning transpired admits of nature. The system was dedicated to highest ideals of 'all round human development', mainly practical, intellectual and spiritual. As against the commonly used teaching practice today, which includes black board centred learning within the four walls leading to restricted learning.These restrictions are leading in increasing peer pressure, lack of attendance and overall progress of the students.

Outdoor learning can be one of the approaches in bringing out better outcome in students. Physical environment plays a major role in determining the quality of learning, in kindling curiosity and imagination of children in teaching them how to live and interact together. Physical environment could not only become more congenial, sensitive and helpful but also contribute meaningfully towards learning and pedagogy. The natural world provides rich experience to children. Through outdoor learning students can explore the diversity of nature and can also associate what they study in books to what they see around them.

There are several factors which affects outdoor learning. The factors can be the weather condition, physical comfort, surroundings, structural comfort and so on. Outdoor learning requires open space away from all the chaos. The learning may also differ for different age groups of students. For smaller sections more playful learning can be implemented on the other hand for elderly crowd more of a self-realization method can be adopted. Space character and the surrounding plays a major role for espousing outdoor learning. Minor changes can be made in the building landscape to create such learning pockets for children.

Potential outdoor spaces around the school building are often neglected. These outdoor spaces by way of design interventions can be evolved to create active learning platform for students. These outdoor spaces can help in better health, decreased stress level, increase in motivation, etc.

The aim of this research is to verify if designed outdoor spaces can create considerable impact on the education outcome of a students. The purpose of this study is to increase participation of students in learning process leading to overall development of the child. Today everybody has limited themselves to the four walls surrounding them. As one grows his/her participation in nature or outdoor seems to be decreased. Outdoor learning can address this issue and help in boosting of self-esteem, finding calmness, focus, boosting the sense of communityetc.The goal of this paper is to study the difference between indoor and outdoor learning process through interview and case – studies. It will also deal with different outdoor spaces which can be later used as classrooms for students. The research also aims to provide changes that can be made in schools to incorporate outdoor learning in academics.

II. Methodology

The research will be done through the help of sampled case studies of three different schools having different context. The paper will also put forward teachers' and student'spoint of viewon the same. The inferences deduced from the interview of students and the teachers would be the base data for the results.

Rishi Gurukulam

Location- Near katharkhadak hills, Pune. with equal distant from two major cities – Pune and Mumbai.

Owner- It is belongingto the foundation SiddhaSamadhi Yoga.

It is a residential school with students studying there 1st to 10th standard. The school aims for overall development of the students following the gurukul system of teaching. The students are taught different art forms, spiritual knowledge, new innovative learning techniques etc. It follows CBSE pattern for academic's purpose.

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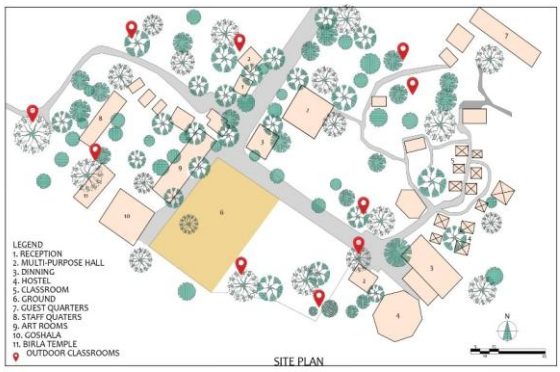


Gurukul plan indicating the outdoor classrooms

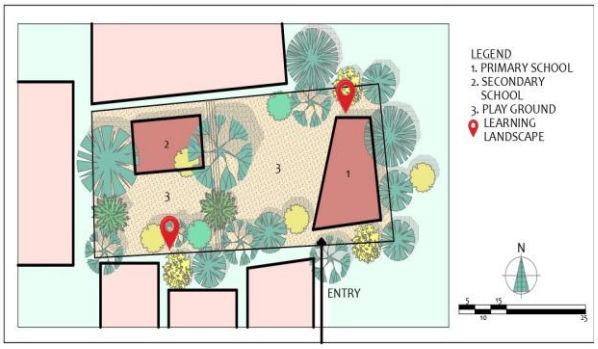
The classes are conducted outside in the open environment like the treehouses under a tree and in gazebos. The location of these open classroomswasdecidedon the basis of shade from the sun, silence-away from all the chaos and part intuition. The relationship between student and teacher is more intimate. It is more student centric class than a teacher centric class. The interaction between the student and the teacher ensue through discussions. These classes have basic amenities like a white board, portable tables for writing purpose and a raised seating for the teacher.It is a region of high rainfall. Thus, in rainy season the classes are conducted inside.

Class under a tree

Class in a tree house

Inferences from the interviews of the teacher

- Energy level of students and teachers is quite high compared to indoors.
- Live instances can be given to the students to make the learning simpler.
- Participation of students is more as compared to indoor learning.
- Students are sometimes distracted due to the birds and insects around, but it also acts as a learning aid to explore nature.



- Learning process becomes more interesting when outdoors.

Aksharnandan School
Location - Senapati Bapat Road, Pune

Owner –The school in Pune in 1992. It was established by N. G. Naralkar Foundation.

Aksharnandan site plan with indicated outdoor learning space

The school believes that Humanscale education needs schools that are small and firmly anchored in their communities, integrating the classroom with the world outside. Education is a process to awaken intelligence, not merely intellect, to cultivate independence of mind and to inculcate values to help children grow into wholesome, productive, creative and responsible human being. However, within this framework Aksharnandan has adopted innovative practices to make the curriculum relevant and linked to actual life. The campus is divided into two halves the primary and the secondary school with a huge playground in the centre. They have inculcated outdoor learning skills for the smaller class so as to improve their fine motor skills, communication skills, problem solving abilities etc. They are able to conduct very few outdoor classes for the secondary school students because of the space constraints. They have variety of plant species planted in the campus to aid the learning process. Mostly discussion and group-based learning is organised outside. They don't have any designated outdoor classroom designed where the learning can be conducted. The terrace of the school is used for farming done by the students. The terrace have small mud pits to plant trees.

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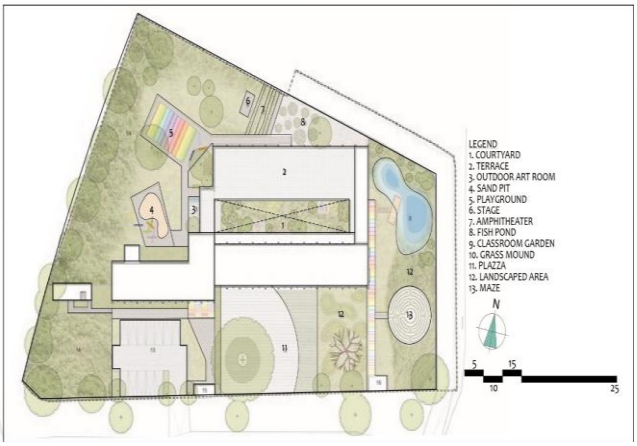
Class 6th and 7th students practicing self assisment

Inferences from the interviews of the teacher

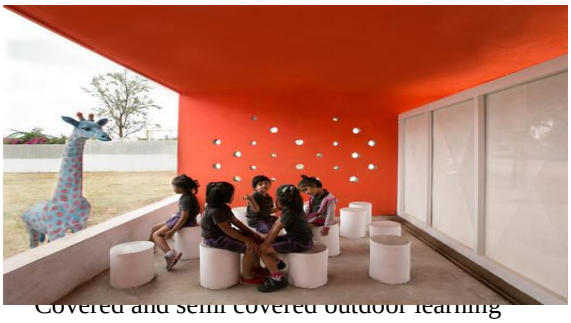
- Students grasp much more knowledge outdoors than indoors.
- They are very enthusiactic and attentive compared to indoors.
- As the number of students are more it is sometimes difficult to control them.
- The surroundig is very chaotic as the location of the school is in the heart of the city.The school has designed a learning cum playing pit for the primary students which helps the overall development of the motor skills.
- Nature aids the learning process therefore teachers too prefer teaching outside.

Ekya School
Location – Kanakapura Road, Banglore.

Owner – Ekya school



It is a exclusive preschool for both Montessori and Kindergarden. The school was developed from an abandened industrial shed. It covers an area of two acres. The primary goal of the school was to provide a constant interaction between student and nature. To achieve this, the boundries are blurred between inside and outside with the 13 learning classrooms accessed from covered walkways. The courtyard is connected to the outdoor learning landscape through four controlled access points. The outdoor space includes an art room, amphitheater, playground and individual classroom gardens. The outdoor classroom gardens are well connected with the indoor spaces for easy access, supervision and maintenance.



Covered and semi covered outdoor learning classroom

III. Observation and Findings

After doing the study of the above cases it is found out that outdoor learning not only affects the educational outcome, also the overall progress of a student. Thus education can be redefined as the knowledge that includes all the subjects from acadamics to play activites.

Design interventions for adaptiong outdoor learning-

- Outdoor learning needs shaded area to sit and learn. Thus spaces under a tree or tree houses can be developed in the vicinity of the school building.
- Students may need portable tables in case of writing purpose.
- Students may also require seating chairs for back support. According to the above cases it was observed that backsupport plays a major role in attentiveness of a student.
- The ‘between’ spaces created in two blocks can be used to have a stuctured classes.
- Natural learning materials can be used as resoures for counting, craftwork, pattern makingand recognising colours. Selecting only those plants species from which natural materials fall on their own or can be gathered withput harming the plant.
  A few suggested species are:
  1. Amaltus
  2. Curassia gulmohar
  3. Imli
  4. Kanak champa
  5. Kaner
  6. Neem
  7. Ratti
  8. Siras etc.
- Selecting and planting species that will invite more birds, bees and buterflies is to promote a

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diverse and fuller interaction of children with nature in school.

Some example for these plants are:

a. Guler
b. Jamun
c. Palash
d. Ber
e. Shehtut
f. Banana
g. Siras

2. There must be some story telling-session areas which should be able to accommodate larger groups, others must be suitable for smaller groups. For these sessions seating can be designed in a circurral manner either under a tree or under a semi-covered area.

- At times children also need private moments to reflect, and spaces to be alone. Small cozy book corners can be developed keeping in mind that such corners are not lonely or entirely secluded.
- Recycled materials can be used for making the outdoor furniture. For example the table or the par can be made out of used glass bottles, chairs can be made of tires and so on. Thus teaching studnets about the 3 R's.
- The choice of materials aims to promote play and enhance the school's territory and culture. Long-lasting organic materials that allow students to experience different texture and smell can be used.
- The roof material used outdoors should be well insulated from the sun.
- The design approach can be minimalistic, with very little harm made to the nature.

A learning landscape communicates the community's knowledge, traditions and values; it also promotes active free play, healthy lifestyle habits, positive relationship and wellbeings.

IV. Conclusion

The 21st century requires polyfunctional educational spaces that provide opportunities for hands-on learning and foster the physical, socioemotional and cognitive development of students.. From architecture, we can give the school outdoors another meaning and contribute to the student's learning, wellbeing, school motivation and sense of belonging.

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Tale of a City: Story Telling as a Medium of Spatial Experience

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Abstract: Buildings tell stories that create a level of meaning and connection for the user that can be appealing and provoking. The viewer can learn something beyond the noticeable causes before keeping them behind. However, the act of architectural storytelling is critical to the building of spaces that convey meaningful messages. However, looking at Indian context and the background of our rich culture Ajmer is a historical shell. A thousand years of infrastructure, roads, arches, and gates still contain the function they had done a thousand years ago. The plan of Ajmer truthfully speaks of its growth, values, and self-esteem at different times PERIOD: Mughal and British. These narratives ARE formed by visiting the old city, observing, gathering information and looking up to the stories which make up the history, conveying it visually as well as through text.
Keywords: Spatial experience, narratives, an image of the city, spaces as storytellers, Ajmer

INTRODUCTION

We use signs, images and words, moulded to make sense of our world, or to communicate with others. We are imaginative beings, driven by curiosity, and 'stories' are often the shape that we use to process the matter that we see and experience. We have our perceptive understanding of stories. From stories in our daily conversations to fairy tales and legends, story-telling was used by the oldest cultures to educate, entertain and propagate knowledge. Similarly, different places have different people with various tales and the people have accepted them and adopt their living around those tales. However, the act of architectural storytelling is critical to the building of spaces that convey meaningful messages. Within the outline of the idea that the architect storyteller is someone who makes buildings and spaces that speak.

Talking about the city I felt Ajmer city, full of life, chaotic, engaging city, 130km southwest of Jaipur and just 13km from the Hindu pilgrimage town of Pushkar. This city is often known as the Holy City, and rightly so. Ajmer is the most sacred place in terms of Islamic history and heritage. It contains one of India's most important Muslim pilgrimages, the shrine of Khwaja Muin-ud-din Chishti. Moreover, the amalgamation of colours, the hauntingly beautiful ruins, forts etched with battle scars, the welcoming natives, and the wealth of the kingdoms and of course, the breath-taking Nasiyan Temple all adds to the holiness of this place.

AIM AND OBJECTIVES

the paper/study/research aims to take up multiple narratives as a method to study the identity of Ajmer and analyze the factors that were evolved through time and what stories made up the grand narrative of the city for what is now.

- To explore the key questions of structure, material and age and the roles they play in the evolution of the city.
- To comprehend beauty and religion along with evolution this adds to the present scenario of the city.
- To understand the adaptability of the people that occurred due to changes in the development of the city.

METHODOLOGY

The method includes the study of the past and present with the roles talking about the stories which make up the history of the city and reading literature which has been written on the city and its focal points. Once all this data will be collected, the tales will be analyzed to form a grand narrative. The tales will be selected on the bases of facts and understanding the literature and observing the city. These narratives will talk about various experiences met during the study visually and experienced and transforming them into memory sketches as well.

AJMER; THE CITY OF HOPES

A million pilgrims of all religions visit Ajmer with a billion prayers. With high held of Dargah Sharif, Ajmer has a lot many things and places in its nest. Beautifully is a small word to describe this place, this town is like a potluck of stories where you find mountains, Serene Lake, amazing food. Here in this paper**,** I've picked up three focal points of the city which I found the most attractive in terms of its history and the beauty which adds up to the experiences which this city has to offer.

Dargah Sharif: Ajmer Sharif Dargah is the most primeval Sufi Shrine in India. A belief is heard across the country that the ones who pray with the Apure heart at Dargah get all their wishes fulfilled. This shrine of Persian Sufi saint, Khwaja Moinuddin Chishti was built by Mughal Emperor Humanyum in 1236 (AD). The initial insight on entering the Dargah is the series of mammoth doors approach to the shrine. Then it the Nizam gate which through its colossal volume depicts as if you are entering somewhere monumental. The sudden change in the senses is perceived through the fragrance of attar. A narrow bustling street with people and the elements offered to Allah like the Chadars and the flowers keep on hovering above your heads. The ingress to the Buland Darwaja suddenly changes the whole of the surroundings. A huge

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courtyard surrounded by shops and mosques on two longitudinal sides which leads to the tomb of Moinuddin Chishti, a marble carved structure. The tomb is plated by gold on the top and is guarded by a railing of silver and marble screen. The Dargah complex is also enriched by several other mosques' that add more holistic values to the place. What makes the place most enriching along with the emotions of the people? The hopes and the beliefs of the people who came to pray to Allah are guided by these beautiful transitions of the space. The whole of the surroundings is beautifully chaotic along with the mixture of emotions of the devotees around. Space is an architectural spectacle connecting to your spiritual identity. The passivity and tranquillity of this place are what attract the beliefs of the place**.**

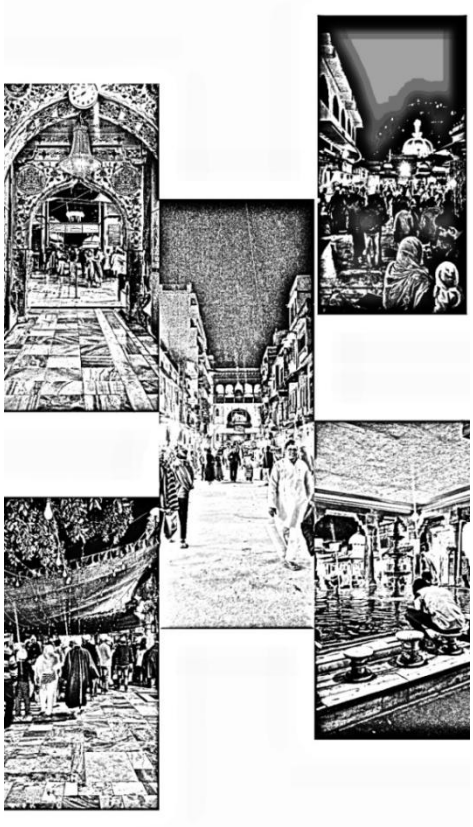

Fig 1.1 Beautiful chaos's at Dargah Sharif

Adhai Din Ka Jhonpra: : Design by an architect Abu Bakr of Herat. This massive shelter was constructed in two and a half days based on an indo-Islamic architecture which signifies high domes with pillars around it, large open Courtyards. Red sandstone used to be a preferred material to build these Indo Islamic structures, and rightly so as this structure showcases the beauty of architecture which continues to inspire, however, the highly decorated front facade with yellow limestone watches is approximately 60 feet high and it is added with 6 smaller urges structure with floral motives mergers and inscriptions from Quran it signifies the boldness of design. entering the main building which comprises of pillars of wearing designs still retain the charm which remains in the older ones which are bold in history and culture.

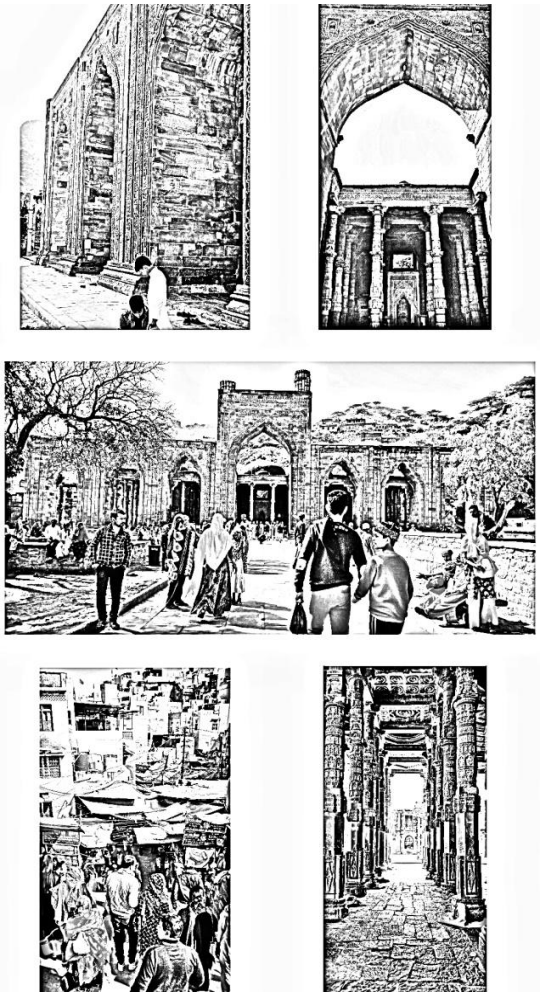

Fig 1.2 Gateway from the bustle to tranquillity at Adhai din ka Jhonpra

Akbari Museum and Fort: It used to be once the residence of Prince Salim, the son of Emperor Akbar but now converted into a museum and comprises of collections of Mughal and Rajput armor and sculpture. Exquisite enter the fort the exhibit is divided into seven categories from the collection of various excavations, Ancient coins, Sculptures of stone and metal, Inscriptions of stone and metal and Armoury and miniature paintings, etc. The fort is divided into these seven parts. The journey here was quite different as it was a silent place, hardly can you find people roaming in here apart from the tourists. You keep on walking looking at the exhibit adoring the small niches through which light rays coming in and the arches on the roof had its beauty whereas white plastered walls and artificial lights added to the whole journey. Once you finish visiting these exhibits you come out and encounter another atmosphere which is full of trees around and benches to sit with a central dome where mannequins are exhibited. It was gracefully articulated with yellow sandstone then maintained well in the present day.

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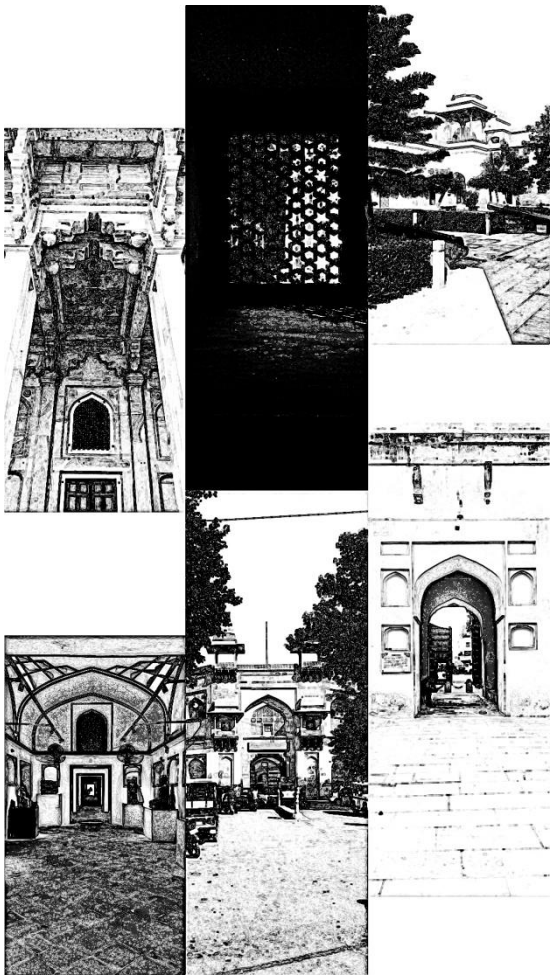

Fig1.3 hushed spaces with exhibits at Akbari Museum.

OBSERVATIONS

Old yet exquisitely managed even though it is a popular tourist attraction that is not biased for Hindus and Muslims, which brings you to experience the beauty of this place. Although being a bustling city it has silent places. This place looks like a blend of religion, community, culture which is coexisting and flourishing in harmony. Also**,** the city is surrounded by the expansive lake of Ana Sagar which changes the view from chaotic to serene. In the same way, this city offers to allot one needs to visit and experience this chaotic yet serene city.

CONCLUSION

From This experience in moving around in the city and being around these architectural monuments helps us learn new thing every time and these learning may be in different form can be experiential through touch, senses, light, and texture hence when we talk about a city and the stories related to it are never-ending also different people have different perceptions so the way they perceive the city and the narratives to it will be different which adds up another layer.

ACKNOWLEDGEMENTS

I sincerely would like to acknowledge and thank my guide Naresh Chhatwani for helping me through the process, encouraging and push me further. I would also like to thank Indus University to offer this precious academic platform.

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Waste to Worth: Potentiality and Use of Recycled Construction & Demolition Waste in the Construction Sector

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Abstract: India's construction sector is a vital driver of the economy but it is also extremely resource intensive. Also, substantial amount of waste is generated from the construction and demolition process of buildings and infrastructure. Poor management of Construction and Demolition(C&D) waste results in illegal dumping, causing nuisance and environmental degradation. Properly processed and recycled C&D waste can be used as a raw material for construction. The objective of this study is to assess the generation and current management status of C&D waste in India and draw conclusions on the potential of C&D waste as an alternative to primary raw materials for the construction sector.

Key Words: Construction and Demolition waste, Recycling, Waste Management, Secondary Raw Materials, Construction Sector, Sustainability.

Introduction:

Construction and Demolition (C&D) waste is defined as 'Waste comprising of building materials, debris & rubble resulting from construction, re-modeling, repair & demolition of any civil structure' (Draft Solid Waste Management Rules) (MoEF&CC, 2015). Literally all material waste coming out of the construction and demolition industry is considered as C&D waste.

Due to rapid urbanization, India's construction sector is projected to grow at a rate of 7-8% over the next 10 years and is likely to become the world's third largest by the middle of the next decade. As per the recent estimates, almost 70% of buildings supposed to exist by 2030 are yet to be built. The boom in construction industry of India is leading to the generation of enormous quantities of C&D waste and this trend is likely to further increase in the decades ahead. The impact on environment due to construction and demolition (C & D) waste are increasingly becoming a major issue in urban solid waste management. Problems such as increase in the flood levels due to the illegal dumping of construction and demolition waste into the rivers, resource depletion, shortage of landfill and illegal dumping on hill slopes are evident in the metro cities. Especially in the older cities, significant demolition often precedes construction, as older buildings are demolished to make way for newer ones, typically high-rises.

A 2015 survey of C&D waste generation in 10 cities across India:

City	Population (Census 2011)	Daily C&Dwaste generation (tonnes/day)	Annual CDW generation* (million tonnes/annum)
Mumbai	12,442, 373	2,500	0.75
Delhi	16,787, 941	4,600	1.38
Bengaluru	8,443, 675	875	0.26
Chennai	6,500,000	2,500	0.75
Kolkata	4,496, 694	1,600	0.48
Jaipur	3,471, 847	200	0.06
Patna	2,514, 590	250	0.08
Ahmadabad	6,063, 047	700	0.21
Bhopal	1,917,051	50	0.02
Coimbatore	2,618,940	92	0.03

* Daily generation has been multiplied by 300 to calculate annual generation since CDW generation is not constant throughout the year, almost disappearing during the monsoon rainy season

Current C&D waste management practices:

Management of C&D waste is still a challenge for urban local bodies. Most cities do not have formal demolition permits and developers hire local contractors for demolition. Even government agencies like PWD invite bids for demolition based on what contractors would pay for recoverables. The recoverables of immediate secondary market value, such as metal rods, pipes and fixtures, wooden frames, etc., are salvaged by the informal sector, typically from demolition sites, leaving behind the "rubble" composed of bulky materials such as concrete, stones, bricks and mortar, etc. A small fraction of this rubble is used for back-filling in construction projects, both for private projects and public works, and the same demolition contractors arrange for its transportation to sites where it is needed. It is estimated that such uses may account for only 10-30% of generated C&D waste depending on the site and region.7 The remaining fraction of C&D waste is disposed, either in designated landfills/dump sites or often in unauthorized places such

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as road sides, river beds and low-lying areas causing a host of nuisance, safety and environmental problems.

Case Studies-

C&D waste management in Delhi and Ahmadabad, India:

Scientific processing and utilization of C&D waste has achieved isolated successes in India.

- Delhi was the first city to implement a C&D waste management plan through a pilot processing facility developed under a public-private-partnership (PPP) in 2010. After the initial success of the pilot plant processing waste at 500 tonnes per day (TPD), the capacity of the plant has been increased to 2,000 TPD. To minimize transportation distances and associated costs, Delhi planned to have a distributed network of processing facilities in different zones of the city. Accordingly, two more smaller(500 TPD and 150 TPD respectively) plants have recently come online (2017-18), with planning for more under way.
- Ahmedabad was the second city in India to implement C&D waste processing, by adopting a similar PPP model as that in Delhi. A 300 TPD processing facility was launched in 2014, the capacity of which was increased to 600 TPD 2016 after successful operation and now to 1,000 TPD in 2018. Table 2. summarizes the key features of the Delhi and Ahmedabad C&D waste management plans.

Table 2: Key features of the Delhi and Ahmadabad C&D waste management plans

Feature	Delhi	Ahmadabad
Year established	2010	2014
Model	Public Private Partnership between Delhi Municipal Corporation (New Delhi Municipal Corporation – NDMC and East Delhi Municipal Corporation-EDMC) and IL&FS Environmental Infrastructure & Services Limited	Public Private Partnership between Ahmadabad Municipal Corporation and Amdavad Enviro Projects Private Limited (AEP)
Number of processing plants	3 in operation (more in planning stages)	1
Capacity	First plant: 2,000 TPD Second plant: 500 TPD Third plant: 150 TPD	300 TPD (increased capacity to 1000 TPD)
Tipping Fee (INR per tonne)	For NDMC Service Area: 147/tonne (with annual escalation of 5%) For EDMC Service Area: 375/tonne (with annual escalation of 3%)	178/tonne
Products	Recycled aggregates, manufactured sand, paver blocks, curb stones, tiles, hollow blocks/bricks	Paver blocks, tiles, hollow blocks/bricks, pre-fabricated structures like frames, manhole covers, benches, etc.

Procedure adopted:

In both Delhi and Ahmadabad, Design Build Operate Finance and Transfer (DBOFT) model is being followed. The Municipal Corporation contracts a private party and this authorized agency is responsible for both transportation and processing of the C&D waste and develops the necessary infrastructure with its own financing. The Municipal Corporation offers land to the contracted party for establishing the processing facility and also designates a series of intermediate collection points at favourable locations throughout the city. The authorized agency collects C&D waste from these designated collection points as well as from unauthorized dumps, as directed by the urban authority, and transports it to the processing facility. The municipal corporation pays the authorized agency an agreed fee per tonne of waste that is collected and transported. The authorized agency may also collect fees directly from large generators (such as Metro Rail) for waste collection; however, if generators bring waste to the processing facility at their own expense, the agency accept it without charge. Therefore, the private partner has two sources of revenue – the "tipping fee" from the ULB and the sale of recycled products made from C&D waste. This ensures the viability of the enterprise. However, in both Delhi and Ahmadabad, market uptake of recycled products made from C&D waste remains an ongoing challenge.

Potential for C&D waste utilization in India:

Recycling and products

Characterization study of C&D waste in India by TIFAC (2001) shows that most fractions including bulky material (concrete, bricks) and fines (sand, excavation soil) are

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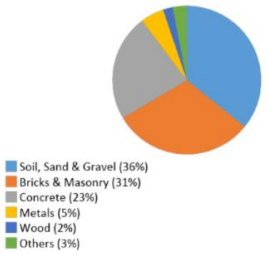
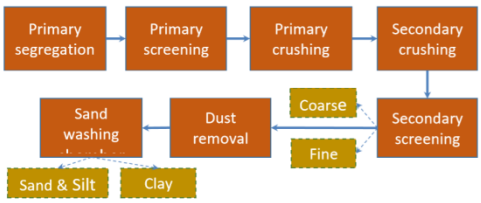
amenable to recycling with proper processing equipment and techniques. Figure 1 shows the typical composition of C&D waste in India.



Recycling of C&D waste starts with segregation of unwanted residual material such as plastic, wood, metal fragments, etc (constituting 10% of the total waste as per the TIFAC composition). The remaining bulky waste is fed into crushers and reduced to smaller and smaller sizes, with size fractions separated depending on end use. Fines are typically best recovered with a "wet process". A simplified diagram depicting C&D waste processing is shown in Figure 2. Below-



These coarse and fine aggregates of various sizes can be used directly as recycled aggregates in construction or used to manufacture a range of pre-cast products. A selection of products made from recycled C&D waste is shown below-

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Street furniture from processed C&D waste

Bollard

Fence Post

Pre-cast compound wall

Planter

Drain Cover

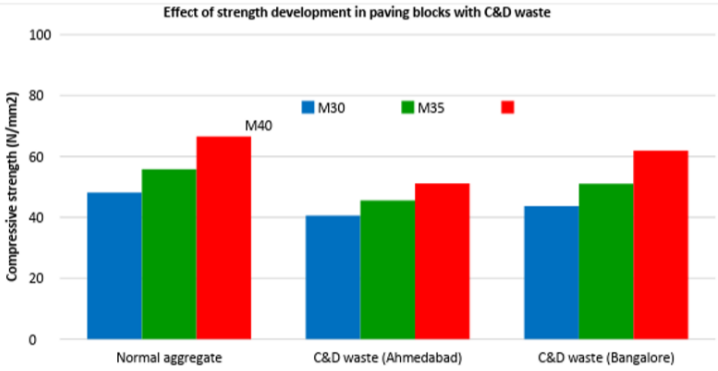
Park Bench

Pre-cast structures from processed C&D waste

On-site assembly type toilet *(Model developed by AEP Pvt. Ltd.)*

Repeated testing by the companies in Delhi and Ahmedabad, as well as by independent researchers has demonstrated that products made from C&D waste meet or exceed minimum standards for their intended applications. A study by GIZ and Development Alternatives (2015) tested compressive strength of paver blocks made from C&D waste collected in Bangalore and Ahmedabad as per BIS 15658:2006 protocol. The results are depicted below-

Test results comparing paver blocks made from natural aggregates versus recycled aggregates from C&D waste:



Products made from recycled aggregates typically tend to have a cost advantage over conventional products since natural aggregates are transported over long distances in most places. This holds true as long as the collection and transportation cost of C&D waste does not become exceedingly high due to long transportation distances. The GIZ-Development Alternatives study modelled production costs for paving blocks made from natural versus recycled aggregates using actual cost figures from Delhi (assuming collection and processing cost at Rs. 400/tonne). The results below show cost advantages of 19-22% for blocks using recycled aggregates.

Cost comparison of paving blocks made with natural vs. recycled aggregates:

Cost and quality:

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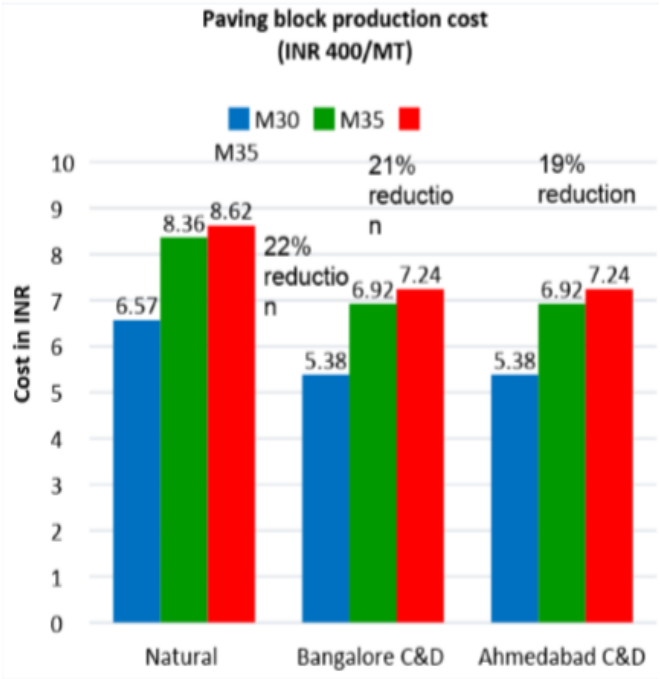

Case Study of Mumbai:

In Mumbai, the Brihanmumbai Municipal Corporation (BMC) formulated Debris Management Regulations, aimed at taking care of the 2,000 tons of construction debris produced every day. However, the regulations failed to have the desired effect, owing to the sluggish attitude of the Building Proposal department, which was in charge of the task. The responsibility for implementing the regulations have now been passed on to the Environment Engineers, who will monitor the new constructions along with being in charge of taking the debris management plan from prospective builders and issuing no-objection certificates for their construction activity on the basis of the plan. As per the existing regulations, builders and developers have to now compulsorily submit a Debris Management Plan along with giving details like the amount of C&D waste likely to be generated during the construction activity, arrangements for its proper storage on site, transportation of debris to a suitable disposable location, etc. The plan will further be submitted to the assistant engineers (Environment) of the Solid Waste Management Department, who will issue the required no objection certificate to the builder.

Highlights of C&D Waste Rules 2016:

Recognising the problems arising from C&D waste, the Government of India has notified the "Construction and Demolition Waste Management Rules" in 2016. These rules are quite comprehensive and address responsibilities of different stakeholders including generators, municipal bodies, state Pollution Control Boards, Urban Development Departments, etc.

Rationale/Justification for C&D Waste Strategy:

Although the C&D Waste Management Rules were notified in 2016, little progress has been made in the intervening two years in terms of widespread adoption of C&D waste processing and utilisation in India. In case of the first two cities with processing facilities – Delhi and Ahmedabad – their facilities actually pre-dated the 2016 Rules. Despite the enabling policy framework, not much progress has been made on the implementation 2016 Rules.

Therefore, it is necessary to identify the challenges and roadblocks so that an effective implementation strategy can be adopted.

Assessment of Challenges and Roadblocks:

There remains a host of challenges and roadblocks faced by both government agencies and the private sector that are hindering a wider and quicker adoption of C&D waste management initiatives. It is important to properly understand these challenges so that proposed actions can target them effectively.

Municipal bodies/Local authorities

Local authorities/municipal bodies have the most important role in planning and implementing C&D waste management in their respective jurisdictions under the 2016 Rules. Even if the collection, transport and processing is actually contracted out to a private entity, the local authority is ultimately responsible for the overall performance of the management scheme. However, local authorities/municipal bodies appear to be the weakest link hindering rapid adoption of initiatives and face several challenges. Several factors are responsible for this, including:

a) City officials may understand the broader aspects of C&D waste management but require support to develop tailor-made solutions to their specific circumstances

b) Cities do not have adequate capacities and trained personnel to take up the initiatives

c) Cities do not have financial resources to hire a consultant for an initial feasibility study and/or a DPR

d) Cities are not convinced how the business case would work in their circumstances, and are apprehensive about the model being a drain on their budget

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e) C&D waste management is considered a low priority (the public is more concerned about Municipal Solid Waste), especially in the absence of strong coordination/facilitation by state-level agencies.

Lack of awareness and concern

The construction industry is entrenched in its ways and is historically used to turning a blind eye to how C&D waste is disposed; getting them to change their ways is likely to be a difficult and gradual task. At the same time, there is little awareness about C&D waste recycling and utilisation beyond using rubble as a filling material.

Dominance of the unorganised sector in demolition

The demolition sector is overwhelmingly dominated by small players in the unorganised sector, the only exception being a handful of specialised companies whose niche is high-tech demolition related to large infrastructure projects. This naturally makes it difficult for urban officials to monitor and regulate small demolition contractors who are typically not registered and are used to getting away with disposing of C&D waste in unauthorised locations.

Lack of confidence in recycled products

The experience in Delhi and Ahmedabad has shown that the market for recycled products made from C&D waste is still quite weak in India. Engagement with the construction industry repeatedly demonstrates that potential buyers are hesitant about such recycled products that they perceive to be inferior in quality. Even when informed about the updated BIS standard (383) that allows recycled aggregates in many applications, potential buyers appear risk averse, pointing to their clients who seem to prefer "conventional" products.

Poor economic viability of recycled products

Currently aggregates are taxed at 5% and manufactured products are taxed at 18% making the use of recycled products economically unviable for customers. GST relaxation for C&D waste recycled products including manufactured products such as tiles, paver blocks, bricks, sand and aggregates may be considered.

Conclusion:

Use of secondary raw materials like C&D waste presents a win-win approach for resource efficiency. Utilizing a waste or by-product eliminates the problem of waste management, especially for bulky waste that needs a lot of expensive land to store in non-productive ways. Simultaneously, by reducing pressure on virgin resources, it aids in reducing environmental degradation and pollution.

Acknowledgement:

I would like to express my deep sense of gratitude from the bottom of my heart to my guide, Ar. **Suraj Kocheta** for his valuable guidance and inspiration. The encouragement from my college, Trinity College of Architecture, made it possible for me to be a part of this Research endeavor.

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Comparative Analysis of Regionalism and Critical Regionalism as an Approach to Counter the Problem of Placelessness in a City

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Abstract: ***Today due to globalization and the concept of modernism we have started to lose the architectural character of the city, as the buildings constructed are not just high rise, they are also constructed using the modern materials which gives them a modern look. Which is now leading to lack of identity and placelessness in a city. To counter this issue regionalism and critical regionalism were the two approaches adopted worldwide. The paper puts forward a comparative analysis between regionalism and critical regionalism. The possible adoption of better option between regionalism and critical regionalism is mentioned. The paper tries to prove the hypothesis that critical regionalism is better approach compared to regionalism.***

Keywords: Globalisation, Critical regionalism, regionalism, city identity, placelessness, region.

Introduction:

Globalisation has made every product available in all parts of the world, right from a nail to the huge machinery. All types of building materials are available, information and implementation of new building technologies is now possible due to globalisation. This has led to many changes, good and bad, in the field of architectural design.

People have started using modern materials available in market which look aesthetically pleasing and give a visual feeling of luxurious lifestyle. Modernism is the new concept adopted by the architects and the clients, this is now leading to lack of identity.

Every city has its own character its own identity. Use of these modern techniques and materials has made all the buildings look similar, as if they are coming out of a same mould. The cities have started losing their character, leading to the problem of placelessness in a city.

To counter the problem of placelessness, regionalism and critical regionalism were the two approaches brought up and are now adopted by the architects worldwide.

In the 1980s during the postmodern era, the architecture started lacking the social individuality and uniqueness of the place where the buildings belonged The architects believed that, people just mimicked the classic style and the actual historicity of the style was lacking. In contrary to the postmodern ideology, regionalism gave importance to identity of a building, ecology, culture and social qualities of that region. As said by Octavio Paz, "To be truly modern, we must first reconcile ourselves with our tradition".

While on the other hand critical regionalism is considered a form of post-modern style of developing the cities. Critical regionalism is different from regionalism, which tries to inculcate the regional character with the modern qualities in a building. As put forth by Tzonis and Lefaivre, critical regionalism need not directly draw from the context, rather elements can be stripped of their context and used in strange rather than familiar ways.

Research background:

The identities of cities is bound to be lost in a time where the most common trend is following international design that mainly preaches the concept of 'form follows function', that's why critical regionalism can be reconsidered as a gateway to maintain a city's identity while adhering to international approaches. (Zeini I.,)

It is clear that Architecture is shaped by the ecology of the place, if we achieve Ecological regionalism; inevitably regionalism in architecture is achieved. It also helps to conserve natural and regional identity in Architecture. (Yadav M.,2008

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Research gap:

It is stated by many researchers that regionalism and critical regionalism are the two approaches which need to be adopted to counter the problem of placelessness in a city. But which approach is better to be adopted and is acceptable in the era where international design is what everybody wants is still not clear. To understand the better possible option which can be adopted, a comparative analysis of both approaches is needed.

Methodology:

The research focuses on the comparative analysis between regionalism and critical regionalism. Regionalism being depicting the regional character of a city and critical regionalism being a blend of regionalism and modernism, it is important to know which is the better approach to be adopted in today's time. The locations chosen were on the basis of the building character and language.

Institutional building:

Figure 1 MIT College, Pune

The comparative analysis was done between MIT college and IUCAA. MIT college being constructed in Pune has adopted Maratha architecture as its style, corridor has been designed with openings which have Maratha style arches. There is a dome and the whole building of MIT college looks like a palace. It is observed that MIT college is designed using regionalism as an approach.

Figure 2 IUCAA, Pune

IUCAA is located in the campus of pune university. It has an entrance which leads into a courtyard where all the rooms open into the courtyard. An interesting element is the toilet duct which is turned into a courtyard with a tree at the centre. From all the observations it can be said that IUCAA is an example of critical regionalism.

IT hubs:

The second case study was of IT parks in Pune. IT parks now being one of the main public zones and main source of income for many citizens in Pune, it is important that architects are sensitive about the regional character and also about the functional quality needed for an IT hub. To understand this Cerebrum IT park and Suzlon One Earth were studied.

Figure 3 Cerebrum Tech. Park

Cerebrum Tech Park was built by Kumar Builders in 2006. The building has got lot of ornamentation. Though the building is trying to inculcate the regional qualities, which can be observed in widow design style and the dome, climate responsiveness is completely missing. Thus it can be stated that Cerebrum Tech park is an example of regionalism.

Figure 4 Suzlon One Earth

Suzlon One Earth derives its inspiration from large Indian historical campuses like Fatehpur Sikri and the Meenakshi temple complex in Madurai both have strong horizontal elements that tie the complexes together. Western portion was built with a central court surrounding with built spaces. It can be said that the architect has adopted critical regionalism as an approach while designing this campus.

Regionalism does preserve the character of the region and gives the region its identity, but sometimes the approach goes back to conservatism.

It can be thus stated that critical regionalism tries to keep the regional character in the design in a modern way, which is minimalistic but also counters the issue of placelessness. It takes some elements in the region as a representation of that region.

Conclusion:

The paper concludes that critical regionalism is a better approach compared to regionalism, as it is a blend of modernism and regionalism. Critical regionalism approach does not mimic the regional

character in the design but includes some elements which are identity of the city.

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Parking And Festivals: A Catalyst In Celebration Or Conflict?

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ABSTRACT : In Maharashtra various festivals such as Ganesh Utsav, Navratri, Diwali, etc. are celebrated at family as well as at community level, causing social interactions. Nowadays parking is a major issue that is faced in festivals. It is noted over the last few years, Ganesh Utsav has impacted on Environment and Architecture due to the adverse effect of unplanned Mandal's. Current study focuses on parking during Ganapati festival of 10-11 days. It's important to understand the effects of use of public places for parking during the festival and its efficiency for public utility. Paper concludes that, there is definite relation between rituals during the festival and parking in the publicspaces.

KEY WORDS

Festival, Parking, Temporary Structure, Pedestrian and Vehicular movement, Public places, Indian culture and tradition,

INTRODUCTION:

Civilization was created through the ages where they neither becreatednorbedestroyedduetothephysicalandvisual impact. Organization of human civilization and belief system lead to the formation of social morphology also known as societies through the edges leads to the formation of culture.The culture formation is based on different regions such as Maharashtra, Tamilnadu, Gujrat, etc., this results in formation of various social boundaries for specific civilization. These civilization includes differentsocietiesduetovariousexposures, which results into formation of various religion and culture. But due to this, the society distributed among themselves and started their own culture andtradition.

In India, there are different type of religion at North, South, East and West. Maharashtra, North-West zone of India, has strong culture, religion and tradition. But some festivals are celebrated in all religions with equality and unity. Considering PandharpurWari which originates from Alandi. Procession takes one day halt in Pune.Duringthis wari,thewhole procession route is made free of vehicle. Entire city stops functioning and participate in procession. Therefore the spaces which are created for specific purpose, temporarily convert into various ceremonial events. A similar function for which Maharashtrian culture is known for is Ganpati festival, there are some conflict faced by various facts. But nowadays there are issues faced due to parking. Rajgurunagar description and issues duringfestival.

RESEARCH BACKGROUND

Apublicmulti-culturalthemecelebrationatwhichpeople of different ethnicities including the dominant have cultural experience(lee&Songshan,2015).Inthistypeofresearchthey say thatfestivalshave aroleinsupportingculturaldiversity and promoting social harmony. They have their own motive about the local resident rather than visitors. Also, the aim iscommunity development.

Themed and inclusive community event or series of events which have created as a result of an inclusive community planningprocesstocelebratetheparticularwayoflifeofpeople and groups in the local community with emphasis onparticular space and time (Allan & Alan, 2012). In this research they studied about the role of local communities played in making decisions affecting their festivals. They had studied about the inclusive and exclusive method about communityfestival.

(Allan, Wiltshier, & Clarke, Community Festivals: involvement and inclusion, 2004) studied about the involvement and inclusion in community festival where it is seen that the vehicles are attracting more tourist into the region.

(Charles Arcodia, 2006) defining festivals are celebrations of somethinglocalcommunitywishestoshareandwhichinvolves public participants in the experience. They had studied aboutthenegativeimpactsofthefestivalsoncommunitywhere these impacts are economic, physical, political, and socio- culture.

(WaldemarCudny,2012)festivalsaredividedintoruraland urban, which is another division based on social class structure, power, and socialroles.(Derrett,2003)concludedthattheyprovide avehicleforcommunitiestohostvisitorstosharetheactivities.

From all literature the research paper studied it is evident that it is the vibrant topic. There are multicultural

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festivals which assumes in future for better development and also the community festivals which stated about the different methodologies. They also had stated about the negative impact of festivals on economic, politics, environment, and socio- culture. The research paper shall be stated about the festivals and its uses and benefits, where parking is the main issue in the urban as well as rural area. Hence the research willbeheldonparkingissueswhicharefacedduringthesocial festivalcelebration.

MATERIAL AND METHODOLOGY

Theresearchis a typeofCaseStudyofGaneshMandal at Rajgurunagar observed on the basis of comparativeanalysis, where it shows the footfall at specific area surrounded near mandap, densities of the peoples in area at different interval of time, different types of activities, accessibility, visual connect, etc. Visual and photographic analysisshouldbedoneforthedifferentactivitiesofpublic places such as dekhava. The parking should be analyzed and observed for the pedestrian and vehicular movement. Also observed for the spacesinfrontofshops,residentialbuildings,etc.

SCOPE AND LIMITATIONS

The outcome of the study shall provide the movement of pedestrian and vehicle which are perceived as negative and generate the concerns such that social sustainability is thought of, and positive coexistence is seen.

GANESH CHATURTHI

Ganesh Chaturthi is also known as Vinayaka Chaturthi and is atthebeginningoftheBhadrapadaShuklaChaturthi,isaHindu festival of celebrating the arrival of Ganesha to earth from Kailash. The festival is marked with the installation of ganesha clay idols privately in homes or publicly on elaborate temporarily stages. Then there are daily prayers which are held in morningandevening.Also Modaka also distributed as a it is believed to be favourite to be lord. The festival last for 10 days, when idol is carried out for public procession with music and group chanting, that immersed in a nearby water body such as river or sea. Thereafter the clay idol dissolves and ganesha is believed to return to mount Kailash to Parvati andShiva.

RAJGURUNAGAR: A CASE STUDY

Rajgurunagarisamoderatesizedtownlocatedinnorthside of Pune city which has historical background of Rajguru who was the freedom fighter. There are different locations in Rajgurunagar where the mandals install the Ganesh idol. Like

- **Juna Motor Stand MitraMandal**
- Wageshwar Mitra Mandal
- Ekvira MitraMandal
- **Sambhaji Groupcha Raja MitraMandal**
- **Shivchatrapati Groupcha Raja MitraMandal**
- Swarajya MitraMandal
- Vetaleshwar Mitra Mandal
- Navyug MitraMandal
- Krantiyug MitraMandal
- Yogeshwar MitraMandal
- Ranapratap MitraMandal
- Ahilyadevi MitraMandal

These mandals are well known as of their areas. According to the location of mandals the case examples are selected. Where at Juna Motor Stand Mitra Mandal have fruit market shifted elsewhere. Similarly second one is Sambhaji Groupcha Raja Mitra Mandal have temporary structure placed onhalf of the road and third one is the Shivchatrapati Groupcha raja Mitra Mandal have placed temporary structure on the road and the roadgetsblocked.Thesethreearethecaseexamplesselectedf or theresearch.

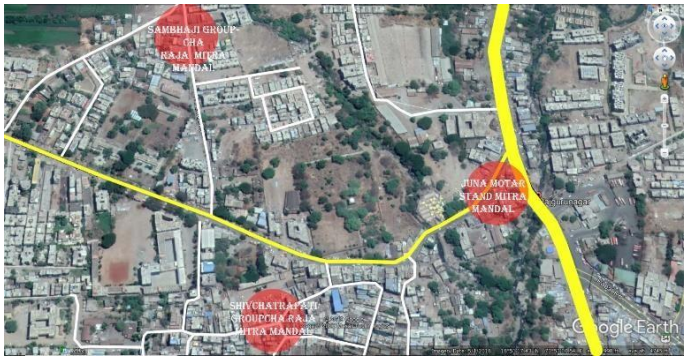

FIG. 1: location showing the three Mandal's of Rajgurunagar.

SCHEDULE

The week before, there are arrangement of temporary structures (Mandap), decoration is done. The installation of Ganesh idol is on the first day of Ganesh Chaturthi, and then the prayer part is taken twice in a day. After installation work started for the Dekhava.Thescaleofthedekhavadependsontheavailability of the space near the mandap setup. During these temporary installations the transportation of vehicles gets denser in that area. This work is done during daytime. Dekhava is held at least for 2-3 days. After that Mandals arrange other competitions for the entertainment purpose. On the last daythe Ganesh idol is taken out for the processional route for visarjan on the nearby Bhīmariver.

SAMBHAJI MITRA MANDAL

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In this case study, mandap is constructed on the half of the road and its surrounding area gets converted for festival purpose. Normally there are shops which are used on the basis of day-today requirements such as medicals, food stalls, bakery,etc.andthushaveasusualactivities.Also,their customers park their vehicles in front of shops for easy access and convenience. But during the festivals these places get convertedintopedestrianpathwaysbutthereisnoawarenessin community for safety as they park their vehicles on pathways also on the roads.as they do not have open land in surrounding area they park their vehicles in that land. The usual footfall is quite normal but during Ganapati festival these areas get highly crowed in evening and low crowed in the morning as they have their dailyschedule.

The pedestrian movement is not specific, but there are not the foot paths for the walkways. They walk on the barrel space among shops and the roads. During festival these are not specific for pedestrian pathways also for the parking. As decorative purpose in front of Mandap the avenue created towards the Ganapati idol. Also these decorative purpose impacts on the festival and parking.

Normal day activities are that street is on time movements and less densities of footfall and during festivalthedensitiesoffootfallis higherthannormaldays.And it gets a specific landmark for the festival in such area. Also in back side of Mandap there is the arrangement for the Mela during festival days as it is the highly dense area in RajgurunagarduringGanapatifestivalforthose2-3daysbefore the visarjan of Ganapati idol. Also in activities mandal arrange somecompetitionssuchasdance,speech,etc.forentertainment purpose. This mandal performing the dekhava as a drama of "Janata Raja". To see dekhava people comes from different area and it gets crowed due to parking, pedestrian and vehicularmovements.

FIG. 2: ***activity mapping at Sambhaji Mitra Mandal***

SHIVCHATRAPATI MITRA MANDAL

In this case study, mandap get constructed on the road and the vehicular movements gets blocked during Ganapati festival. This area gets more congested, where there are no open spaces, notified for parking. It is a residential and commercial zone, with existing parking issues. But during Ganapati festival the vehicular movement pattern get changed and vehicles as usual get parked their vehicles in front of shops. There is no space for the pedestrian movement as theypark their vehicles on both edges of the road. The road width is approx. 5-6 m which is not suitable for easy movements.

Activityduringnormaldaysis as explained earlier.Thereare such types of activities occurred during festival where People gets attracted and visited or involved Ganesh festival. As they called up for the celebrities and also they organized some competitions for. These activities directly affect on parking due to lack of open places and un-notified parking

FIG.3: ***Activity mapping at Chatrapati Mitra Mandal***

JUNA MOTOR STAND

In this case study, mandap get constructed in fruit market due to which fruit stalls get shifted outside the market area. The area is located near the Pune-Nashik highway and most of the surrounding zone is commercial. In this mandal pre-existing offices are converted into ganpati mandap. Also the mandap decoration is done till the fruit market boundary.

DuringGaneshfestivalthereistherestrictionofvehiclesi n the evening. The parking of the existing buildings is allowed. This mandal is well organized about the parking, pedestrian and vehicular movement can't affect the existing once. During the festivals, the area near the Juna Mortar Stand getsaffectedduetothevariousamenitiesinsurroundingwhich are vegetable market, fish market, fruit market, commercial buildings, residential buildings, ST stand, etc. This causes congestion and damages the socialsustainability.

Activities in this mandals are the dekhava and competitions. These activities affect the surrounding zones in respect to pedestrian, vehicular movement, public transport, etc.

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FIG.4: ***Activity mapping at Juna Motor stand***

CONCLUSION

In festival these should be awareness with in people about culture, religion and tradition which are getting affected by some issues which are not relevant. Architecturally there should of have sense towards the sustainability also the importance of our culture and traditions will get loose day-by-day.

ACKNOLEDGEMENT

I sincerely express my deep sense of gratitude to Ar. RavindraPatwardhan, Dr. Supriya Nene, Ar. Jyoti Jain Tholiya (RIA faculty) for their extra ordinary coordination and invaluable guidance and supervision. I sincerely acknowledge the efforts of all those who have helped directly or indirectly in completing my research successfully.

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Usability of Outdoor Open, Semi Open and Dead Open Spaces in De-Addiction Centre

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Abstract: ***The topic outlines the parameters necessary to increase the usability of outdoor open, semi open and dead open spaces in de-addiction centre. In case study, the semi open spaces are mostly used because of various parameters which increases the quality of that space resulting in maximum usability.Its observed that, while designing an open, semi open , dead open space-location, vegetation, accessibility, shading pattern, natural material, seating arrangement,function etc parameters shall be considered to increase the usability of space.The results revealed that semi open spaces are mostly used in the de-addiction centre because of Location, Vegetation, Shading Pattern etc.***

Keywords-open, semi open, dead open, usability, space quality, Function

Introduction

a de-addiction centre deals with psychological, physiological and social condition of patients.It may use different types of spaces to treat patients in different stages of addiction conditions. This research is undertaken to understand usability of different type of spaces in buildings such as open, semi open and covered spaces.The focus is to assess the parameters on which the usability of open, semi open and covered spaces depends.Outdoor environment is the environment which is a complimentary space outside the building in which physical activities can be carried out. Outdoor environment have important qualities that has positive effect on health and there are negative effects as well. The experiences of the outdoor open, semi open and well treated dead open spaces,even views of greenery brought in through a de-addiction centre window can have a positive effect on addict's emotional and mental functioning which cause positive effect on his health. Outdoor open spaces promote healthy behaviours by providing an accessible, affordable and enjoyable place to be physically active.Open spaces encourage walking and outdoor activities such as outdoor games, meditation, interaction with other addicts and cycling, which is the best way to improve physical health and mental wellbeing. So outdoor open,semi open spaces are necessary in the de-addiction centre.Also, the covered spaces can be provided in such a way that it is useful for patients for recovery.

The outdoor open, semi open and dead open spaces promotes addicts for outdoor activities and exercise, have natural daylight, and natural ventilation and the aesthetic experiences that affects positively on the addict's physical health. Negative effects such as in the larger open space, addict may feel isolated from the world which would impact his health negatively resulting in aggression, stress etc. So, the space quality is important. The usability of these spaces depends on spatial quality of these spaces.

Usability in architecture is often understood as the functionality or the space's ability to carry out the function for which it has been designed.Space usability becomes comprehensive to assess how people utilise the space to meet their needs and on which spatial characters,the usability of different type of spaces depends including how the usability of dead open spaces or spaces which are not being used or used less,can be increased.

Need and justification of research

- To study the usability of outdoor open spaces in de-addiction centre.
- To assess the parameters necessary for increasing the usability of an open,semi open and dead open spaces in de-addiction centre.

Aim

To study and analyse the usability of outdoor open, semi open and dead open spaces in de-addiction centre.

Objectives

- To study the open and semi open spaces in de-addiction centre.
- To study the parameters for outdoor spaces to increase its usability in de-addiction centre.
- To study the significance of outdoor open spaces in de-addiction centre.
- To analyse the problems faced by users, its causes and solutions regarding outdoor open spaces to increase its usability.

Scope

- To understand the pattern of use of outdoor open, semi open and dead spaces in de-addiction centre.
- To analyse the parameters on which the usability of outdoor open and semi open spaces depends.

Limitations

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- The study is limited to day time observations after an interval of 30mins from 9am to 6pm.
- To study the usability of open spaces, the identified parameters are taken from the literature review.
- The study is limited to the age group preferably from 25years to 50 years.

Methodology

- These are the following methods that will be used for analysing the usability of outdoor open and semiopen spaces in de-addiction centre.

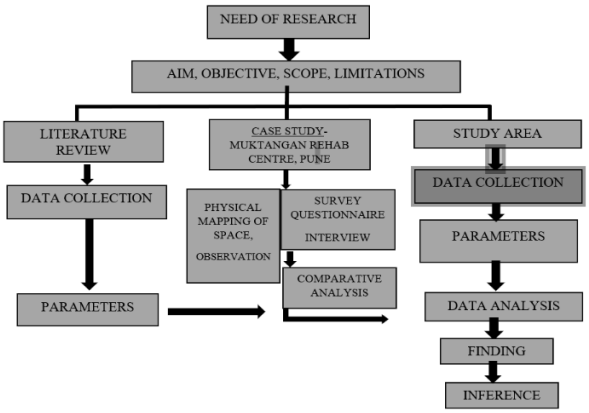

Chart.1 methodology flow chart

The research methodology adopted was divided in three phases according to the informationgathering technique.

- From literature review the parameters for studying the open, semi open and dead open are developed.
- The case study is done to observe the usability of outdoor spaces used in the de-addiction centre by different user group in same space at a same time.
- Activity mapping in the open,semi open and dead open spaces in de-addiction centre on different timings by different user groups is done to understand the flow of use of the space.
- When establishing the criteria for space quality, it was necessary to consult the user's subjective evaluation. For this reason, the questionnaire technique, which is the most suitable method in field study was applied. The interview of different user groups by preparing a questionnaire based on parameters studied in literature review is carried out, which gave the data necessary for analysing the pattern of use of outdoor spaces in de-addiction centre.
- Then open, semi open and dead open spaces are compared from which we get to know the characters of each space.
- From activity mapping. The pattern of use of the space is understood from which the mostly used space is identified and from the comparative analysis. Because of which characters. The space is being used is understood.

Case study- Muktangan rehabilitation centre, Pune

Architect- Shirish Beri

Completed- 2000

The drug rehabilitation centre designed by shirish beri is designed to accommodate a central courtyard that creates transparency, openness and fluidity between spaces and between patients. The de-addiction centre is the combination of indoor and outdoor spaces in which the nature plays a very important role, which helps addict to interact with another releasing the stress, feeling of isolation.

A balance was struck between the sense of freedom and disciplinary control. The design having transparency becomes expressive of this freedom and increases the physical and visual interaction, reducing the feeling of isolation. Even the main entrance is transparent. The transparency ,the cut outs, the terraced balconies, and the seating encourages the patients to open up.

Methods-

- On site observations
- Activity mapping
- User interview - 1.staff 2.patients

Observations on site

Spaces studied –

- Open space - open air amphitheatre
- Semi open space -seating space in entrance lobby
- Dead open space – building setback

Fig.1 Plan showing spaces to be studied

- Open air amphitheatre –
- Seating space in entrance lobby-
- Building setback

Parameters for studying the usability of open, semi open and dead open space

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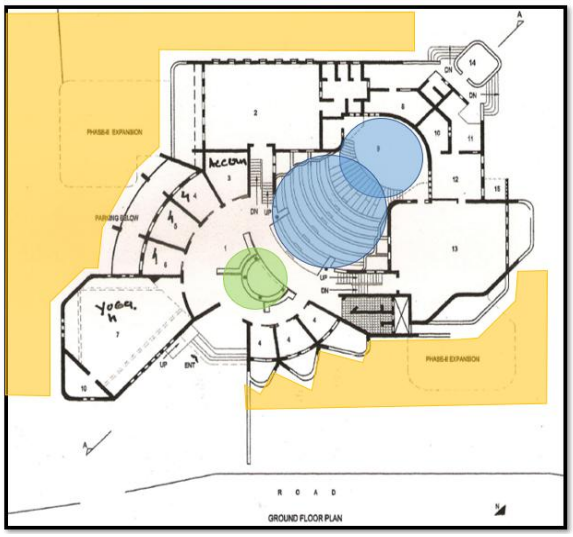
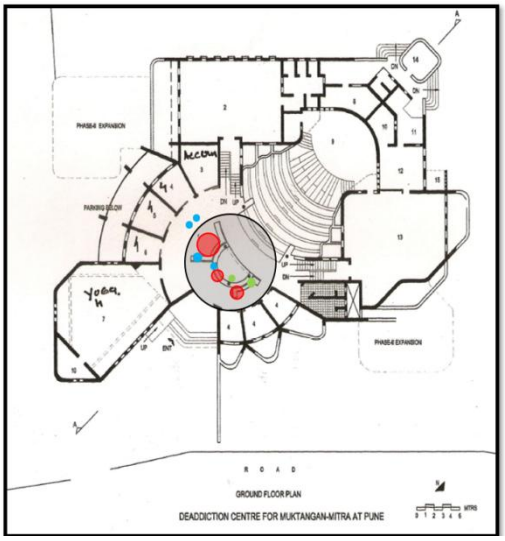


In this study, usability of open, semi open and dead open spaces is evaluated in regard to parameters which are identified in the literature study. These parameters are developed by the study of related literature about the space quality on which usability depends.

- Mapping of spaces
- Circulation
- Orientation
- Entry / exit
- Spatial characteristics
- Material
- Function/activity
- Time of use
- Seating arrangement
- Shadow patterns
- Natural light and ventilation
- Visual impact – views from the space
  -views towards the space

Observations

Table.1 Comparative study of open,semi open and dead open spaces shows the spatial characteristics of the space related to time,context and design.



Activity mapping- user footfall and activity

Users-

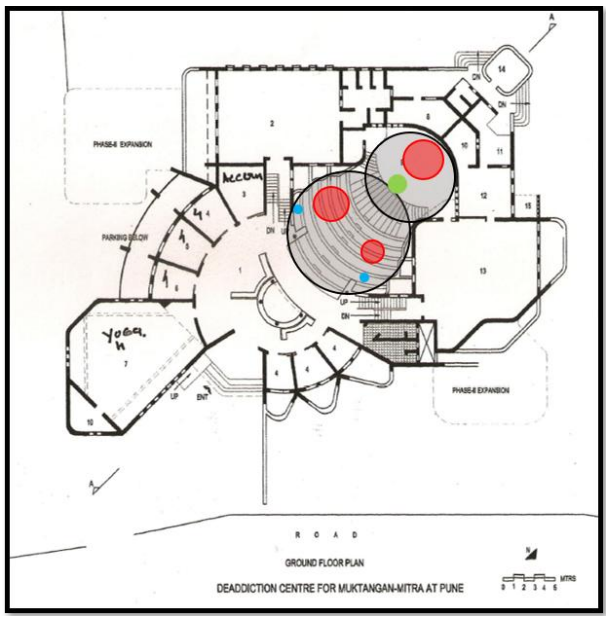
- Patient
- Doctor/counsellor
- Patient's family

In this study, the users are distinguished into three groups as patients, doctor/counsellor/staff member, and patient's family members.

Patients-

The patients were defined as the recipients of rehabilitation treatment in muktangan rehabilitation centre, pune.

Doctor/counsellor/staff members -



Doctor/counsellor/staff members are the people who accompany patients during their treatments in the rehabilitation centre or take care of patient's daily living in the rehabilitation centre.

1.open air amphitheatre

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Fig.2.A User footfall and Activity mapping of open air
Table.2.ATimewise activity mapping in specific space anduser

2. Semi open seating

Fig.2.B User footfall and Activity mapping of semi open seating

Table.2.B time wise activity mapping in specific space and user

3. Building setback

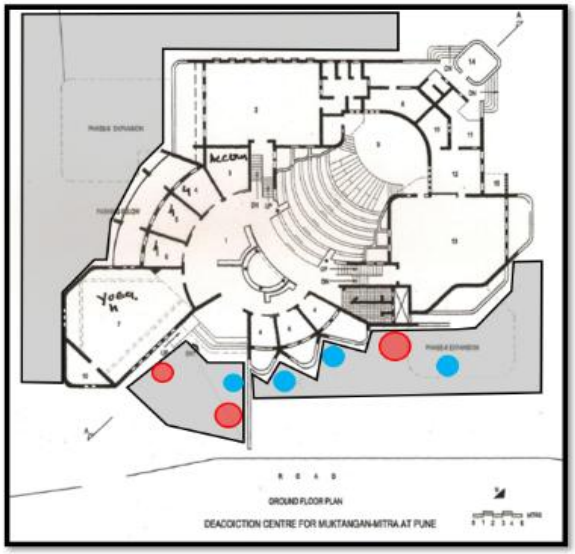

Fig.2.C User footfall and Activity mapping in building setback

Timing	Space user	Activity
10am - 12pm	• Patient • Doctor/counsellor • Patient's family	-yoga, exercise -meditation -yoga, exercise -meditation, sitting, interacting
12pm - 2pm	• Patient • Doctor/counsellor • Patient's family	-dining, sitting - -sitting
2pm-4pm	• Patient • Doctor/counsellor • Patient's family	- - -interacting
4pm-6pm	• **Patient** • **Doctor/counsellor** • **Patient's family**	**-interacting, workshops -relaxing -workshops -interacting**
10am-12am	Patient Doctor/counsellor Patient's family	-walking - -sitting -interacting

Timing	Space user	Activity
10am-12am	• Patient • Doctor/counsellor • Patient's family	-interacting -relaxing -sitting - -sitting -interaction
12pm-2pm	• Patient • Doctor/counsellor • Patient's family	-dining - -sitting -interaction
2pm-4pm	• Patient • Doctor/counsellor • Patient's family	- - -sitting -interaction
4pm-6pm	• Patient • Doctor/counsellor • Patient's family	-sitting -interaction -relaxing -sitting -interaction
12pm-2pm	Patient Doctor/counsellor Patient's family	- - -sitting -interacting
2pm-4pm	Patient Doctor/counsellor Patient's family	- - -sitting -interacting
4pm-6pm	Patient Doctor/counsellor Patient's family	- - -sitting -interacting

Table.2.CTimewise activity mapping in specific space anduser

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Space	Usability	Time	Reasons of usability
Semi open space	Most	-morning - afternoon -evening	-location -vegetation -shading pattern -accessibility -view from the space -natural ventilation
Open space	Moderate	-morning -evening	-location -vegetation -accessibility -natural material -natural light and ventilation -seating arrangement -view from the space -function
Dead open space	Least	-morning	-shading pattern -spatial character(openness) -vegetation

Data analysis

Reasons of non usability	Solution
-natural light (less as compared to amphitheatre and setback area)	-the **roofing material** of the double height atrium could be changed to the **transparent/opaque** material. -
- excess sunlight -shading pattern	-shade giving trees could be planted to give shade. -shading devices like pergolas could be added.
-view from the space -function -seating arrangement	-the space is dead, the space has not allotted the proper function, so planning proper activity in the space could increase the usability of space. -attractive landscaping and sitting arrangement could invite users.

Table.3.ATable showing Usability of the space and its reason

Table.3.BTable showing Usability of the space and its reason

The table 3A and 3B shows the usability of the space, time of use, reason for the utilization of the space and solution to increase its usability. Therefore, the open air amphitheatre has good spatial character but because of shading issue, it is less used. On the other hand, the semi open seating is mostly used. And dead open space is less used as compared to open and semi open space, so to increase its usability, mentioned parameters could be used.

Results

This research shows that people in de-addiction centre having a open and semi open spacehave a greater impact on people in de-addiction centre. They spend maximum amount of their day time in outdoor spaces.so the spatial relationship of indoor spaces with open spaces can have connection to them. It is seen that the semi open spaces are mostly used,which could be evaluated on different spatial characters.in my case study of muktangan,on the basis of observation, the semi open spaces are mostly used in design because of various parameters which increases the quality of that space resulting in maximumusability.

This paper describes a research that contributes towards understanding the characters of open, semi open and dead open space designs in de-addiction centre. The results revealed that semi open spaces are mostly used in the de-addiction centre because of location, vegetation,shading pattern, accessibility, view from the space, natural ventilation.

Conclusion

It could be observed that,while designing an open, semi open , dead open space,following parameters shall be considered to increase the usability of space. -location, vegetation, accessibility, shading pattern, natural material,natural light and ventilation, seating arrangement, view from the space, function.

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Flood and Landslide Resistant Structures: Western Ghats

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Abstract: Natural calamities occur due to rapid changes in environment like geophysical, hydrological and climatological etc. calamities such as flood, landslide, hurricane, cyclones etc. are considered as natural though hidden reasons can be manmade. Natural calamity which is the source of largescale destruction can be invited by the haphazard development, increasing population and urbanization. Collapsed structures, buried lives under the debris, soil erosion, economical destruction etc. are some of the major effects after these calamities. Disaster resistant structure preparation is the need of current situation to stop damage. Flood and landslide hazard mitigation is required, on which the paper focuses.

Key words – Natural calamity, Flood, Landslide, Haphazard development, resistant structures, flood mitigation.

I. INTRODUCTION

Flood and landslide are normal phenomena that have been affecting human settlements. Nature has been warning people about the consequences of unwise occupancy.In India, 12% of geographical area is flood prone and over 12% of total land mass falls under the landslide-prone zone.[i]Flood and landslides are classified according to duration and location. Flash floods, slow on set flood, and rapid onset flood are classified according to duration. Coastal, lake, and canal flooding are according to location.

Rapid flows of landslide are fastest and slump and debris slide is slowest type of landslide. These calamities have several aspects such as climate, social, economic and technical that is differently addressed for rural and urban conditions. In urban condition, problems are increasing due to the different reasons. Uneven settlement pattern, filling up natural drainage channels, and high value of urban land for living are the causes of urban flooding. In the present paper, an attempt has been made to study the encroachment on the river bank in Pune city and seek for the hidden reasons behind that and mitigation requirements.

Pune city lies on Western margin of Deccan plateau, on leeward side of Sahyadri mountain range. It is an altitude of 560m and it covers total geographical area of 15.642 square kms. The city is blessed with Mula and Mutha rivers that originate from Sahyadri ranges. Pune city is part of tropical climate and hence shows variation in temperature as well as rainfall conditions. Heavy urbanization in Pune from past few decades has led to haphazard development along the river and extend at the edge of the river.

Causes and impact of flood and landslide in urban area:

- Flood is natural phenomena, but may also be cause by manmade activities. Massive rainfall, climate change are the natural causes. Deforestation, urban drainage, broken dams etc. aremanmade reasons of flood. Floodplain areas are subjected to hydrostatic (standing water) and hydrodynamic (flowing water) pressures during floods. Flash flood damage roads, Direct loss of buildings, houses, vehicles, livestock, crops, and infrastructure.
- Main causes of landslide are increase of shear stress and decrease of material strength. Intense rainfall, soil erosion etc. are the physical causes and excavation, mining, quarrying, land use pattern are human causes of landslide. Crowded settlement patterns have also contributed to toehold erosion in many places. Due to heavy rainfall, clay soil and stones are moving down and this creates massive landslide. Stone quarrying results in formation that are unstable and could cause sudden landslide. The human activity is common in the inhabited areas of the hilly terrain that produce landslide.

II. METHODOLOGY

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Case study: AmbilOdha (Canal) flood (Aranyeshwar, Pune.)

Pune, which had not seen floods in years, was hit twice by this disaster in 2019. Most of the devastation and economic loss was experience near the banks of the river. AmbilOdha originates from the hillsof Western Ghats., in the southern part of Pune in Katraj. It flows in the north direction towards the city Centre, and many Streams join ambilodha before it meets the Mutha river.

On 25thSeptember heavy rains covered the major portion in just four hours, city recorded 106 millimeters of rainfall. On comparing survey of India maps, built up area had increased to 47% in 2015 from 37% in 1991.Streams existed till 1999, then they started disappearing. "These Changes happened when the width of the odha (canal) was reduced to about 8 feet from more than 20 feet, and the depth was reduced to 3.5-4 feet from about 12 feet, said by survivor."[iii.]

Fig- 1 (Source- google earth)

As per the observations, in 2005 canal was wide but due to encroachment the width has been reduce which resulted in disaster. Illegal and unplanned construction, settlements near the canal,dumping of construction debris and household waste, divert its path. no proper drainage, increased runoff owing to cement, concrete roads and encroachments near canal etc. are main reasons behind the ambilodha flood.

Fig- 2 (Source- google earth)

Malin landslide 2014 (Ambegaon taluka, Pune)

A massive landslide exterminated a village and it was identified ecological sensitive area. Culprits of landslide were heavy rainfall, deforestation, levelling of land for cultivation, human interference in nature etc.

The region receiving heavy rainfall, "data suggests 600mm precipitation may have affected this area prior to the landslide occurring." [iv] There was continuous heavy rainfall, soil-soaked rainwater and developed loose mud. After gaining some momentum, soil flowed down and sweeping, houses in village.

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From the study, we came to know landslide happened due to human intervention such as excavation, poor construction techniques, deforestation, and changed agriculture pattern etc.

Net case study:

Ar. G Shankar designed house which effectively resist flood and natural calamities in Thiruvananthapuram. The house has 3 stories, stands on pillar built with treated bamboo, mud and concrete. Mud bricks which could be interlocked are used to build structure, cement plastering done on wall prevent from seeping in moisture. Recycled mud tiles, coconut shell and treated bamboo were used in plastering.[v]

Aum houses (design and built by Autryville earth institute) was created disaster resistant and cost effective houses that could precast and transport anywhere, area about 23m^2, stabilized rammed earth foundations, plinth and walls constructed by hollow interlocking earth blocks (CSEB) and reinforced concrete ring beams, CSEB tiles for flooring, ferrocement used for doors and roof.[vi]

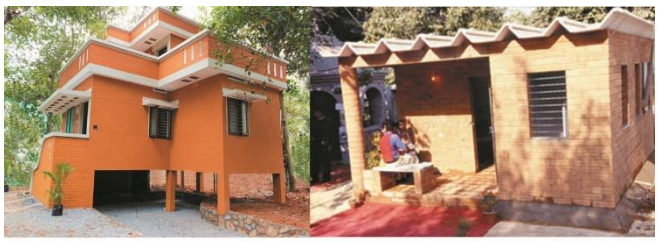

Fig- 3 Flood resistant model house. (Source- delhipostnews.com)

Disaster resistant structure. (Source- earth.auroville.com)

III. RESULTS

Construction within the flood line:

Avoiding the impact of flood is sensible development layout which reduce the need of resistance and resilience It is necessary to consider flood line during construction near the river bed. Flood lines are marked along the river bank indicating a potential threat of flood. No construction is allowed up to blue line, only restricted construction is allowed in between blue and red lines.

According to DC rules,

1. Area between the river bank and blue flood line shall be prohibited zone for any construction except parking, open vegetable market, garden, lawns, open space, cremation and burial ground public toilet, or like uses, provided the land is feasible for such utilization.
2. Constructions within river bank and blue flood line, may be permitted subject to conditioned that, the plinth height of the building shall not less than 0.45 m. above the R.L. of red flood line.
3. If the area between the river bank and flood line forms the part of entire plot in development zone i.e. residential, commercial, public-semi-public, industrial, then FSI of this part of land may be allowed to be utilized on remaining land.[vii]

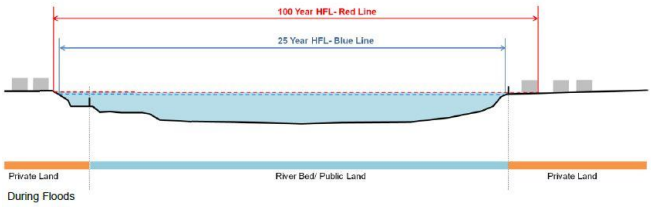

Fig-4 Demarcation of flood line (source-www.pmc.gov.in)

Design consideration for flood

- Properly design of embankments, drainage sluice, spilling section, anti-erosion works, diversion of flood water, catchment area treatment, in combination with other works such as reservoir, channel improvement, drainage improvement structure, etc. will be long term solution for flood problem.
- In wet flood proofingmain aim is to allow water to pass through lower level of houses.
- In dry flood proofingmain aim is to watertight the house includes sealants, coatings. Use one-way valves to prevent water from entering. Walls and foundation should resist flood pressure. Boundary wall and fencing can be designed to create flood resistant barriers.
- Levees and flood walls are made up of cement block or poured concrete, sump pump has to be installed to control the seepage and infiltration.
- Closed cell insulation should be used for pipes which are below the predicted flood level. Non return valves are recommended in drainage system to prevent back flow, are General services need to consider.
- Flood resistant flooring material such as concrete, clay, terrazzo, pressure treated tiles etc. use metal door and cabinets.[viii]

Design consideration for landslide:

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- Heavy rainfall is main reason for landslide, construct retaining wall, fill slope and soil nailing, construct ground anchor wall, horizontal drain to dewater are the landslide mitigation techniques. There are various direct methods, Erosion protection, channeling, vegetation, ground improvement, earth ramparts, stabilization of slope, berm provide at base of home, etc.
- Sheet piles, ground, soil and rock anchoring for resist soil.[ix]
- Foundation should design to carry the building load according to the soil bearing capacity.
- load bearing walls are preferred to carry flood water pressure. Construct timber crib wall, gabion wall, material behind the wall should be well drained.
- In Drainage system water should not allowed to flow down, should drain through pipes.[x]

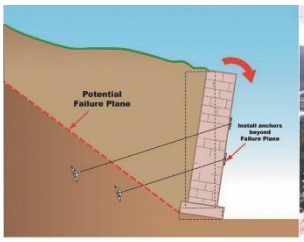

Fig- 5 Soil nailing
(Source- cirtx.com.au)

Retaining wall construction
(Source- nidm.gov.in)

IV. CONCLUSION

In recent years, flash flood and landslides frequencies have increased due to encroachments. Flood and other calamities Are increasing at an alarming rate. To overcome these issues, feasible planning as well as sustainable construction techniques should be put forth. This could be the first step towards better future.

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Study of Cooling Strategies of Animals and its Application in Habitable Spaces in Arid Climate

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ABSTRACT: Bionics', the science of emulating nature's strategies, has remarkably contributed to solving many of human problems in different fields. This paper discusses the use of various strategies and adaptations that animal species in arid condition use for better living and survival. Emphasis is on animal behaviour and then study expands to the living patternsinto five viewpoints which consist of form, material, way of construction, function and process. Ultimately by expanding the results into architecture finds new solution to get sustainable architecture.An analytical study is done to understand which strategy can be used for natural cooling and further studied in detail. This strategy further can be implemented to reduce energy consumption by humans used forcooling in desert regions. Analysis of selected thermal strategy or adaptation, existing in animal species is done.A hypothesis is built on the conclusion of the comparative and analytical study of strategies. Bionics and architecture are strongly related and hence bionics can be used in architecture to make it more sustainable and energy efficient.

KEYWORDS:bionics, arid, thermal strategies, natural cooling, skin, energy efficiency, sustainability.

INTRODUCTION:

Bionics is an interdisciplinary science crossing biology and technical science, developedwithin the recent 30 years.The term 'bionics' can be traced back to the 1950s. An American major, Jack E. Steele, coined this term in 1958 and further expanded its usage in 1960 with many other bionics' scholars at the first bionics seminar, held in America. This seminar marked bionics as a formal subject and laid the foundations of bionics. At that time, 'bionics referred to transferring technologies into life-forms, also known as biomimetics, diagnosis, biomimicry or biotical creativity engineering. Later, the term was also applied to bionic design, which is the harmonious relationship between the human and nature in industrial design, and also a major path to systematically study and improve the way of life.Human thermal comfort is defined as a condition of mind, which expresses satisfaction with the surrounding environment. High temperatures and humidity provide discomfort sensations and sometimes heat stress (i.e., reducing the body's ability to cool itself). Moreover, discomfort and heat stress reduce productivity and may lead to more serious health problems, especially for aged persons. In hot summers of arid regions, high outdoor air temperatures due to intensive solar radiation and low relative humidity are present. Consequently, discomfort sensations and heat stress are expected. Therefore, persons should take care when they go outside in hot summer to protect their health from heat and/or sunstroke.The indoor environment also plays an important role on the person's comfort and in arid conditions it is more important to work on the indoor habitat and energy consumption is high to keep the space lively and comfortable. To reduce the energy consumption and start a walk towards sustainability using the natural techniques that animals use in arid zones. Bionics is somewhere it not only implements the strategies but also puts in the research and development of that built environment.

METHODOLOGY:

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An analytical study is done based on secondary data, building a hypothesis at the end as a base work for further area of research

Humans and their adaptation in hot arid conditions.

Humans are physiologically very good at keeping cool, but rather poor at conserving water. Sweating is the primary method of cooling the body; the evaporation of this sweat from all over the body cools the naked skin. During a really hot day in the desert, however, a human will lose as much as 12 litres (a little over 3 gallons) of water through sweat. Humans have a special mechanism for cooling their big brain: The blood cooled by evaporation of sweat on the face and head penetrate the skull through tiny emissary veins, thus delivering freshly-cooled blood to the brain. This cranial radiator is unique among primates. Humans' upright, two-legged stance also confers some advantages for keeping cool. When the sun isdirectly overhead, only the head and shoulders are from the desert surface is much less than that of quadrupeds. Being upright also exposes more of the body to cool air currents, and thus body heat can be lost by convection. Nakednessis also an advantage. Without insulating fur, heat can be lost more easily through convection, and sweat can be more easily evaporated. And that patch of thick hair on top of our heads is more than mere decoration-it shades the head and its heat-sensitive brain from the sun. Unlike other desert mammals, humans have come up with many cultural and technological adaptations to the desert heat and aridity.in full sunlight-a four-legged animal has its entire back, shoulders and head exposed to the sun. Humans therefore gain much less radiant heat than four-legged animals. Also, by standing upright, most of the body is raised above the hot desert floor; this means that humans' rate of heat gain.

Desert iguana: Active in daylight, desert iguanas change colour to regulate body temperature. They are darkest in the morning to absorb more heat from the sun, and they will turn nearly pure white by early afternoon to reflect sunlight. These lizards can stand hotter temperatures than most, remaining active in up to 46º C (115º F). In extreme heat they seek the shade of a creosote bush. During breeding season, theirbellies turn pinkish. Theimportantfeatures chameleons have regarding skin colour are located in the dermis. It is within the dermis that the blood vessels, nerves, skin muscles, and special cells named chromatophores are present. The chromatophores contain guanine crystals and are subdivided into differing types including iridophores, xanthophores, erythrophores,guanophores, and melanophores.

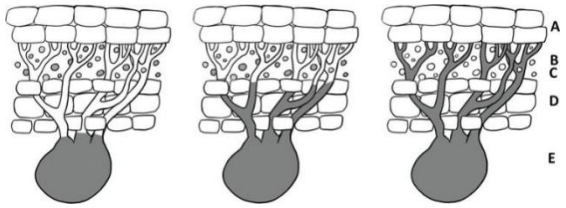

Figure 1 Dermal section.

A. Keratin layer, B. Xanthophores, C. Erythrophores, D. Gonophores, E. Melanophores. The three figures show how coloration is achieved through their extensions.

Desert ants: A single ant is capable of carrying up to 50 times its own weight, so working together as a colony means they're able to accomplish impressive feats. In fact, within a week a large army of garden ants can construct an underground city big enough to house thousands of insects. Established deep underground, ant nests are made up of multiple chambers and connecting tunnels. Each chamber has a different use; some store food while others are used as nurseries for the young and resting spaces for busy worker ants. You'll find the queen ant in the central chamber where she will lay her eggs. Porous turrets are also built above ground to ventilate the nest and maintain an even temperature inside

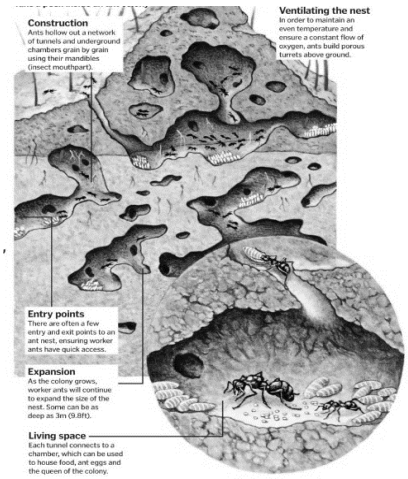

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Figure 2 Ant's Nest

Caterpillars:The temperature can influence how much the caterpillars eat and grow. Larvae are pupated and emerge while being affected by heat or cold. This thermoregulatory behavior can be implemented.Other strategies are the creation of a cocoon around the animal to minimize water evaporation or to produce an appropriate environment for a specific process, e.g. the metamorphoses of the caterpillar. In the cases analyzed, the cocoon material is always self-created by the animal. In HVAC systems, these actions inspire the possibility of using new organic materials or components.

Figure 3 Larvae pupating going through metamorphosis.

. **Honey Bees:**Residing in temperate environments, honey bees (*Apis mellifera*) work especially hard to maintain brood comb temperature between 32 and 36 °C. Heat shielding is a social homeostatic mechanism employed to combat local heat stress. Workers press the ventral side of their bodies against heated surfaces, absorb heat, and thus protect developing brood. While the absorption of heat hasbeen characterized, the dissipation of absorbed heat has not.

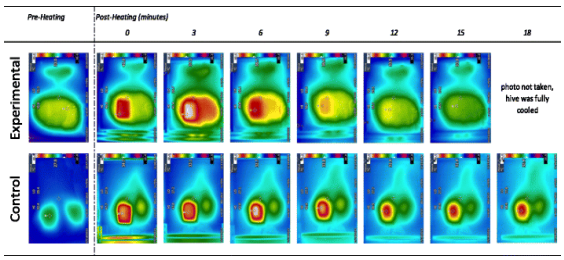

Figure 4 Heat dissipation in honey bee.

Desert Snails: The shell of some desert snails helps them survive extreme heat using light reflectance and architecturally-derived, insulating layers of air. Sphincterochilaboissieriwhich occurs in the deserts of the Near East. Live specimens of this snail, withdrawn in the shell and dormant, can be found on the desert surface in mid-summer, fully exposed to sun and heat. The surface temperature of these deserts may reach 70 °C and more than a year may pass between rains. The maximum air temperature, reached at noon, was 42.6 °C, and the maximum soil surface temperature in the sun, reached at 13.00, was 65.3 °C. Under the snail, in the space between the soil surface and the smooth shell, the maximum temperature was 60.1 °C, or 5.2 °C below the adjacent soil surface in the open sun. The lower temperature under the shell is expected, for the shell provides shade for that particular spot of the soil surface on which it sits. Inside the shell in the largest whorl, located in contact with the ground, the maximum temperature was 56.2 °C. In the second and third whorls the temperature was lower, reaching a maximum of 50.3 °C.

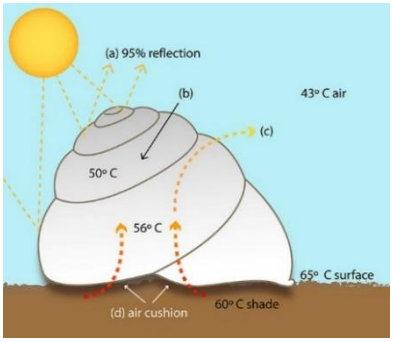

Figure 5Fig (5) The surface of the shell is highly reflective, resulting in 95% reflectance within the near infrared, 90% in the visible spectrum (a). While the maximum air temperature might reach 43 °C (109 °F) surface temperatures can reach 65 °C (149 °F). However, shading and the rough surface of the soil results in a temperature of 60 °C (140 °F) (d). During the heat of the day, the snail retreats into an upper whorl where the temperature is an even cooler 50 °C (122 °F) (b). Heat flows in the direction of lower temperature, result in heat flow through the shell, with resultant decrease higher in the shell (c

All the above studied strategies have a strong potential to be implemented. It will further help the construction and technical world to understand the working of natural species reducing the gap between natural and synthetic living.

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FURTHER AREA OFRESEARCH: Building up a prototype of structure on the analysis of shell of desert snailSphincterochilaboissieriand testing it in a software.

CONCLUSION:

This paper has analysed various cooling strategies in animal species and also found immediate use of those strategies within the architectural boundaries to attain energy efficiency and sustainability. While the entire analytical process various research opportunities rose for many other fields.The study has validated the solution-based approach methodology proposed.

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Table (1) Analysis of various animal strategies.

Desert animals	***Desert iguana***	***Ants***	***Caterpillar***	***Honey bee***	***Desert snail.***

Adaptation compared to normal species	Thick skin with scales to protect from sun.	Construction technique for their dwelling space	Change in its form.	Social behavior.	Pure white shell, with curvature having high reflective indices.
Strategies used by them	Color changes according to temperature.	Thatched nest construction with holes to protect the larvae and fungus kept inside.	Indoor temperature maintained by change in the spatial configuration	Indoor temperature control in bee hive by social organization.	Cooling inside of the shell to avoid harsh temperature outside.
	Designing a façade with changing color according to temperature	Construction technique and materials can be used for building structures.	Construction can be done with geometrical experimentations.	Cellular division technique can be used.	The structure and material of shell having reflective index can be used.

Table (2) Based onthemodelsanalysed, several technologicalhypotheses wereproposedandclassified depending on scale.Table consists of factors, theevolutionary strategy and the animal response mechanisms.

Biological Domain				**Goals**			**Technological Domain**	
Animal	**Strategy**			**Energy Management**			**Objectives**	**Application Scale**
	System	**Process**	**Action**	**Heat Gain**	**Heat Storage**	**Heat Dissipation**		
Desert Iguana	Solar control	Color change	Darker/ lighter	YES	NO	NO	Material or façade that changes its color depending on temperature.	Building
Ants	Air control	air movement	Force flow	YES	NO	YES	Ventilation. Openings optimization	Building
Caterpillars	Air control	surface to volume	Construction	YES	NO	NO	Passive ventilation control	Building
Honey Bee	Air control	Air movement	Obstruction	YES	YES	YES	Division of elements in atrium spaces to diminish losses caused by air currents.	Building
Desert Snail	Air control	Air movement	Force flow	YES	NO	YES	Implementation of indoor air micro currents for temperature control.	Building

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Role of Transit Hubs in Social A Developing Smart City

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Abstract:The literature review shows, that among the three facets of sustainability; environmental, economic and social, the third has always been the neglected one by scholars and policy makers. This paper draws attention on the relation between transit and social sustainability. The paper argues, while considering transit's sustainability, only transit systems are studied whereastransit hubs are equally significant. A survey was carried out to find, how people of different age groups, gender and economic class perceive these transit hubs in terms of equity, quality, interconnectedness and access. Paper concludes by elaborating the relation between transit hubs and social sustainability.

Keywords: *sustainability, transit, social sustainability, transit hubs, smart cities, transit oriented developments*

Introduction

Sustainability has been a wide subject of interest for scholars for past few decades, which is further subcategorized into three dimensions which are, Environmental, economic and social (Partridge, 2012; Lucas , Marsden, Brooks & Kimble, 2007; Gomaa & Sakr, 2015). Though the term sustainability has included the social aspect, for two decades this aspect of the sustainability has been neglected(Vallance, Perkins, & Dixon, 2009). Few scholars define social sustainability as development which leads towards harmonious evolution of the society(Gomaa & Sakr, 2015).

This paper argues that the social dimension of sustainable development is also important in order to achieve sustainability as a whole. Social sustainability still lacks the recognition whereas it's an independent dimension which is Equally significant to the economic and environmental sustainability (Omann & Spangenberg, 2002).

The literature review shows that there's a relation between transit and social sustainability. Transportation system is a very important factor which shapes the city and which impacts all three aspects of the city's sustainability. (Bamwesigye & Hlavackova, 2019).

Literature review suggests, that more research needs to be done on transit system's sustainability in general and social sustainability in particular. The social elements are in-fact significantly affected by transit systems.

(Pucher , Korattyswaropam, Mittal & Ittyerah, 2005; Lucas et al., 2007; Mattioli, 2015).

Transit oriented development (TOD) has been an emerging topic in urban India. The study shows that the cities in India which have tried to incorporate TOD, have failed to consider social sustainability.(Joshi, Joseph, Patel, & Darji , 2017). Joshi (2017) suggests that TODs in India shall be inclusive of social sustainability to achieve their goal.

This research argues that, while considering sustainability of transit systems, only macro level planning is taken into account, where the micro level aspects are also equally significant. Here, transit systems and transit corridors are termed as macro and transit hubs such as train stations, bus stands are termed as micro(Elshater & Ibraheem, 2014). Few scholars argue that TODs worldwide and in India have not really focused on the transit hubs. Transit hubs are nodes where different modes of transport are exchanged(Elshater & Ibraheem, 2014).

The government of India recently announced "Smart Cities Mission" where transportation has been given a great importance(Bamwesigye & Hlavackova, 2019). Few scholars argue that very less is done in order to promote public transit in these cities. They claim that the transit routes that are developed are unknowingly encouraging the usage of private vehicles among people (Ramos , Vicente , Passos, Costa & Reis, 2019).

This research proposes, that Maximum focus shall be given on increasing the amount of public transit usage and reducing the number of private motor vehicle users in India. This reduction of private vehicles will result in low carbon emission, safe environment, social equity and economic sustainability of these cities. This paper argues, that equal importance shall be given to the transit hubs and how they affect social sustainability of that city. (Srinivasan, 2019).

Research background

Partridge (2012) has discussed main principals of social sustainability which are quality of life, equity or social justice, inclusion or inter connectedness and access. Pucher (2005) emphasizes on the relation between transport crisis and the economic class of the people. He argues that the mode of transport changes as the economic class of the user changes. Mass public transit is most commonly used by poor and middle class. The paper argues that the lower income group of the society remains to be the most neglected one. The argument raised is about accessibility and social discrimination. Ramos (2019) focuses mainly on the negative aspects of people's perception which lead to not adopting the public transit. Ramos (2019) concludes by stating, that the users' needs and expectations shall be considered while developing transit services in order to achieve sustainability.

Joshi (2017) in his research states that transit oriented development is taking its shape in India. While explaining TOD, paper provides a definition by Calthrope (1993): '*Mixed use communities within an average 2000-foot walking distance of a transit stop and a core commercial area. TODs mixed residential, retail, office, open space, and public uses in a walkable environment, making it convenient for residents and employees to travel by transit, bicycle, foot or car*.'Paper further states that TOD comprises a mix of commercial, residential, and institutional developments built to support a transportation hub and to encourage non-motor vehicle mobility options.

Mattioli (2015) draws relation between social sustainability and transit. Author discusses the relation between transport system and economic groups in the society. It claims that, individuals who have lack of access to car or public transit are more at risk of social omission. This issue of accessibility has also been addressed in Pucher's (2005) work. Author argues that ensuring fair levels of access to everyone will result into achieving a rapid reduction in transport emissions and energy consumption in developing countries. Author also argues that there is a tension between the need and the want of people as the satisfaction of transit has come to depend upon the usage of private vehicles.

Bamwesigye (2019) relates smart cities and sustainable transport. Paper expresses importance of sustainable transport in all three aspects. Elshater et al. (2014) discuss various definitions of hubs. They discuss hub in urbanization field asa node for exchanging the transit mode.Gomaa's (2015) research directly connects social sustainability with a transit station named as El-Raml. It mainly focuses on maintenance of socio cultural characteristics. Lucas (2007) talks about assessing social sustainability in transport. She claims that the research can be of relevance to other countries. She discusses a set of merits of social sustainability which are, poverty, accessibility, employment, health and education, quality of life.

Srinivasan (2019) in her research relates social inequity and public transport infrastructure. She exclusively focuses on transit hubs and their impact on social equity. She argues that infrastructure of transit hubs has an impact on social sustainability. She points out the factors such as safety, gender, economic and cultural are very much affected by these transit stations. She suggests that these transit stations shall be made more inclusive in order to achieve social sustainability.

Scope and limitations

The scope of this study is limited to, only one transit hub (Swargate, Pune). Strata are limited to gender, age groups and economic class of people,and the sample was limited to 85 respondents.

Methodology

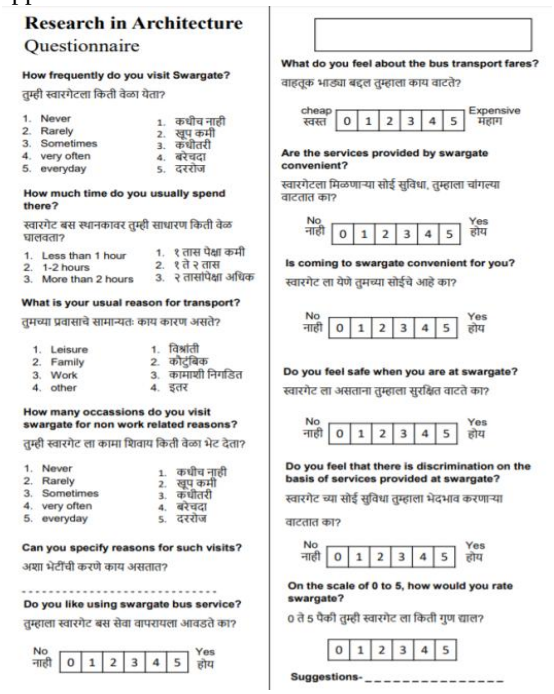
Research focuses on Swargate bus stand in Pune. This methodology views Swargate in lenses of four elements of social sustainability which are; equity, quality, interconnectedness and access. Stratified random sampling of 85 people was done. Strata 1 was Gender: Males, Females; Strata 2 was Age groups: 18 to 39, 40 to 60, 60+; strata 3 was Economic class: Lower, Middle, Higher. Indicators used were; Frequency of travel, Time spent at Swargate, Reasons for transport, affordability, convenience, safety, discrimination, and liking.Data was collected by using primary data. A survey was carried out by the means of questionnaire consisting of 12 questions.

Results and Analysis:

The survey was analysed in a pixel format to understand the results better, in a broad as well as micro fashion. Every pixel in the table of any indicators, represents a single person.

Every hierarchy was shown with the help of gradient. In the case of frequency of travel, the darkest colour represents highest frequency, and the darkness fades as the frequency decreases. For the time spent at transit hub, the darkest colour represents highest amount of time spent and the darkness fades as the amount of time decreases.Reasons for transport are broadly classified into four types which are, leisure, family, work and other. Red represents leisure, yellow represents family, green represents work and the blue represents other.

In case of all the qualitative indicators which are, liking, affordability, quality, convenience, safety, discrimination and overall rating; the darkest colour represents negative perception of people and the lightest colour represents positive perception of people. Purple colour represents 'not applicable'.



Research in Architecture
Questionnaire

How frequently do you visit Swargate?
तुम्ही स्वारगेटला किती वेळा येता?

1. Never — 1. कधीच नाही
2. Rarely — 2. खुप कमी
3. Sometimes — 3. कधीतरी
4. very often — 4. बरेचदा
5. everyday — 5. दररोज

How much time do you usually spend there?
स्वारगेट बस स्थानकावर तुम्ही साधारण किती वेळ घालवता?

1. Less than 1 hour — 1. १ तास पेक्षा कमी
2. 1-2 hours — 2. १ ते २ तास
3. More than 2 hours — 3. २ तासांपेक्षा अधिक

What is your usual reason for transport?
तुमच्या प्रवासाचे सामान्यतः काय कारण असते?

1. Leisure — 1. विश्रांती
2. Family — 2. कौटुंबिक
3. Work — 3. कामाशी निगडित
4. other — 4. इतर

How many occassions do you visit swargate for non work related reasons?
तुम्ही स्वारगेट ला कामा शिवाय किती वेळा भेट देता?

1. Never — 1. कधीच नाही
2. Rarely — 2. खुप कमी
3. Sometimes — 3. कधीतरी
4. very often — 4. बरेचदा
5. everyday — 5. दररोज

Can you specify reasons for such visits?
अशा भेटींची करणे काय असतात?

Do you like using swargate bus service?
तुम्हाला स्वारगेट बस सेवा वापरायला आवडते का?

No नाही 0 1 2 3 4 5 Yes होय

What do you feel about the bus transport fares?
वाहतूक भाड्या बद्दल तुम्हाला काय वाटते?

cheap स्वस्त 0 1 2 3 4 5 Expensive महाग

Are the services provided by swargate convenient?
स्वारगेटला मिळणाऱ्या सोई सुविधा, तुम्हाला चांगल्या वाटतात का?

No नाही 0 1 2 3 4 5 Yes होय

Is coming to swargate convenient for you?
स्वारगेट ला येणे तुमच्या सोईचे आहे का?

No नाही 0 1 2 3 4 5 Yes होय

Do you feel safe when you are at swargate?
स्वारगेट ला असताना तुम्हाला सुरक्षित वाटते का?

No नाही 0 1 2 3 4 5 Yes होय

Do you feel that there is discrimination on the basis of services provided at swargate?
स्वारगेट च्या सोई सुविधा तुम्हाला भेदभाव करणाऱ्या वाटतात का?

No नाही 0 1 2 3 4 5 Yes होय

On the scale of 0 to 5, how would you rate swargate?
0 ते 5 पैकी तुम्ही स्वारगेट ला किती गुण द्याल?

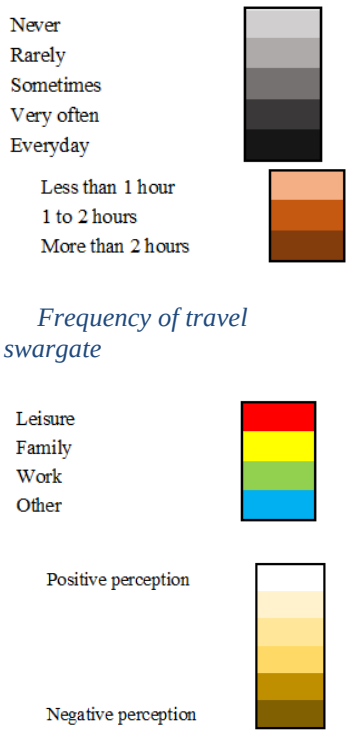
0 1 2 3 4 5

Suggestions-

Figure 1: Questionnaire

Gender	males									Females								
Age groups	18-39			40-60			60+			18-39			40-60			60+		
Economic class	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H	L	M	H
Frequency of travel																		
Time spent																		
Reasons for transport																		
Liking																		
Affordability																		
Quality																		
Convinience																		
Safety																		
Discrimination																		
Rating																		

Table1: Results



Frequency of travel *Time spent at swargate*

Reason for travelling *Perception of people*

Figure 2: Legend

Discussion

Study shows that people from lower and middle economic class are more likely to use swargate bus service than the people belonging to the higher economic class. It is observed that even if people like using the bus transportation system, they tend to not use it because of the current condition of swargate. The lower economic class, which is apparently the most important user of swargate bus station, can't afford the current transit fares. But the higher economic class which can easily afford the current fares, doesn't use it because of the condition of the swargate bus station.

Maximum people perceive the quality provided at swargate negatively, hence most of the respondents believe that the quality of facilities, planning, services etc. provided at swargate are not satisfactory. Discrimination is the factor which people perceive much positively;which means, most of the respondents don't believe that there is any sort of discrimination at swargate with respect to gender, economic class and age group. The overall rating that respondents gave to the swargate bus station is average.

Female respondents were not happy with the conditions of toilets and other infrastructure facilities. Women also perceive the station to be not very safe during night time and also many respondents were afraid of theft. Even if

most of the respondents do not perceive the transit station to be discriminatory in nature, the people who rate it to be discriminatory, belong to the lower economic section of society. When the suggestions or opinion of people was asked at the end of the questionnaire, most of the respondents expressed their problems related to safety and security, congestion, lack of planning, lack of management and punctuality, traffic etc.

Conclusion

In the conclusion it may be said that, the elements of social sustainability which are interconnected, need to be worked uponto make these transit systems sustainable in a true sense. Which shall promote the equal participation and usage by all the classes of society, ultimately enhancing the current nature of inclusion at these transit hubs. The paper ends by proposing that social sustainability through transit hubs shall also be taken into account to get a broader idea of sustainability of transit systems itself.

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Understanding Building Image Perceptions through Associated Adjectives

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Abstract : Buildings constructed of different materials, styles and patterns are referred to by different adjectives, probably understood uniformly by people related to the building industry. However, they may be interpreted differently by laypersons, who are also the end-users.Their perception needs to be analysed to understand how the impressions formed which would also depend upon the person's upbringing, cultural background, education and exposure. Different responses from interviews can be analysed and categorized in various ways which would be significant in understanding users' impression in a particular context about a building of specific materials, style, pattern and function.

Keywords: Building terminologies, layperson, perception, adjectives, impression

I. Introduction:

Architects design buildings with a certain image which they try to project to the masses. Putting forth an image to be associated with a building usually is done through usage of variety of surface finishes, landscape elements, textures, colours, materials, and so on. The architect can certainly attempt to create an impression that he wants in the peoples' minds about the building, but what people actually feel about that building is an individualistic perception. Different building-related terminologies invoke different images and responses in the mind of an individual who is not directly related to the building industry. This response depends not only on the building, but also the upbringing, background and exposure of the person. For example, the description 'a stone building' might bring forth images of grand *wadas*to word impression means the initial feeling and the image stored by the person's memory about a person or something-cognitive experience. [i]
Creating an impression of a building is a conscious attempt of the designer to impress or imbibe an a long-time resident of Pune, whereas the same description might remind a senior Mumbaikar of the British era and colonial buildings. The context changes the impression of a specific description.

Research has been done previously on perceptions of individuals based on first-hand responses of people to a particular material, texture or colour.[ii], [iii].When all of these come together on a building façade of a considerable scale, the perception might be entirely different.

This study works closely together with psychology and language along with architecture to gain an insight into what the end-users actually feel about a particular type of building with respect to the materials used. For instance, an elderly person might say a wooden building seems warm and homely, but a youngster might say it is unfamiliar or traditional. This research attempts to find a common thread between all the different associated adjectives for material-based building descriptions expressed by individuals of different backgrounds, with respect to profession and exposure to other cultures and places.The study would be beneficial to practicing architects to understand the association of different materials and its related perceptions for common man.

- **Perception and Impression**

The term perception is derived from a Latin origin "Perceptio" means to feel, to comprehend and to take hold of.The perception is the way through which the man contacts his environment. [i]
Perception depends on the awareness andattention. The impression is an effect, feeling or preserving an image due to the experience. The experience or characteristic(s) onto the users' minds. Getting an impression is entirely dependent on perception.

- **Building Materials:**

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Building materials have at least one of the two functions: structural or finishing. The materials used on building facades are the primary impression-creating elements. Up to the mid-20th century, the form of construction was primarily load bearing. Therefore, these buildings came to be associated with masonry units, bulkiness, small openings and dim, cool interiors. The impression was a result of the construction methodology. In Pune, *wadas* were the predominant buildings. These were constructed of stone or brick in combination with timber frames. Again, the available materials and known technology dictated the aesthetics and 'feel' of the building. As time progressed, newer materials and construction technologies were put to use. RCC became the most common and preferred material for building construction. It became possible to explore glass and steel, which have now become a common feature on facades of buildings in metropolitan cities.

The typology of building and the age, profession and exposure of end users are variables which would affect the impression of the building based on the materials used.

II.Methodology:

This research considers perception of people as the unit of analysis. Descriptions in the form of short phrases were asked to get an idea about the impression of a building of a particular material. Using only words and not pictures as the form of communication ensured that an unbiased response based only on previous impressions and exposure was obtained.

The sampling selected consisted of 31 individuals across a range of financial and professional backgrounds. The profession of a person and the education required for it shapes the way an individual senses his/her surroundings. The financial background decides how much a person is exposed to other cultures and places, usually in the form of travelling.

The methodology adopted was interviews with all open-ended questions which gave material -based building descriptions. The first few questions gained information about profession and exposure. The remaining questions attempted to obtain impressions about building descriptions.

III. Observations:

The sampling included 31 individuals within the age range of 20 to 55 years and having varying professions ranging from student to housewife to businessman. 22% were engineers, 6 % were lawyers,6% were teachers, 6% were students, 10% were businessmen26% were housewives and remaining 30% were of other professions. All the people in the sample have been residents of Pune for at least 20 years.

Individuals who had widely travelled in India and abroad had different opinions about a particular building description than those who had been less exposed to other places.

IV.Results and Tables:

The obtained data was analysed based on two criteria: the frequency of an adjective used for a particular type of building, represented in the form of percentages, and categorization of adjectives based on visual impression, structure and/or strength, and physical experience. For instance, the adjective 'cool' for a stone building is most probably based on the experience of being inside a stone building, whereas the adjective 'antique' is based on its aesthetics.

The frequency of an adjective used for a particular building description determined the understanding of an overall impression, represented in table nos. 1 and 2. According to colour used, adjectives are categorized as:

- Impressions based on aesthetics
- Impressions based on structure
- Impressions based on experience

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Categorization of different adjectives under three headings: experience, structure and aesthetics showed that except for steel structures, the impressions formed of buildings were primarily based on their aesthetical appearances. (Fig.1)

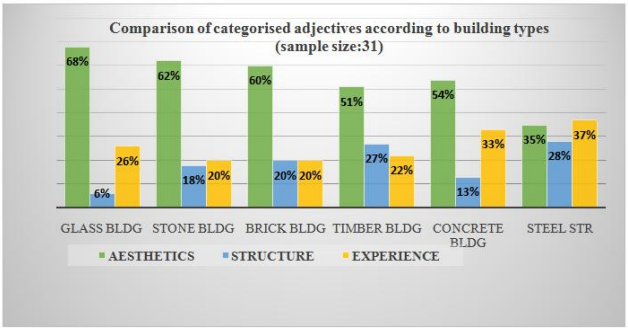

Fig.1 : Comparison between categorised adjectives for different building types

V.Conclusion:

This research shows that in a particular context, in this case Pune, impressions about different buildings by individuals of different age, professions and exposures are largely variable. However, as the cultural background is similar, there is also some commonality observed in these associated adjectives.

VI. Discussion:

This research is a pilot study to gain insight into common man's perception of buildings. The sampling was limited to residents of Pune, therefore this study would be helpful only in the context of Pune city. The impressions obtained were adjectives based on past experiences of users. A study could be done further to obtain responses of people actually using that building at that point of time. This study will be useful for designers to use those materials in and on a particular typology of buildingwhich the users would find comfortable, likable and desirable.

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Table no.1- Adjectives associated with glass, stone and brick buildings

Type of Building	Stone		Type Of Building	Glass		Type Of Building	Brick	
Adjectives Used	Frequency	%	Adjectives Used	Frequency	%	**Adjectives Used**	Frequency	%
Antique	9	30%	Artificial	2	6%	Ancestral	1	3%
Attractive	3	10%	Attractive	9	30%	Average	1	3%
Brittle	1	3%	Beautiful	1	3%	Brittle	3	10%
Bulky	1	3%	Boxy	3	10%	Closed/Boxy	1	3%
Cave-Like	1	3%	Breakable	2	6%	Cool	2	6%
Classic	2	6%	Bright	8	26%	Cosy	1	3%
Collapsible	1	3%	Classy	3	10%	Crude	1	3%
Colonial	3	10%	Clean	4	13%	Dignified	1	3%
Commercial	1	3%	Commercial	7	22%	Dilapidated	3	10%
Cool	16	52%	Common	1	3%	Dull	1	3%
Crude	2	6%	Cool	1	3%	Earthy	2	6%
Dark	1	3%	Corporate	5	16%	Easy Reconstruction	1	3%
Decorative	3	10%	Decent	1	3%	Exotic	2	6%
Difficult To Rebuild	1	3%	Decorative	1	3%	Fast Construction	1	3%
Elegant	2	6%	Delicate	9	30%	Fire-Proof	1	3%
Exotic	3	10%	Dramatic	1	3%	Generic	4	13%
Expensive	1	3%	Dynamic	1	3%	Heat-Absorbing	2	6%
Fort	3	10%	Elegant	2	6%	High Maintenance	1	3%
Haveli	1	3%	Elite	1	3%	Homely	3	10%
High Maintenance	1	3%	Esteemed	1	3%	Informal	1	3%
Historical	3	10%	Exclusive	1	3%	Insulating	2	6%
Imposing	9	30%	Expensive	5	19%	Leakage-Prone	2	6%
Indestructible	1	3%	Foreign	1	3%	Leisurely	1	3%
Insulating	1	3%	Formal	1	3%	Long-Lasting	2	6%
Long-Lasting	6	19%	Fresh	2	6%	Low-Cost	4	13%
Low Cost	11	35%	Glare	2	6%	Modern	1	3%
Low Maintenance	1	3%	Good Views	3	10%	Moisture-Absorbing	1	3%
Low Rise	1	3%	Graceful	1	3%	Official	1	3%
Mysterious	1	3%	Heat-Absorbing	3	10%	Old	2	6%
Naturally Beautiful	1	3%	Heavenly	1	3%	Residential	2	6%
Nostalgic	2	6%	High Maintenace	7	22%	Rich	1	3%
Old	1	3%	Impressive	2	6%	Rough	1	3%
Privacy	1	3%	Interesting	1	3%	Rural	1	3%
Rare	8	26%	Lightweight	1	3%	Safe	1	3%
Residential	1	3%	Modern	3	10%	Shabby	4	13%
Rigid	2	6%	No Privacy	4	13%	Sleek	1	3%
Safe	2	6%	Open	2	6%	Small	2	6%
Strong	2	6%	Palatial	1	3%	Staggered	1	3%
Sturdy	8	26%	Permeable	1	3%	Standardized	4	13%
Sustainable	13	42%	Posh	1	3%	Strong	4	13%
Traditional	7	22%	Prosperous	1	3%	Style Statement	2	6%
Under Developed	1	3%	Reflective	2	6%	Temporary	1	3%
Unprocessed	5	16%	Scarring	4	13%	Traditional	2	6%
Vernacular	1	3%	Simple	1	3%	Unfinished	6	20%
Wada	1	3%	Smooth	1	3%	Unpleasant	3	10%
			Sound Proof	1	3%	Unreliable	2	6%
			Spacious	1	3%	Unstable	1	3%
			Suffocating	1	3%	Vernacular	1	3%
			Timeless	2	6%	Wada	1	3%
			Transparent	7	22%	Weak	4	13%
			Unsafe	8	26%	Workable	1	3%
			Wonderful	1	3%			
Total number of Stone building:45 Adjectives used	**Glass building : 52**		**Brick building: 50**					

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Table no. 2- Adjectives associated with timber, concrete buildings and steel structures

Type Of Building	Timber		Type Of Building	Steel		Type Of Building	Concrete	
Adjectives Used	Frequency	%	Adjectives Used	Frequency	%	Adjectives Used	Frequency	%
Expensive	8	26%	Industrial	10	32%	Apartments	3	10%
Antique	1	3%	Assemblable	6	19%	Artificial	2	6%
Artistic	2	6%	Cheap	3	10%	Commercial	2	6%
Attractive	5	16%	Cold	1	3%	Congestion	1	3%
Breakable	1	3%	Collapsible	1	3%	Convenient	2	6%
Classy	2	6%	Commercial	2	6%	Dead	2	6%
Cool	2	6%	Convenient	1	3%	Designed	1	3%
Cozy	3	10%	Cool	1	3%	Dull	2	6%
Damageable	1	3%	Corrosion	5	16%	Durable	4	13%
Decent	1	3%	Costly	1	3%	Easy Maintenance	1	3%
Decorative	1	3%	Curious	1	3%	Finished	1	3%
Deteriorating	3	10%	Dark	1	3%	Flexible	1	3%
Dim	1	3%	Dinstinctive	1	3%	Generic	6	19%
Earthquake Resistant	2	6%	Durable	5	16%	Heat Absorbing	7	22%
Eco-Friendly	2	6%	Exhibitions	1	3%	Heterogenous	1	3%
Exotic	1	3%	Eye-Catching	1	3%	High Maintenance	2	6%
Fire Hazard	4	13%	Factory Shed	3	10%	Infrastructural	2	6%
Foreign	1	3%	Flexible	2	6%	Large Scale	1	3%
Fragile	1	3%	Hard	1	3%	Leakage Prone	1	3%
Fragrant	3	10%	Heat-Gaining	9	30%	Low Cost	5	16%
Fresh	1	3%	Heavy	1	3%	Modern	2	6%
Heritage	3	10%	High Maintenance	3	10%	Necessity	1	3%
High Maintenace	7	22%	Huge	1	3%	Not Insulating	2	6%
Historical	2	6%	Illegal	1	3%	Not User-Friendly	5	16%
Impressive	2	6%	Immovable	1	3%	Quick Construction	1	3%
Insulating	3	10%	Infrastructural	1	3%	Residential	1	3%
Leakage-Prone	1	3%	Intricate	2	6%	Rigid	2	6%
Light-Weight	5	16%	Leakage-Prone	1	3%	Rough	2	6%
Limited	1	3%	Light Weight	2	6%	Safe	1	3%
Natural	2	6%	Low Maintennce	2	6%	Simple	3	10%
Not Eco-Friendly	1	3%	Mechanical	5	16%	Solid	2	6%
Not Sound-Proof	2	6%	Monumental	1	3%	Solid	1	3%
Not Sturdy	1	3%	Necessity	1	3%	Strong	10	32%
Old	4	13%	Noisy In Rains	3	10%	Unchangeable	2	6%
Pleasant	2	6%	Not Homely	2	6%	Unfinished	4	13%
Portable	1	3%	Open	1	3%	Unpleasant	5	16%
Quick Construction	1	3%	Portable	1	3%	Unsafe	1	3%
Rare	4	13%	Raw	1	3%	Various Forms	1	3%
Recreational	1	3%	Reliable	1	3%	Weathered	1	3%
Resilient	3	10%	Reusable	1	3%			
Rich	4	13%	Safe	1	3%			
Rural	1	3%	Strong	4	13%			
Shikara	1	3%	Temporary	1	3%			
Shiny	1	3%	Unpleasant	1	3%			
Strong	1	3%	Utilitarian	2	6%			
Sustainable	1	3%						
Termite-Prone	2	6%						
Traditional	3	10%						
Unsafe	1	3%						
Vernacular	1	3%						
Wada	3	10%						
Warm	7	22%						
Workable	1	3%						

Total number of Timber building:49 Adjectives used	**Steel structure : 43**	**Concrete building: 39**

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Water Towers and Forgotten Value of Public Space in Old Kalyan

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Abstract: Municipal Water Towers are always looked at as a service building provided by the local corporation. Recently refined bylaws have changed an environment and image of water towers in a city. Most of the towers have their defined space bounded by compound walls unlike in earlier time where there was the most possible scenario of the encroachment of nearby slums or markets. But this policy is well executed in newer or expanded part of the city, whereas in old or core part of the city it creates a different picture. To explain this; research will focus on the Old Kalyan as a case study which is always under struggle of finding an open space. And add on to this situation, population and building growth demands for service base infrastructure and overhead water tanks are one of them.

Research's objective is to question the brutal mono-functional service infrastructure of water conservation and explore the scope of sensible infrastructure in today's era of environmental crisis and decade long problem of open & healthy environment in the suburbs.

Key words – Water Towers, Service buildings, core city, public open space, Kalyan city.

INTRODUCTION

Site for research was chosen by the parameters of urban fabric (settlements in old cities) and space impact of overhead tanks within the context. Based on this, PARNAKA region of Old KALYAN city was selected as a case study. Before explaining an exact scenario of site, let's have a look on overall contextual situation of PARNAKA, Old KALYAN. Earlier, i.e. pre-independent period, core Kalyan consist of Wadas, Chawls as residential typology and some old structures from Maratha Empire. PARNAKA which is one of the important landmark of old city, has its own character, it has a vibrancy of socio-cultural spaces like markets, schools, community hall, eateries, residences, temples and lastly the PAAR, from which the name derives PARNAKA.

Currently, city is undergoing 'Development' and multi-storey residential apartment starts affecting an overall skyline of old city which were constructed after demolishing an old wadas in a region. Still, old city has its own vibrancy because of central public space (paar) in a dense settlements, and ruins of old structures in the surrounding.

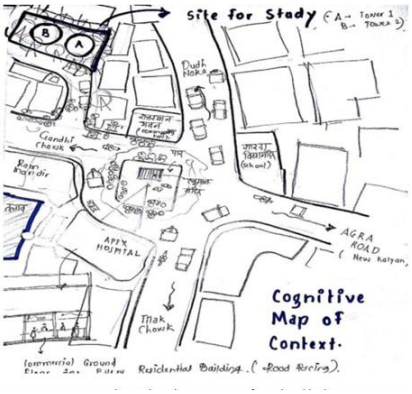

Figure – 1- Site situations explaining through cognitive map of Parnaka, Old Kalyan (Source – Author)

Within this context there are two adjacent water towers which play an important role in overall environment of core area.

But before this water towers; there was a Sarakar Wada which was actually an administrative building with open ground around it. After demolishing a Sarkar Wada, first water tower of 15 mil. litre capacity constructed in 70's and remaining open site was used for the same purpose for which it was known for, i.e. as a Maidan for children and senior citizens of locality.

According to Development Plan of this region of the city, it was declared as Reserved Area for Public Utility, on the basis of which water tower was constructed with the public park on adjacent open Plot. After the years, because of increasing demand of water supply, there was a need to

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build another water tower for the area. According to Central Government Rules and Regulation for Water Towers-2000, if municipality has enough space; funding will provided by central authority. In this way, local corporation decides to construct another water tower next to old one, for the cost of Public Open Space. That was an only open space remaining in a dense packed old city, whereas spaces like Paar gets stuck in the chaos. Now in present time, community wants an open space to breathe, to interact. New city is developing according to ideal city planning which responds to open space requirements of city, but what about old cities? Is there any need to go beyond norms? Objectives of research are as follow –

•To understand value of municipal water towers as a footprint and not only a service providing structure.

•To analysing how its existence affects overall character of ground in a dense built environment of core city.

•To understand existing situation of water towers and its neighbourhood by documenting their behaviour responding to each other.

•To question a norms; which doesn't allow an official public access and make that space as an abandoned pocket.

1. **2.**

1. Overhead tanks(Source – Author)
2. Old Photo of sarkar wada, before construction of water tanks
(Source - Sanjay Udamale Architects, Kalyan, Conservation of Urban Heritage Of Kalyan) (https://sanjayudamalearchitectsmumbai.weebly.com/kal-heritage-conservation-of-kalyan-city.html)

LITERATURE REVIEW

To understand a concerns more briefly, research covers a few reference studies, which are selected based on following factors –

•Attempts done for changing a perspective of water towers in an Urban context.

• Water towers as an identity of city.

1. A guide to Water Towers of East Anglia:

Author - The Water Tower Project,Holton House, South hold Road, Halesworth Suffolk. (https://www.ice.org.uk/ICEDevelopmentWebPortal/media/Documents/Disciplines%20and%20Resources/Information%20Sheets/Water-Towers-of-East-Anglia.pdf)

• Although knowing the fact that, no life exist without water and no society prospers without plenty water supply, it has hardly been acknowledge as an architectural element of society.

• It was period 18's and earlier of 19's when there was high demand of water towers in town, because of industrial civilisation in European countries. After that era there is no any significant change in use of building and its existence in changing society, construction technique is only thing which is evolving as per quantity demands.

Future of water towers in East Anglia likely lies in their imaginative or adoptive reuse. Their visibility gives a commercial value.

2. More Than A Water Tower: The Art, History And Utility Of Alhambra Reservoir:

Author – Melody Stone, 4 November, 2016 (Capardio)
(http://www.capradio.org/84523)

• The Alhambra Reservoir, as its known in the Sacramento utilities department, is one of the largest reinforced concrete elevated tanks ever constructed.

• The first floor of the tower was converted into offices for blood bank employees. They stored bags of plasma in the large cavernous part of the tower, because the water keeps it a really low temperature, so you just keep the plasma in there and there's very little refrigeration.

3 & 4 – RCC overhead tank at Alhambra (Source – Melody Stone, More Than A Water Tower: The Art, History And Utility Of Alhambra Reservoir)

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3. The urban infrastructural landscape in transition: Lauttasaari water tower, from technological monument to recreational place –

Author -(2015) Saari, Heini-Emilia Department: Arkkitehtuurin laitos.
(https://aaltodoc.aalto.fi/handle/123456789/18585)

• The research addresses the qualities of infrastructure as part of the collective memory of a place, and seeks to uncover its potential in enriching the experience of urban realm.

• The project is an exploration of a water treatment environment as a place of recreation, integrating the hidden city to the landscape of everyday.

4. The Water Tank Project, New York:

Author – Mary Jordan, Project Head
(http://www.thewatertankproject.org/)

• The Water Tank Project is part art exhibition, part awareness campaign in New york. For the duration of the project, art above will be complemented by action on the ground through educational programs, public tours, social media activities and a symposium dedicated to inspiring fresh views on global water issues.

5. 6.

5 & 6 - Art showcasing water issue
(Author – The Water Tank Project Team)

METHODOLOGY & OBSERVATIONS

Since research is more orient towards the public overhead tanks and its impact on the immediate neighborhood. To understand the existing scenario, research is carried out on the basis of photographic survey along with some add on graphics.

Here are the observations represented through photographic and graphical method –

• The earlier scenario; when the park was there on front ground of first water tank (Superimposed graphics)-

7.
(Source – Author)

• After the construction of another tower just next to existing one, entire jogging track and nearby public space declared as a restricted zone for residents, as followed by the updated norms for water towers to assure safety and avoid any encroachment.

• But its implementation on ground was not as idealistic as it supposed to be. These tanks are no more just the tanks, they are urban infrastructure which is taking considerable amount of footprint in a dense fabric.

• Hence if we look at the present situation of the site, these are the few observations –

1. Dumping Zone - The space below the tanks and other premises become the dumping zone.

8. 9.
(Source – Author)

2. Encroachments – This is another observation coming out from this. It's not always about residential encroachment but also about space use for different types of activities whether the intention is good or bad.

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8. Residential use 9. Commercial use
(Source – Author)

3. Ignored Ecology – Because of presence of moistness in land of water tank and also microclimate of water tank's area new ecology is generated or existing one is get enhanced. There are huge green canopies on the site which has the great potential of green pocket for public in the core city.

10. 11.
Ignored Green Zone of the context
(Source – Author)

4. Observations from the context – One can understand the vibrancy of the context and may leads to rethink on this urban infrastructure.

- Religious Node: Since the site has the old settlements and had saw the transition of wadas to the apartments. One thing not changed yet is that religious culture. It is epicenter of celebrations of festivals in old Kalyan.
- Street Market: It is the zone of street vendors and has the typical character of street in the old city.

12. Urban temple 13. Old Temple
(Source – Author)

14. 15.
Paar and street market
(Source – Author)

Analysis & Result

Analysis of the research is divided by the three major component – a. Site specific analysis

b. Policy level analysis

a. Site specific analysis :

- Water tanks are the structures which creates the sense of comfort and leads people to use for different purpose.
- Any official unused space in dense fabric led to trigger the different type of space usage by different types of people
- Hence in anyways norms are not getting followed, thus it is need of time to discuss about the norms for the public infrastructure instead of making the abandoned pocket by inserting standardized rigid mass in vibrant surrounding.
- Context has the issues of traffic because of street markets; and vendors are not ready to settled at space allotted for them because of the fact that they are not getting rod front.
- This makes to imagine the scenario where public infrastructure is responding to contextual requirements.

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16. Adda at night time **17. Urinal at day time**

(Source – Author)

18. **19.**

18 - Traffic and street market
19 - Substitute space for vendors
(Source – Author)

b. Policy Level Analysis :

- Safety Concerns -

I. Public Water Tanks are the highest tensioned infrastructure and hence safety concerns are at the top priority.

II. But there are examples where safety concern and accessibility of water tanks for community are handled hand in hand.

III. Hence by just creating the compound walls; concern is not going to satisfied.

- Questioning a standardized prototype –

I. We can compare the water tanks with the step wells on the basis of its function. Are step wells standardized? They have the layers of community attachments because of the architectural character. Whereas water tanks are the just heavy dead concrete body.

II. As a function, it is a part of pipeline water supply system which is very smooth functioned and maintenance friendly. But when this prototype inserted in certain context, it is no more just service building .

III. Hence there is requirement to relook at this infrastructure as not only engineered service building but as a thoughtful, sensible site specific architectural insert which should not be standardized.

- More than the Water Tank –

I. Providing the multifunctional aspect to any space is the smarter way of ownership based environment for community.

II. Can water tanks go beyond the mono functional aspect? –

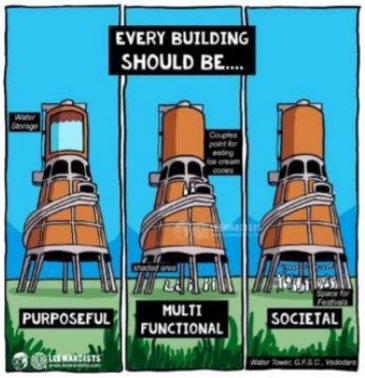
A. Can it be a structure in urban context which is dealing with the modern environmental issues?

B. Can it be the self-sustainable structure; which deals with the solar energy, wind purifying function and bigger rainwater catchment area?

C. Can it be a recreational space?

D. Can it be view point for the urbanites?

E. Can it be a catalyst for boosting local economy? (eg.- urban farming, fish farming)



20. Water Tower designed by Ar. B.V. Doshi for G.F.S.C., Vadodara, Gujrat

(Source – Graphics by Ar. Anuj Kale, Leewardist)

(https://www.facebook.com/leewardists/photos/pcb.1993006867378355/1993004350711940/?type=3&theater)

CONCLUSION

If policies are tackled sensitively; then the Service buildings might become a one of the celebrated public space in dense settlements of suburbs. Collaborating a public space and service providing infrastructure will create typical character of Indian way of creating a spaces – Purposeful, Multifunctional, Sociocultural.

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I would like to thanks my parents, specially my mother

Mrs. Swapnila Shah for suggesting me an appropriate site for research.

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Evolution And Development Of Spaces Around Temple Complex In Pune : Case Study-Ram Mandir, Tulshi Baug

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Abstract: Pune is known for its heritage and culture along with the exquisite Maratha temples built during the Peshwa reign (1720), traces of Mughal invasions, followed by British Colonization and subsequent modernization in the city which gave it its architectural identity. After several years, some of these temples and complexes from the 'Golden period' came under conservation. Till then the surrounding vicinities of temple complex's had developed to a prominent level. A distinct architectural style of evolution is observed in some of the temples. This development observed is in the form of residential as well as commercial and a number of buildings are of mix used typology. A detail analysis will obtained after further study, with help of data collection majorly primary live case study, surveys and questionnaire's, accompanying the descriptive collection with photographs etc. with respect to architectural material, elements and construction type. This research paper will try to analysis how this development affected the area and surroundings with respect to traffic/congestions, culture, economy and lastly on the people and also to understand and explore the meaning of 'genius loci' and how it has still been preserved till date and focuses on preserving the existing form and space.

Key words:- Ram Mandir, Development, Evolution, Style of Architecture, temple complex, Tulshi Baug.

INTRODUCTION:

Pune, also called **Poona**, city, located in west-central Maharashtra state, western India, at the junction of the Mula and Mutha rivers.The name Pune comes from the Sanskrit word – *"Puṇyanagara"*. It means "city of virtue". Pune is also known as the "Oxford of the East." Pune was once the center of power for the Maratha Empire. It is known to have existed as a town since 847 AD. Pune was the first capital of ShivajiMaharaj. (Editors of Encyclopedia britinicca)

The city is known for the exquisite examples of heritage monument and structures such Maratha temples, *Wadas* and *Peths* built during the *Peshwa* reign, traces of Mughal invasions, followed by British Colonization cantonments and majorly the establishment of Camp area and subsequent modernization in the city which gave it its architectural identity .The city is also famous for having a reputation of being the cultural capital of Maharashtra. (Editors of Encyclopedia britinicca) (Didde & Gupta, 2003)

As time progressed, most of the heritage structures of Pune came under conservation meaning all the monuments such as temples, *wadas* and churches etc. were repaired , finished, maintained and preserved as they were in all their glory when first constructed. But some of these heritage structures are located in one of the city's noisiest and very densely populated areas such as TulshiBaug, Narayan Peth,ShaniwarPeth, SadshivPeth etc. where tremendous growth and development is observed over the period of time, since its establishments some of the heritage structures had planned growth and development keeping the heritage structure as their focal point and the development around them is both in form of residential as well as commercial. Whereas, the development around some of these structures was neglected and the growth was hap hazardous.

This research mainly focuses on "**Ram *Mandir***" and its changes in architectural pattern and style, its immediate adjacent surrounding vicinity, which is located in Tulshibaug to study in detail and document the changes and developments it has underwent till now in the context of architectural style and what it reflects in terms of history to current situations. The scope is to understand the dense

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urban fabric and its impact on its social, economical, cultural shift along the surroundings, vicinity.

Background

Location of Ram Mandir in Tulshi baag.

Source: Google Earth

Naro Appaji Khire, an administrator in the Peshwa Court, decided to build a Ram Mandir in 1763. The Temple was made extensively of wood and stone work in **Maratha style of architecture** and ornamented with elements such as wooden '*Mahirapi'* arches, wooden *'Kelphuls'* carved on to the columns, wooden floral carved roofing and stone carved '*Shikhara'*.

He owned a garden/ orchard called the Tulshibaug in Shukrawar Peth. The Ram Mandir came up in the corner of this garden. It symbolically reminds the people of the glory of the Maratha Empire and to boost their morale in some way, the *Shikhara* of the temple was intentionally kept high. It is still the highest in Maharashtra. (ref:-Tulshi Baug –Mandai: loss of symbolism) to symbolize the establishment and start of Peshwa empire and reign. Over the period of the temple grew in importance in social life of "punekars". As it became a place for ladies to engage in social activity such as exploring the market, shopping of utensils, cloths and jewellery etc. who were mostly indoors and engrossed in their daily chores. And also because of change in skyline, due to high "*shikhara*", it gives a sense of orientation. The Ram Mandir became the focal point of Tulshibaug.

Later on in 1818, the British took over the peshwas and the city came under their rule. Giving rise to political disputes, during these times it became difficult for the **Tulshibaugwalas** and **Khasgiwalas** to maintain the huge gardens. Maintaining the temple complex too became difficult for Tulshibaugwalas. The ***"Owrya"*** or the spaces in the outer walls of complex were rented out as shops for revenue generation. (Holkar) (Didde & Gupta, 2003)

Post independence, the boundaries of the city began to grow and expand as the population of the city thrived. The markets continue to prosper at a greater speed as more and mores shops came up to generate revenue making the area of Tulshi Baug one of most densly populated part of the city. The development that occurred during this time was still around the Ram Manidr, Tulshibaug. Maintaining Ram Mandir as the focal point of market. The growth that occured was both of commercials complexs likes shops, markets and residential settlements of the shop keepers or the owner and locals for employment of work etc. This area of TulshiBaug ganined a lot of cultural and social importance as more and more temples and wadas were constructed (Didde & Gupta, 2003) (Holkar).

Image courtesy:- Research paper:- Tulshi Baug –Mandai: loss of symbolism

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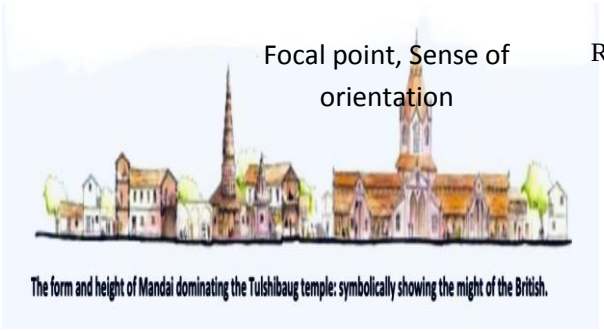

To help me explore and clarify my research topic better, I have selected 5 relevant documents to my research topics such as articles, research papers, books and verified webpages etc.

In the year 2008 Ar. Kiran Kalamdani and his team was sanctioned to conserve the Ram Mandir. The repairing and conservation work of the temple is still progressing. The research is focus on the way the conservation work is done and how the area / precinct is deprived by restoration.

Following are the reviews on these 5 documents:-

1. 'A Guide to City's Peshwa history'

This article is written by Siddhart Joshi and was published online on 3rd December 2016.

This article basically talks extensively about the Ram *Mandir's* rich and magnificent history, how it got established, the reason of its establishment and the importance it held during the *Maratha* reign.

The article majorly focuses on the history and establishment of the temple. It is observed is that the author talks very passionately about this *Mandir's* heritage and even now how well it has been conserved. The article also somewhat covers the importance of this particular Mandir complex with respect to people and location as it is located in one of the noisiest parts of the old city. But the article lacks in explaining the architectural style, construction type and architectural features which adds up to the beautification of the complex and correlating it to its history.

2. Article Review on 'Nageshwar temple by PMC

The article is documented and published by authorized authors on the official PMC site. Accessed on 7th August 2019.

The article covers the heritage and the information related to the establishment of the temple complex in detail. The changes the temple complex that has underwent due to negligence and time. The conservation strategies and process is disused very much in detail and photographic description is provided to understand the works carried out by the authorities to restore the place as it was first constructed. The overall language of the article is kept simple which helps the reader's to understand the authentic archival material, facts and current situations clearly

3. Literature Review on TulshiBaug - Mandai:- The Loss of Symbolism.

The paper is written by Amol Sampatrao Holy and submitted to Dept. of Architecture and Regional Planning Indian Institute of Technology, Khragpur. And accessed on 26th July 2019.The paper covers the vast and divine history, culture and heritage of the heart of Pune city that is the TulshiBaug and *Mandai* region. This paper covers the changes it has undergone since its establishment, through the British colonization, modernization and urbanization.

The paper majorly focuses on the history and establishment of the temple. It is observed is that the author talks very passionately about this *Mandir's*heritage and even now how wellit has been conserved. The article also somewhat covers the importance of this particular Mandir complex with respect to people and location as it is located in one of the noisiest parts of the old city. But the article lacks in explaining the architectural style, construction type and architectural features which adds up to the beautification of the complex and correlating it to its history.

4. On Hindu temples and development of Localities in Tamil Nadu (South India)

This research paper is written by Pierre Yues Trouillet and was published on 20th January 2018 and was extracted from "In Subaltern Urbanization in India: An Introduction to the Dynamics of Ordinary Towns."This research paper is based on six case

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studies taken into the regional context of Tamil Nadu (the "Tamil country" in South India), the article demonstrates that Hindu temples take part actively to the development of their settlements in many ways, and that they locally produce some centrality which is able to trigger phenomena of local development.

This research paper majorly focuses on the development of locality in correlation with temples of Tamil Nadu. The author has put intensive work on surveys and case studies to collect all the authentic history and heritage information, facts and current situations. This is a very well documented research paper which helps to understand the importance of how the locality and development of temple towns-old as well as revolves around, making the temples or their complex's as their focal/ central points. The paper also focuses on the changes and developments observed over period of time of 'old temple cities' and Urban Morphology of the temple city.

5. Book Review on 'Pune, Queen of Deccan'

The book is written by jaymalaDidde and Samita Gupta. It was published on 1st June, 2003.A simple biography on life of Pune, which rapidly evolves into a gripping trove of anecdotes and folklores alike. The authors take you on journey of weaving timelines of the history of Pune city, without a doubt proves the authenticity of their extensive research. The book starts off with establishment of golden period that is the Peshwa Dynasty during which Ram *Mandir,*Vishrambaugwada, omkareshvar temple, nageshwar temple etc such magnificent monuments came into existence, traces Mughal invasions, followed by British Colonization and subsequent modernization in the city which gave it its architectural identityThis book majorly covers the architectural, geographical and political significance of the city and its growth over the centuries, the impacts and impressions left on the city. Also talks about the city's transformation from rural to urban. It's a delight to read as the language is kept simple and eloquent yet the matter has been put aptly and to the point.

From the above detail studies of each document, we understand the need to study the development and growth around the temple complex of Ram Mandir in correlation with its immediate surroundings (locality) and the affect it has on people.

Methodology

Qualitative and exploratory study was made by conducting a live case study of the Ram Mandir in Tulshi Baug, Pune. The study included, photographic documentation of current scenarios, observing distinctive architectural styles (elements), understanding the significant historic value and the impact it has on the visitors by interacting with the locals; some who visit regularly, some who visit occasional, some tourists and the shop keeper/ owners.

Observations

While surveying the complex and interacting with the locals it was observed that usually the peak timings of visiting the temple complex is around 8am to 9am in the morning's and 5pm to 7pm in the evening's, on average about 10-15 regular locals and 5-6 tourists. During socio-cultural activities such as festivals like Ramnavmi, Dussehra and Gudi padva etc. the number people visiting increases in greatly averaging to more than 100 visitors throughout the day. While surveying the complex and interacting with the locals it was observed that usually the peak timings of visiting the temple complex is around 8am to 9am in the morning's and 5pm to 7pm in the evening's, on average about 10-15 regular locals and 5-6 tourists. During socio-cultural activities such as festivals like Ramnavmi, Dussehra and Gudi padva etc. the number people visiting increases in greatly averaging to more than 100 visitors throughout the day.

After interacting with some of the shop keepers it was understood that all the shops have been in the family for several generations and are being passed down to next in kin eventually. The shops inside the Mandir complex are in the same family for roughly 80-90 years. None of the shops were newly opened or newly purchased and some were leased. The utensils, clothes, and jewelleries etc. that were sold

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by the shop keepers were all in context of religious value. Above the shops there are few rooms which were used for the purpose of storing before it started deterioration due to age. Currently the rooms are being restored by Ar. Kiran Kalamdani and his team.

Construction in modern day technique of R.C.C

(Mural paintings on the complex wall and stone seating below.)

Near the entrance of the Ram Mandir, there is a seating made of stone and above the seating there is a mural painting made on the wall of temple complex depicting the storyline of **Ramayana** in vivid and vibrant colors making it eye catching and simultaneously contributing to the historic value of the complex. (Image attached above)

On the other side of temple complex, above and adjacent to the shops there are rooms, place allocated for storage of instruments played by the musicians during '*poojas'* and '*artis'* called as **'*Nagarkhana'***, in red with faded paintings in white, in Maratha style of architecture with '*Mahirapi'* arch entrance below on right made of stone where the musicians and their family resides, also constructed in stone and brick masonry with wooden window frames and shutters.

Next to ***Nagarkhana***, towards left after the wooden staircase in continuation of complex façade there is residency of ***Tulshibaugwalas*** above and behind some shops.

he most interesting feature of this particular complex facade is that you can **observe evolution of 3 different distinct architectural styles** evolved over large period of time resulting in a very eye catching and exquisite amalgamation.

British style influence: wooden

Marath style influence: Mahirapi arch

1. The **'*Mahirapi'*** arch at the entrance constructed in stone with stone steps raised at a plinth level of 600 mm, reflects the Maratha style of architecture.

2. The '***jail work'*** above doors constructed in brick masonry on the first floor with a balcony, resembles British colonized influence style of architecture.

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3. The recent most addition of second floor constructed in **modern day technique of R.C.C** can be clearly differentiated with its visible beam band and sliding windows
4. The temple complex of Ram Mandir is majorly occupied of commercial shops, with only residential areas of; residency of the '*Tulshibaugwalas'* and adjoining '*Nagarkhana'* residency of musicians.

Analysis and Conclusion

According to study, the complex should be given as much importance as the main structural body of temple or shrine (Ram Mandir), which has come under conservation. But the complex surrounding should also be conserved, preserved and seen in a different light because even the complex facade shows the clear evidence of evolution which should not be neglected or ignored as that is what is contributing in creating, protecting, and preserving its historical values, ethics, peaceful sanctuary, revival of spirit of place which is also known as 'genius loci', etc.

Even though the Mandir is located in one of the most hustling and bustling market place of Pune it still manages to achieve and preserve a different kind of calmness, serenity and peaceful environment due to all the above mentioned architectural features, aspects and factors.

Once entering the temple complex, the people visiting experience a positive and peaceful impact with sense of calm serenity and can feel the revival of spirit of place (genius loci) in comparison to its densely populated and congested locality.

Acknowledgement

I would like to express my deep sense of gratitude to my subject **faculty Ar. Pranoti Lad, Ar. Shreyas Paranjape** and **Ar. Lily Roy** for giving me this opportunity and their valuable guidance, inspiration and encouragement throughout the semester. ar.shreyasparanjape@gmail.com , pranoti_lad@yahoo.com

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(*Images on the left showing ongoing work of restoration on the Ram Mandir)*

(Didde & Gupta, 2003)

Courtesy- Ar. Kiran Kalamdani. (https://www.behance.net/gallery/3774586/Conservation-of-Tulshibag-Pune)

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Spirit of Outdoor Spaces between Urban Heritage Buildings-A Case of Pune

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Abstract : Heritage means inherited civilization of predecessor, which is not limited to language or literature alone, but it also includes physical elements of the community, which includes spaces along these buildings. Heritage buildings are very important because it provides a sense of identity and continuity in a fast-changing world for future generations. The character and identity of these urban spaces can be differentiated into two main characteristics- positive and negative spaces. Positive outdoor spaces are lively and are being used to its full potential, while negative spaces are leftover spaces that are often not used despite having potential. The physical characteristics are influenced by tangible and intangible factors in urban space, which affect the human perception of those spaces. This paper will present the study and analyse these spaces around urban heritage. It also tries to put forward the analysis of positive and negative spaces and strategies for them to develop.

***Keywords*: Heritage, positive and negative outdoor space, character, analysis, strategies.**

1. INTRODUCTION

Heritage means a property that is or may be inherited. These inheritances could be cultural, traditional, social, architectural etc which come from past and are still important. Heritage structures are the ones which hold architectural, aesthetic, historical and cultural values. These structures are very significant as it can positively influence on the way a community develops. This is because, heritage places can be a potent driver for community, there is increase in community values; heritage buildings by their form, layout and material can often give a sense of identity to the place in a world of increasing new buildings which are now present everywhere.

While these structures are significant, the spaces around them are also play an important role. Over the years, the identity and character of these spaces has changed drastically. There are many tangible and intangible attributes/aspects which change and enhance the quality of these spaces. Broadly these spaces can be differentiated into two main physical characteristics: positive and negative outdoor space. Positive and Negative spaces are two sides of same coin. Though they have different geometries, these spaces cannot be easily differentiated.

Christopher Alexander, in *A Pattern Language*, describes the following in regard to the shape of spaces: **Outdoor spaces which are merely "left over" between buildings will, in general, not be used.** There are two fundamentally different kinds of outdoor space: **negative space and positive space**. Outdoor space is negative when it is shapeless, the residue left behind when buildings — which are generally viewed as positive — are placed on the land. An outdoor space is positive when it has a distinct and definite shape, as definite as the shape of a room, and when its shape is as important as the shapes of the buildings which surround it. These two kinds of space have entirely different plan geometries, which may be most easily distinguished by their figure-ground reversal.

1.1 POSITIVE SPACES

Positive spaces are spaces which are used to its full potential. These spaces could be; meeting points, buying and selling point, is a major interactive point, wherein most of the community activities are done, one's which can generate economy for people of the locality. These are part of cities where people of the community can feel sense of belonging, which maintains social interaction between them and enhances the character and nature of the place.

Figure 1: indicating the positive spaces on the streets which are used to its full potential.

1.2 NEGATIVE SPACES

Negative spaces are spaces which despite having potential are not being used up to its potential. These spaces are qualified by their own senses of absence and emptiness. These could be spaces which are abandoned by its use completely despite being in the urban context, they could be spaces under low surveillance, dull or maybe hardly used. But these spaces constitute positive potential if activated appropriately with relevant considerations.

2. METHODOLOGY

The conduct of this research is employed by two main methods: unobtrusive and non-participatory observations. The unobtrusive methodincluded data collection and categorizing secondary through content analysis.

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Observations were based on the use of spaces and accordingly data collection was done. The content analysis was used to analyse the character of outdoor positive and negative spaces between urban heritage.

3. A CASE OF PUNE

Pune is a city in Maharashtra. It is considered as cultural capital of Maharashtra. The city has its earliest reference from the Rashtrakutas dynasty. The old city is at confluence of Mula and Mutha rivers. The old city consists of Peths & Wada's and has dense population. The city is also known for the rich heritage it has. The modern city has many distinct neighbourhoods. These old Wada's and Peths are of importance and are in the core of the city. Number of activities takes place alongside these Wada's, which are source of economy generation for the community.

3.1Pataleshwar Cave Temple

The earliest reference of the city is from Rashtrakutas period and the oldest structure existing from this era is the 'Pataleshwar temple'. The temple is alongside Jungli Maharaj road (JM road).

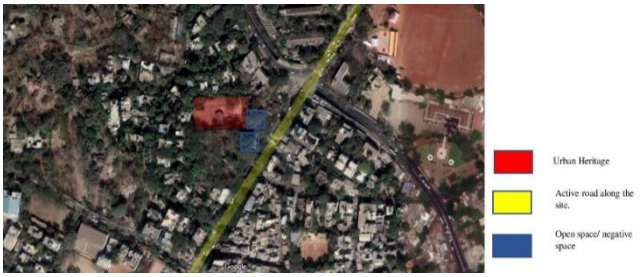

Figure 2: Indicates map of Pataleshwar temple

The **Pataleshwar Cave Temple** (*also called Panchaleshvara or Bamburde*) is a rock-cut cave temple, carved out in the 8th century in the Rashtrakuta period. It was originally situated outside the town, but the city limits have expanded so that it is now located on the downtown Jungali Maharaj Road. The premise of the temple complex consists of an entrance, the open space after entrance with trees, and then the temple. The surrounding spaces around the temple are: food corner at the right;Jungli Maharaj temple at left; housing at the back; and the front had pedestrian path, JM road (which is the most active road), and commercial shops. The open space is actively(positively) used by the students from nearby hostel and college. From 8:00am to 11:30am this space and the space around the JM temple is used by students to study, as it has serene environment, which becomes an ideal place for students to use the space. This space is used constructively in the morning period, but in the evening this space is very dull and dead and no activities take place. The food corner the right is alongside the road junction, which makes it an active space, and has people come in throughout the day. The peak hours are in the morning and evening. The pedestrian path is used by people to reach their desired location; by some people to sleep, even during the day time, it also has some breakfast stalls which are open only in morning. The residences behind the temple do not direct connection with the temple.

The buildings around this temple is oriented away from the temple, because of which it loses its direct connection with space. Thus, the space is only used by students from around the space, and only the temple is visited by some people residences.

3.2 Shaniwarwada

Figure 3: Indicates area of Shaniwarwada and the active circumambulatory road.

Shaniwarwada was a place of historical fortification in the city of Pune, and was built in 1732. Today this space is a historical sightseeing place for tourists and students from different schools and colleges. The site consists of huge entrance, which is the only built form existing and lawns. These lawns are not used for any other function. The road around this heritage is crowded and busiest path. Shaniwarwada has many other small wada and peths around it. The spaces opposite to Shaniwarwada consists of buildings which are multi-purpose use, it has commercial shops and cafés at the ground and residences above the stores. As this heritage is located in the core of the city, the design and the population are dense. The roads around are narrow compared to the spaces around it. Even though its one-way route, the road still faces congestion. There is illegal parking on the roads. The space which is allotted for only cycle and bike parking, car parking is done. The internal roads along the buildings are also narrow, which doesn't leave any scope for more potential use. Further long the road is Lal Mahal, which is also being positively used. It is used as a memorial, which consist of oil paintings depicting life events of Shivaji Maharaj. Beside Lal Mahal is a small garden which is used by children of age 3-7 years.

3.3 TulshiBaug

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Figure 4: Indicates area of tulshibaug, with wada and mandai marked, with its most active road.

Tulshibaug is an area in Pune, which is located in the heart of the city. Its main feature is historic temple precinct, wadas and large market. The prominent Tulshibaug market is located in front of famous Vishrambaug wada. This wada is efficiently used today. It consists of post office on the ground floor and few other small offices of municipal corporation and a small museum above which has Maratha artefacts put together by noted Maratha historian, Babasaheb Purandare. The market sells goods including traditional Maharashtrian cooking item, cosmetics, household goods, as well as puja items. This market is located in between the lanes of residences, which is vehicular-free for free movement of people, which is an efficient way for use of lanes between residences.

The road which leads to Mandai is also an active useable street. It consists commercial shops, and vendors which sell different things. All these activities create an opportunity for an active interaction space, between buyers and sellers. This unique ambience and character of the street and the space, makes the space livelier. The area in front of Mandai is becomes more vibrant and active during Hindu festival 'Ganesh Chaturthi'.

3.4 Aga Khan Palace.

Figure 5: Indicates area in and around Aga Khan Palace.

The Aga Khan Palace was built by Sultan Muhammed Shah Aga Khan III, in Pune. Historically this palace holds great significance, because of which in 2003 it was declared as monument of national importance by ASI. In 1972 this palace was donated to Gandhi Smarak Samittee, and since then the organization is maintaining it. The palace is a memorial for Gandhiji which have portraits depicting glimpses of life events in Gandhiji's life. It is also the headquarters for Gandhi Memorial Society.

The site has large spacious lawns around the palace. Currently this place is used as memorial and for hosting events that are related to khadi and other hand loomed textile. Every morning prayer sessions are held at the samadhi. The prayer draws huge crowd daily.

The spaces around the site is barren land which are not being used potentially. There are no activities that takes place around this heritage. It also consists of residentials, but it has large vacant lands around.

4. INFERENCE

Site	Observation	Inference and potential use.
Pataleshwar cave temple	-The site is used by many students in and around the place for studying purpose. -The site is only used in morning hour, by evening it becomes a dead space. -The orientation of the buildings around the temple is away from the temple, hence itloses its connection from the temple.	-The dead space can be activated by proposing various activities, which would make the space lively at the evening too.
ShaniwarWada	-The space inside the Wada has potential, but is not used for anything except sightseeing. -The roads around the site is very congested, even though it's a one-way route.	-As there is no huge space for community gathering and activities, the space inside the Wada could be used for such purpose. Currently the space which is negative can be strategically used.
TulshiBaug	-The space in and around the site are very active and used very potentially.	-The site invites lots of opportunities for local vendors and people of the locality to have great interaction space.
Aga Khan Palace	-The site is very potentially used for workshops, prayer sessions, etc. -There are a lot of vacant land (negative spaces) around the site.	-The vacant land can be well developed, in a way which could increase the significance of the heritage space and the place could be livelier.

5. CONCLUSION

Thus, positive outdoor spaces are the ones which are supportive places for these prominent buildings. The Negative spaces are thus the spaces which have the potential, but due to non-activeness of these spaces, they are not used to its full potential. The negative spaces in

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turn could be developed in a way which could be the source of economy generation for the public realm.

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Dis-Assembly: Ship Breaking Activities Affecting the Built and Unbuilt at Alang, Gujarat, India

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Abstract: The world has witnessed a tremendous increase of industries post World War I. This has given rise to a newer 21st century phenomenon of Industrial waste. Waste is nothing but matter at the wrong place. Handling industrial waste involves a large amount of space, time and labor. All of them being available at the Gulf of Kambhat in India. These favorable geographical conditions made Alang, Gujarat, India the world's largest dump yard of Industrial waste. Alang is a home to some large and old ships which are on their deathbeds. To suffice these needs almost 50,000 workers are estimated to be working and living in the Shantytowns of Alang under unfavorable and foul conditions. This paper emphasizes on not only the tangible but also the intangible aspects, of the effect, that this industry has on the built and unbolt of Alang. The built consisting of the living, working and commercial spaces and the intangibles being psychology, health and safety of the humans of Alang,

Key words – Labor, Waste, Ship Breaking, Settlement, Shanty-towns

INTRODUCTION

The post-Independence era and after the economic liberalization of 1991, India has nurtured and nourished some notable businesses and industries. Till the beginning of 1980s, ship-breaking was mainly concentrated in Mumbai, Kolkata and Cochin. Gujarat has natural advantage of the longest coastal lines of about 1600 Km. and port facilities for international trade at Jamnagar, Porbandar and Kandla. Having foreseen the potential, Government of India planned the development of new locations at Gujarat, Andhra Pradesh, Kerala and Karnataka. In Gujarat, Alang was identified as the most suitable site for ship-breaking activity. The Alang ship-breaking yard came into existence in February 1983. The first ship named 'Kota-Ionjong' beached for breaking at 9.30 PM with the help of a signal of a simple torch light on 13th February 1983. This was done by small Industries Service Institute, Ahmedabad. This incident proved that all parameters are suitable for promoting ship-breaking activities on a larger scale at Alang. The ship-breaking activity at Alang and 50siya directly generated 1.25 lakh employment. (Mehta, 2012) Out of this 25,000 are the self-employment generation. Other than this employment is generated in the relative activities too. The above parameters led to a condition where supply could not meet the demand. Around 50,000 workers migrate to Alang every year from different parts of the country majorly from the states of Uttar Pradesh, Bihar, and West Bengal. (International Federation for Human Rights (FIDH, 2002) and work in various industries. The industries include re-rolling mills, oxygen bottling plants, transportation companies, local scrap dealers and storage agents. Upstream activity includes the brokers, insurance and banking sector, communication industry. They migrate to Alang on their own, taking a train ride of over 3 days. They send money to their families back home every month which constitutes on an average 50% of their total earnings. They return to their homes once a year during the monsoons (Gujarat Ecological Society et al., 1998). Often the migration dynamics comes into play with the cast system in India. Though officially banned it still remains present deep in the conscience. Most of the workers hail from lower classes of the society where as the owners are from higher. This sometimes results into paternalistic approach towards the workers but often it ends up being discriminatory.

Figure – 1 Shanty Towns of Alang. (Source: Author)

Other basic amenities like hospitals, recreational spaces, and transport facilities are on the downside as well. The working conditions are far from ideal, though there have

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been some improvements, the entire operation remains under total power of the employer. He has the power to hire and fire any worker at any time. Employers, not long ago, saw formation of labor unions completely unwelcome; A change that will end the industry. Likewise working hours, wages and benefits are controlled by employers without workers having much of a say in these matters. This situation prevails due to the abundance of unskilled workforce. The totalitarian control of operation by the owners, abundance of cheap labor and no job security generates a feeling of helplessness among the workers which was evident from the interviews conducted on site.

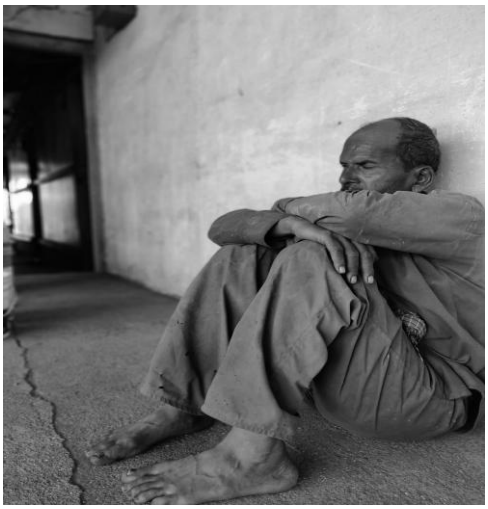

Figure – 2 Shadows of Oppression (Source: Author)

The villages in and around 10Km of radius from the port of Alang, have experienced a paradigm shift since 1983. The community which was primarily agrarian had to leave the occupation in search of other means on livelihood. This was majorly due to scarcity of water caused by the increased pressure on ground water (the only water source) due to migration and the rise of the industry, many villages got involved into trade, transport and other industrial jobs. From the villager's perspective, the industry has only brought in more problems to them namely pollution, diseases and mental health degradation. On a long enough timeline Alang is now and alienated place which has absolutely no connection with its cultural or social history and roots.

Figure – 3 Alang 2002 to 2018 (Source: Google Earth)

LITERATURE REVIEW

Safety

Workers at Alang face a direct health threat due to inadequate safety facilities while working and dealing with hazardous waste. There are many recorded instances of explosions on site. In this connection, it is important to mention that the Final Report of the Supreme Court-ap pointed Technical Experts Committee has revealed the pathetic situation faced by these workers. With regard to accidents, the Final Report notes: [T]he average annual incidence of fatal accidents in the ship breaking industry is 2.0 per 1,000 workers while the all India incidence of fatal accidents during the same period in the mining industry, which is considered to be the most accident-prone industry, is 0.34 per 1,000 workers. These facts provide the first official confirmation of Alang's long-standing notoriety as a hazardous and unsafe place to work in. Likewise, the National Institute of Occupational Health (NIOH), Gujarat, carried out X-rays of 94 workers, and found that 15 of them could be suffering from very early stages of asbestos poisoning (NIOH 2006-07). According to an interview conducted, the workers reported that it takes around 1.5 hours for an Ambulance to reach Alang through a narrow two lane Highway which connects Alang to Bhavnagar (Nearest city). Until 2003, there was no formal setup of a hospital, It was in 2003 when Red Cross Hospital was set up. (Sahu, 2013)

Sanitation

As there is no organization of workers in terms of their livelihood, workers suffer from a major sanitation issue. Many workers reported that outside the yard there are 13 toilet blocks each with 6 toilets are built by a private agency and a social institute named National Sanitation Improvement Foundation (NASA). Out of 13 toilet blocks, 5 are built by private agency which charges Rs. 1 for using toilet whereas other two toilets are run by social institute providing service free of charge. Therefore, workers prefer to use the facilities provided to them free of charge rather than those that charge. Many workers are forced to defecate on open grounds as well. (Sahu, 2013)

It is also important to mention here that the ESI Act, 1948, provides for the provision of benefits to employees in case of sickness, maternity, and employment injury. To implement this scheme in the ship-breaking industries at Alang-Sosiya, the Labor and Employment Department of Gujarat issued a notification in its official gazette on 1 October 2009. As per the ESI scheme norms for constructing a hospital with 100 beds at Alang-Sosiya, the notification issued by the Labor and Employment Department requires that at least 25,000 employees be registered under this scheme. However, in the case of Alang- -Sosiya, a total of 16,067 workers have registered.

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The ship-breaking association has been demanding a relaxation in this norm (as Alang-Sosiya seems to be an exceptional case), so that the Employee's State Insurance Corporation (ESIC) can construct a hospital here.

Housing

In Alang ship breaking yard neither Gujarat Maritime Board (GMB) nor employers provide residential accommodation to labors. To provide suitable accommodation with proper infrastructure facilities to labours, GMB has acquired land of 242813 Sq.m (GMB, 2002). But till date GMB not started construction of the housing colony for labours. On the other hand, employer provides residential accommodation to labor contractors and managers but not to labours. Therefore, labours have to make their own arrangements for accommodation. In the present study, out of 300 respondents, 103 (34.3 percent) are living in rent free accommodation (table 6.2). They are living in the spontaneous houses which are built in the Government/private land. It appears that more migrants are on the look for rent free accommodation to minimize their living expenses. A considerable proportion of respondents live in rented private houses in nearby village. 39 percent of respondents live in rented houses belonging to private landlords. Further 26 percent of the respondents live in collective dormitories in which they are paying rent for living as well as for minimal facilities. In some dormitories there is a facility of common mess. These dormitories are owned by the people from different states. For instance, numbers of dormitories in existence are owned by the non Gujarati personnel. The average expenditure on water by respondents is RS. 132.95 Per month. The study found that migrants have close contact with their family members in the native place. It is found that 93 percent of respondents regularly visit their place of origin and most of migrants visit half-yearly (42.3 percent) or annually (50 percent). The frequency of visit is once in a year or twice in a year due to low wages and high traveling cost associated with visit. On average respondents stayed for 32 days at their place of origin to attend ceremonies, marriages and in harvesting period. The study found that migrants in Alang maintain close contact with their native place.

METHODOLOGY

Sampling strategy

Group of people surveyed for information gathering.

A. Local residents.
- Residents of Alang
- Residents of Sosiya
- Residents of Manar
- Residents of Bhavnagar

B. Migrant Residents.
- Non-Localities from the above towns.
- Non-residents non-workers
- Non-resident workers

C. Local Workers.

D. Migrant Workers

E. Workers from other occupations near the coast.
- Local Agrarian community
- Local Fishing community
- Local retailers and sellers

F. Local Governing Authority members.
- GMB: Gujarat Maritime Board

Interview questions Questions to Migrant Residents + Local Workers + Migrant Workers related to:

A. Quality of Life
- How difficult is it to cope up with the day to day needs given the salary you earn?
- Are sufficient facilities been provided by either the Government bodies or the plot owners?
- Are the basic sanitary facilities in place?
- Do you have access to clean potable water?
- Do you aspire for recreational spaces in the town of Alang? ● Do you have enough mental satisfaction working at Alang?

B. Health of Workers
- Are there enough safety precautions while working at the Scrapyard?
- Are there enough hospitals to suffice the medical needs?
- In case of an emergency, how long does the ambulance take to reach on site?
- Do you feel personally safe working on site? C. Worker Exploitation
- Are you being given the adequate salary as per the laws?
- Are the situations on site such that the owners manipulate you?
- Is there an authoritarian environment on site? D. Worker Housing
- Do you have enough space to accommodate you and your furniture?
- Are the spaces you live in well ventilated and lit?
- Do you feel any sense of ownership in the spaces you live in?
- Are these structure stable enough to resist weather conditions at Alang?

E. Worker Issues

F. Worker Aspirations

G. Environmental Changes

Expert Bodies

1. GMB: Gujarat Maritime Board Engineers
2. Ship Breaking Managers
3. Hasmukh C Patel and Associates
4. GTPA: Gujarat Town Planning Authority

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Archival records/ Drawings/ Base material

A. Map representing the changes in the coast line from 1980 to 2018
B. History of flora and fauna
C. Population Growth
D. Development Control Rules
E. Land use history

Tools for Data Collection
A. Movie Making
B. Sketching / Measured Drawing
C. Interviews
D. Photographs
E. Data Mapping by Observation
F. Data Mapping/Obtainment by Collection
G. Firsthand experience

Mapping Alang

The town of Alang comprises of 4 major parts namely

1. The port The port comprises of around 170+ plots where ship breaking is carried out individually on contract basis. These plots are well defined with compound walls on the side of the road guarded by watchmen/guardsmen. The entry to these plots is restricted unless you have a valid ID or contact.
2. Labour Shanty Towns On the other side of the roads, opposing the port lie the labour shanty towns.
3. Shops Materials extracted from the ships as well as other raw materials likes electronics, plastic wares, household materials, furniture etc.
4. Asbestos Dump yard
5. 50 Bed Hospital

DISCUSSION

Strategies need to. There cannot be any further delays in ensuring basic working and living conditions for workers, and the responsibilities of each implementing agency need to be fixed. (Sahu, 2013) Efforts must be made to involve people from all across south Asia namely Pakistan, Sri Lanka, Bangladesh, Singapore, Vietnam etc so that pressure can be relieved from the workers working at Alang and this industry will no more be a burden on a few. Attempts need to be made for International laws to be standard and monitored stringently all across, particularly in India, it is generally the larger political economy and interests of the market that determine the operation of these industries, at the cost of the environment and workers' health (Kumar 2011)

CONCLUSION

The government should provide adequate space for workers' representatives to articulate their concerns in policy formulation and the implementation of labour laws. This can be made possible by allowing workers' participation in safety committees. Workers should have the right to seek remedies and, in the case of occupational diseases, identification procedures should be strengthened by putting in place special departments in hospitals. Finally, there is no comprehensive occupational health and safety law in the country. As the Government of India is planning amendments to labor laws with a view to providing a safe working environment for workers, every attempt must be made to protect and respect workers' rights. (Sahu, 2013) Attempts need to be made in the housing sector as well. Adequate and sufficient ancillary facilities need to be provided to workers in the departments of water, health, sanitation and safety. Regulations need to be made on worker wages.

ACKNOWLEDGEMENT

I would like to take this opportunity to thank Ar. Vijaya Srinivasan for guiding me and giving me her valuable inputs on this topics. I would also like to express my empathy towards the labors working relentlessly at Alang away from their homes and under a constant cloud of threat. Trapped by the dark whose name is exploitation?

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Potential of Rooftop Farming for Micro Climate Control in Urban Areas : case study of Pune

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Abstract : In dense urban infrastructure developments, most of the walls and roofs face the direct sunlight which gain a lot of heat and result in increased heat loads on structures. The rooftops are beneficial to individual as well as environment to reduce urban heat island effect. There are examples where these exposed rooftops are seen to be used for farming, considering the potential energy benefitsto buildings and their surroundings in ways such as; passive cooling, less energy consumption, water management, water runoff quality, air purification, use of unused rooftops, reductionin urban pollution, and other productive benefits. The paper concludes by highlighting certain techniques, potentials and benefits of rooftop farming with the help of case examples and by highlighting the role of rooftop farming in creating sustainable environment besides its other productivebenefits.

Keywords: *Urban Rooftops, Rooftop Farms, Techniques, Sustainable Environment, Potential.*

INTRODUCTION:

Urbanization is one of the main factors which is linked with the decreasing green spaces. The city development results in increasing migration. Urbanization results in changing the demographic and landscape patterns which are usually asymmetric and random. Apart from urbanization, other factors also affect the ecosystem of the city. The rooftops cover most of the cityfootprint area which represents potential of current unused rooftops. City infrastructure with a lot of surfaces exposed to direct sun, result in heat gain and release further leading to the heat island effect.

There are modern buildings which use reflective materials, the walls are exposed to direct sun which gain two-third of solar radiation (Poptani, 2014,). Because of exposed roof, structures gain more heat load which indirectly tends to use electrical energy to maintain temperature. The electronic devices like air conditioner releases chlorofluorocarbon which resultsin decreased ozone layer. The roof surfaces can be used as the green covers for urban areas, they have potential to minimize and control the climatic conditions. The rooftops areof two types; extensive rooftop and intensive. Extensive type of rooftop has thin layer of soil substrate layer around 50-150 mm. has minimal maintenance and can be very lightweight in structure. Intensive rooftop system has deeper soil substrate around 150-600 mm to allow deeper rooting plants. It needs preplanned structural system which includes dead loads ofgreen rooftop (Proksch, 2011). It has more capacity to reduce heat loads in building than extensive type.

Green rooftops reduce the solar radiation falling on rooftops because of the soil substrate, green cover, moisture contain in soil, foliage shade.

Establishment of Pune city goes back to 18th century when the Pune was the tiny agricultural city and under British rules.Pune increased from 7.74 sq.km to 243.84 sq.km from 1857 to 1999 with addition of 23 villages surrounding to Pune. As per the 2011 data Pune is the 9th city in population of 3,115,300, Which show high rate of development and sprawl is taking place along the national highway at the cost of adjacent agricultural, forestlands. Pune city has lost 37% of its cultivable land between period of 1980 to 2001 (Census, 2011).

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This paper presents the findings of a research to investigate the micro climatic condition withing the build form after application of green roof. It is hoped that the research information will be useful to promoting sustainable building and environment in urban areas.

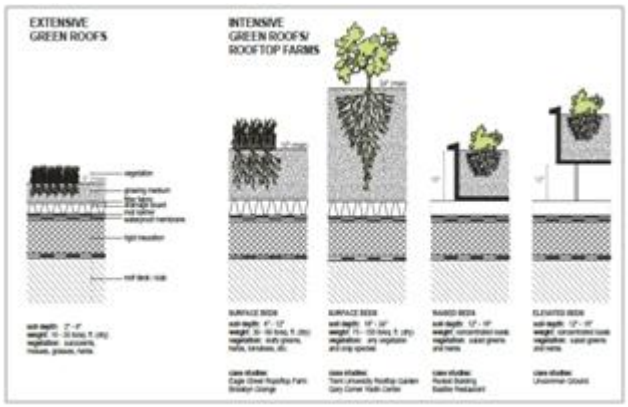

Figure i. Green roof and rooftop farm construction types.

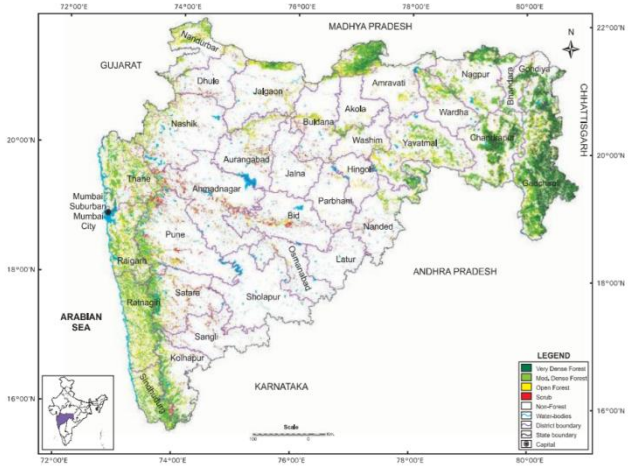

Figure ii . India state of forest report 2011.

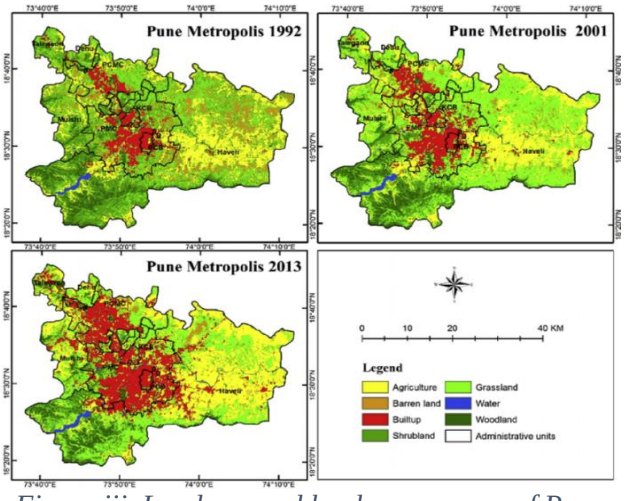

Figure iii. Land-use and land-cover maps of Pune

SCOPE AND LIMITATIONS:

The limitation of research includes the time spent. The scope of study was limited to two number of case examples. since the study is restricted to pune city therefore the results could be applicable in the same.

RESEARCH BACKROUND:

Earlier studies show that the conventional hard, nonporous surfaces do not absorb the precipitation which contribute to heavy runoff in city. “on the yearly basis retention capacity range from 75% for intensive green roofs to 45% for extensive green roofs with a median substrate depth of 4” said by Getter and Rowe.

Study shows that the intensive rooftop has higher potential to reduce pollution in city while extensive green roofs with lesser depth has lower potential. The intensive roof top has planters with maximum foliage and shaded space and Because of the substate depth it adds insulation and thermal mass to the roof. The total solar radiation absorbed by the planted roof: 27% is reflected, 60% is absorbed by the plants and the soil and only13% is transmitted into the soil (Eumorfopoulou 1998). Green roofs reduce the wind speed surrounding to it which cause reduces in surrounding temperature.

The green roofs are also energy saving for the building, which reduce electricity use for cooling. on a summer building consumes 65% of energy (Proksch, 2011). The Yi-Hsuan Hsieh concludes that the city rooftops can produce their own food required and can be self-dependent(Hsieh, 2017).

The research gap was found to analyse the potential of green rooftop within pune and its micro climatic aspect with respect to surrounding.

MATERIAL AND METHODOLOGY:

the basis for the argument of this study is derived from various case studies of urban roof top farming, which shows difference between the conventional and productive green rooftop.

Population of the research includes the structures with rooftop farming and conventional bare roof

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structures in pune. Random sampling of two green rooftops and two conventional rooftops was done. Analysis was done base on comparative study between the green and conventional bare rooftops.

Comparative study includes the actual measurement of temperatures at these respective rooftops.

DISCUSSION:

The research was conducted in two adjacent places, which were, thegreen rooftop of PMC ward terracealong with a conventional bare rooftop of IDBI bank and the other one was, the green rooftop at Mrs. Priya Bhide residencealong with M.M.C.O.A. conventional rooftop.

Table 1

Site	Name of structure	Noted Temperature	Time and date
1	IDBI bank	27.5	7/02/2020, 02:00
	PMC ward terrace	26	7/02/2020, 02:00
2	Mrs. Priya Bhide residence.	25.5	8/02/2020, 02:00
	M.M.C.O.A. College	28	8/02/2020, 02:00

as shown in table 1; the site 1 shows up to 1.5^0C reduction which was covered with shrubs and site 2 shows 2.5^0C reduction which was covered with plants and climbers, in given location and environmental condition as compared to that of bare conventional roof.

CONCLUSION:

Review of various scientific research works and case studies shows the potential and importance of green roof tops. There green rooftop meets the environmental benefits such as aesthetical value to the structure, summer cooling, improved building performance and contribution to water management. In urban areas lot of energy is spent in conditioning the spaces. Exploiting fossil fuels and emission by AC, generator systems further adds to the increment in urban heat. Thereby the controlling the temperature of surrounding and individuals by making use of unused roof tops will reduce the external and internal temperatures.

By using rooftops for farming which can contribute in expanding urban agricultural food production and make individuals self-reliance. However, the green roofs are not supposed to provide food security to cities, but they should be considered as contribution to other sources of food production, as well as they can play a role in planning future agricultural systems.

The comparison of green rooftop and conventional bare rooftop shows that room temperature of green rooftop structure is lower than that of that of conventional bare roof with respect to external ambient temperature. It concludes that the green roof reduces heat gain capacity according to external ambient temperature. increases and decreases on the basis of external climatic condition. In winter days the substrate maintains the inside heat within the structure while in summer it reduces the heat gain through exposed surface to solar radiation.

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This study would not have been possible without the essential support of the RIA faculty and I would to gratitude **to Ar. Ravi Patwardhan, Dr. Supriya Nene, Ar. Jyoti Jain** Tholiafor their extra ordinary coordination and invaluable guidance and supervision. I sincerely acknowledge the efforts of all these who have helped direct or indirectly in completing my research successfully.

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Of Lights and Mass: The Role of Artificial Light in Experience of Architecture

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Abstract: The artificial lighting has become a significant consideration while experiencing a building. Gradually architects have incorporated artificial lights in the design to provide a new spatial experience. The research aims to investigate the role of artificial light in creating different architectural experiences. The scope of this paper has been limited to the contemporary institutions of Ahmadabad constructed in the past two decades. The research has been conducted by visiting the case studies multiple times and representing the experiences in forms of sketches. Thus, the research will conclude on a distinct experience of a building in artificial light as compared to the day.

Keywords: Spatial Experience, Architecture at Night, Artificial Lighting in Architecture, Institutional Buildings of Ahmadabad.

INTRODUCTION

"*Light is of decisive importance in experiencing architecture.*" (Rasmussen, 1959). The primary experience of a space is the visual perception which occurs when the light falling on objects defines the physical attributes of the space like shape, mass, material, texture, transparency, colours. The surfaces that receive the light are the most important surfaces. Traditionally these surfaces were found in elements like *Jaalis*, *Jharokhas*, niches, alcoves. Architects have articulated these surfaces using various architectural elements like sun-breakers, louvers, fins, diffusers, water bodies.

An architect intricately curates a unique experience for the spectators and users of the buildings by manipulating the quality of light in the space. The light entering a space may have different purposes like Volumetric light may simply be used to illuminate the room and widely used to make the spaces visible, whereas the scattered light, light that keeps changing, is used as a guiding element, creating drama, invoke a sense of symbolism, hold a spiritual value.

Traditionally, post-sundown the spaces would be lit with some or other form of fire. In colder climates, the fireplace served the purpose of keeping the spaces warm while providing the light for the activities to be carried out around them. Whereas, in hotter regions, smaller and less intense oil lamps or candles would be lit and placed in an array to provide enough light to space. The necessity of artificial light moulded the architectural elements to create a space for the sources of light to evenly distribute the lights. In traditional buildings, the niches were carved out in thick masonry walls to put *'diyas'* or oil lamps. The use of *diyas* would create a warm glow in the space that did not exist during the daytime and the flickering of the lamp would create its drama of light intensity. Due to the evolution of technology, the lamps were replaced with electrical lights, but their architectural counterparts' traces are still found in some form or the other.

Although technological evolution allowed us to have different types of light intensity, direction, and colours, the spatial experience was not so enhanced as found in traditional architecture. Gradually, architects have tried to reinvent the importance of the spatial experiences of buildings at night and it is now being reinstated. Architects instead of leaving artificial light just as an afterthought, have incorporated it in their design process and provide the users with a completely new spatial experience of the same building at night.

AIM

The aim of the research is to investigate the role of artificial lighting in rendering an enhanced experience of contemporary architecture.

OBJECTIVES

- To identify contemporary approaches in designing spatial experience with the help of artificial.
- To analyse the experience of movement of a building under two different lighting conditions.
- To represent the findings of the study in form of architectural diagrams.

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METHODOLOGY

The research has majorly conducted through the first-hand experiences along with the help of literature review and available resources. The following steps have been undertaken as a part of the research:

- Literature review.
- First-hand experience of the case studies during different times of the day and note down the observations in forms of sketches and photographs.
- Analysing the change in experiences of different lighting condition and representing it with the help of architectural diagramming.

CRITERIA FOR SELECTION OF CASE STUDIES

- The case studies selected are contemporary institutional buildings that are built in the past two decades.
- The architects that have designed the buildings must have put a conscious forethought of experience of artificial light in the spaces.
- The nature of research demands multiple visits to the case studies, hence the case studies selected are such which have little to no permissions for accessing the buildings. The case studies have been selected in and around Ahmadabad for the same reason.

ARTIFICIAL LIGHT IN CONTEMPORARY ARCHITECTURE

Contemporary architects have various interpretations of the artificial lights in space and its use in the building. Some architects have used a combination of the natural light along with the artificial light to accentuate the meaning of the spaces, whereas some rely on natural light to illuminate the spaces in the daylight and create a completely different environment during the night. The role of artificial light doesn't simply end with providing enough lux levels, it has been thought in a way to bring a spatial order to spaces. Architects have viewed light as a guiding element, divisor of spaces, creating a hierarchy of spaces, invoking emotions with the help of intensity, colours, and direction of light.

Alvaro Siza has aptly manipulated the use of artificial lighting in a combination with the natural light to accentuate the experience of the spaces. In his works, he has used different spatial techniques to form architectural spaces with the means of light. When viewing the curvilinear ramps of Museum of Imbe Camargo, they seem as if the white curved walls are revolving around the triple-height void. When the sunlight is not directly penetrating through the opening on the side of the ramp, the diffused light harmonizes with the artificial light making the ramps seem edgeless and the entire experience is focussed around the void, slowly revealing the path to the user. Similarly, in Mimesis Museum, the natural light is welcomed through the clearstory such that the ground plane is uniformly illuminated by the indirect light. This makes the forms of Siza seem even more 'fluid' and spaces become free flowing.

"*The use of electrical lighting alters the perception of forms and volumes in a way no environment aid ever could.*" (Banham, 1969). Banham elaborates that Le Corbusier's 'Forms Assembled in Light' turns his shapes inside-out as the light is emerging from within without the shadows. He further adds that the true nature of building comes out at night when the building is viewed in artificial lighting; the light blazes out through the transparent and translucent surfaces, revealing its true nature. When an architect conceptualizes the building, right from the first sketch to the visualizations of spaces, and talking about the intricate play of light, the architect seldom refers to the spaces and their relationship with natural light.

While visiting the Mill Owner's Association building in the day, the first glance of the building is that of the concrete fins and ramps in the foreground, and the shadows of the foyer and fins creating the background. As one moves from forecourt onto the ramp, the shadow of the ramp rises gradually with the visitor and eventually, when one reaches the foyer, visitors are greeted by soft shadows of the cylindrical columns over the floor, a floating white washroom in front of the curved auditorium wall and fins overlooking the landscape on the East. Whereas at night, the concrete fins on the East let out a gentle glow over the garden while the angled fins on the West let out very scattered light. The cylindrical columns cast an unidirectional shadow and are read individually. As one descends from the dimly lit foyer space to the dark forecourt, the 'missing edge' of the ramp makes the journey of the ramp even more prolonged and stretched.

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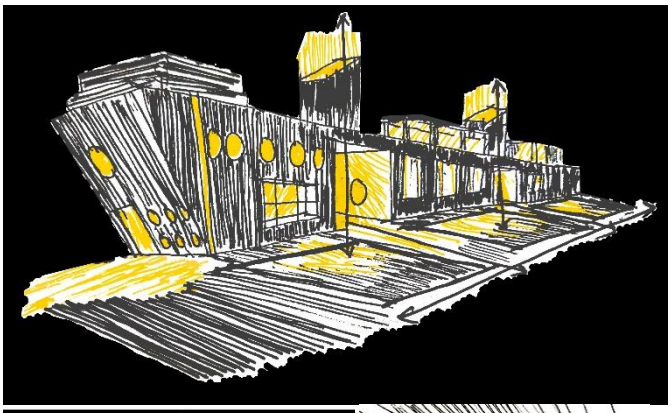
TRANSMUTING THE SPIRIT OF THE BUILDINGS

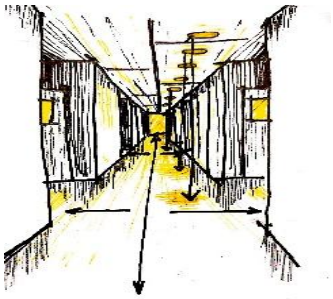
Ahmadabad Management Association (HCP, 1997-2010)

AMA having a linear mass of concrete, sits prominently on the main road, opposite to the old IIM campus. The public institution is hidden behind a promenade of trees and isn't very evidently visible while moving through the traffic. During the day, the entrance of the building is highlighted by the double-height volume of the shadows, creating a thoroughfare between the landscapes on either side of the built form. The vast mass of concrete almost looks like a ship of concrete floating on the soft sea of grass sailing in the rustling melody of leaves (fig. 1.3). While entering through the hull, one almost feels compelled to walk onto the gracious ramp connecting the reception, jutting outwards to the backyard and



moving up to the upper level (fig. 1.4).

The lengthy linear corridors (fig. 1.5) are provided with subtle reliefs of classrooms with full height glazing, overlooking the landscape. This adds to the transparency of the building, allows a deeper penetration of sunlight and provide a contrast to a monolithic structure of concrete. The classrooms have a strong presence of twinkling light through the foliage of neem trees creating a mellow indoors environment (fig. 1.6). On the upper level, the sense of being one with nature is further strengthened in the library when one is reading in the ample amount of natural light, strongly diffused by the adjacent foliage.



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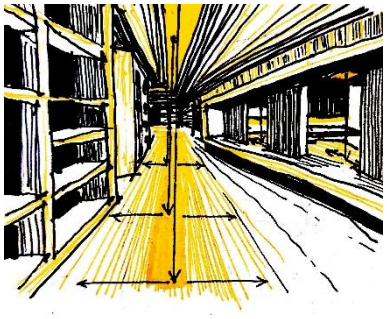
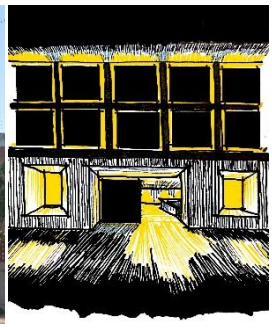


During night, the entrance foyer becomes the kernel of the institution with the illuminated double-height space (fig. 1.7) looking at the trees and gently lit corridor spilling into the classrooms and connects to the auditorium. The journey down the corridor feels stretched due to the uniformly lighting as opposed to the day. The glass panes reflecting the light blocks the view of the landscape giving the feeling of a stretched passage rather than a spillover of classrooms. The upper-level corridor has a sense of relief while viewing the moving traffic and the city lights in an airy balcony under the night sky. The hanging lights in the classrooms and library make the volume of the classroom seem taller as the user is unable to see the ceiling very clearly against the suspended lights (fig.1.8). The ship is anchored in the monochromatic aberrations of night light sets the tone of the spaces to come to a still.



Lilavati Lalbhai Library (RMA, 2017)

Located in the heart ofCEPT campus, the library building is a cuboidal mass which sinks into the Earth, providing pavilion-like structures for public interaction. During the day, cubical volume with entrance from all the cardinal directions is seen floating in the middle of CEPT campus, contrasting in terms of material and language. The thin attenuated slab covers the light steel frame with timber fins diffusers. This light-weight structure sits atop a heavy concrete pedestal with intermediate sittings carved out. The depth of the transparent building is not very clear because of the limited direct light allowed in the building (fig. 2.3). While entering through the bridges, overlooking the exhibition space in the basement, one feels relief from the sun.

As one passes through the exhibition space on the ground and overlooking the one in the basement, one catches a glimpse of a series of vertical skies amidst the timber fins. As users proceed to move towards the basement, they are constantly isolated from the surrounding environment which provides them with the calmness for reading. In the upper basement, the user is greeted with a split volume of two mezzanine levels hovering over the lower basement. The lacquered book racks going from the floor to the ceiling act as a partition between spaces and naturally guide your movement in the space. The polished Kota stone corridors have a sitting space on one side which juts out

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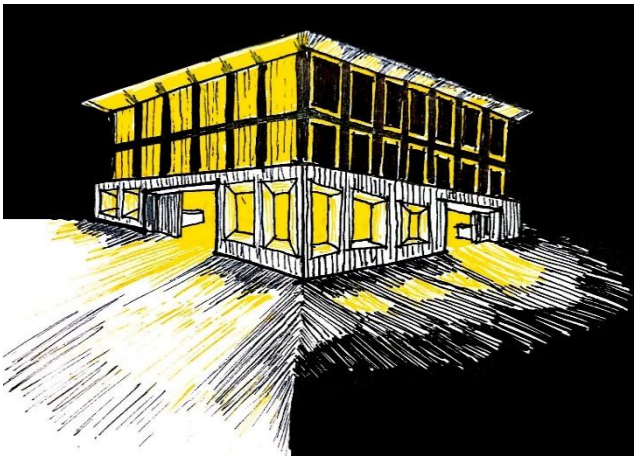
of the glass partition to draw in as much diffused light as possible, whereas the book racks on the other side. Separating these two is a continuous band of artificial light which segregates the functions of the spaces (fig. 2.5).

A tubular strip light over the reading tables on the mezzanines, creates an emphasis on reading while marking its boundary on the reading zone and book selection zone. In the lower basement, the volume suddenly feels huge as the mezzanines descend into a uniformly lit foyer. The provision of strip lights in the table controlled individually by the person sitting on the table makes the space dynamic in its terms (fig. 2.6).



During the night, when viewing the building from outside, the upper volume of fins radiates ample light from within and it makes the entire building act as a lampshade (fig. 2.7). The gradient of light falling on the underside of the delicate paper-thin slab and gently fading away before reaching the edge of the slab makes the building blend into the darkness of the night sky and completes the analogy of object floating in space (fig. 2.8).

OBSERVATIONS

The two types of institutional buildings have a very different requirement in terms of lighting and the way they have addressed the use of it. The role of artificial light has been guided by the functional use of the spaces of the library and management association. The reading spaces were required to have enough lux levels for providing comfort to the eye, while both provide a different connection with the outside. Artificial lights have been looked at as a division of spaces and demarcating the movement in the library, whereas the management institute has treated artificial light to diverge from the monolithic feel concrete.

The first glance of the library hides the fact that it is a large volume of concrete and is well hidden in plain sight. Only by moving around the building, one realizes the scale of its mass. The interrelation of using fins to diffuse the light in space during the day and the light that leaks out through them at night creates a frame of the lampshade which blends the roof into the night sky. Perceiving the silhouette of the buildings at night becomes a tad bit difficult which further brings down the vertical volume of the buildings.

While the large mass of concrete stays very well hidden behind the foliage of trees, the focal point of the institution remains in the foyer space whereas the ramp has been given the utmost importance for moving between levels. The boring nature of linearity has been broken with an interplay of transparent connections with the landscape and providing a various amount of changing light conditions in the corridor with activities occurring right beside it.

CONCLUSIONS

These two institutes have provided us with contemporary attitudes towards the integration of artificial light in the building and experiences created by them. The movement throughout the buildings have been enhanced while imparting a new experience to the building, while creating a functional hierarchy and a division of spaces.

ACKNOWLEDGEMENTS

I would sincerely like to thank my guide and co-author Prof. Naresh Chhatwani for constantly helping me with this research, providing me with his invaluable insights and keen indulgence with the topic. I would also like to thank Indus University to provide a precious academic platform for me.

LIST OF ILLUSTRATIONS

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Street Art as Modern Cityscape

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ABSTRACT: Urban street art is a powerful tool in reflecting the experience of the urban, provoking an engagement of urbanites with their environment, and in re-socialising public spaces. The concept of the city has come to play a central role in the practices of a new generation of artists for whom the city is their canvas. Street art is a complex social issue. For decades, its presence has fueled intense debate among residents of modern cities. Street art is considered by some to be a natural expression that exercises a collective right to the city, and by others, it is seen as a destructive attack upon an otherwise clean and orderly society. This research focuses on various forms of street art from the perspective of the urban cityscape. The general aim is to further an understanding of how people interact with and respond to street art. Qualitative and quantitative data were gathered via direct participant observations of street art installations in pune city. The collective data and analysis will help to know various typologies favoured by public interest, their impact on surrounding, issues related to various aspects. Emerging the need in future city scape enhancement by promoting art to develop sense of responsibility in urban context by authorities and public participation.

KEYWORDS: Enhancement, Urban, Social, Environment, Public, Artist, Artistic, Graffiti.

INTRODUCTION

Street art refers to a practice of unsanctioned artistic expression found in urban public spaces and thus openly accessible for anyone to execute and observe (Jakob, 2008). Many different directions and subcultures come together to form what we think of as street art and graffiti today.

Street art, was originally coined by **Allan Schwartzman** in 1985(fig.1 New York) (Lewisohn, 2008), is an all-encompassing varied artistic expression against an urban backdrop, deriving directly from the graffiti revolution, in a two-dimensional or three-dimensional state. Often referred to as post-graffiti (Bou, 2005, p.7), it carries a new set of aesthetic ideals, media, and techniques that were not witnessed in the 1970s and 1980s graffiti art movement in New York City. Allan Schwartzman is a Founder and Principal of Art Agency, Partners and Chairman, Co-Leader of the Fine Art Division of Sotheby's. This research focuses on human-environment relationships by examining unauthorized artistic interventions in the city, otherwise known as street art. Street art has found its way into museums, but it started out as illegal protest in large cities - from Mexico to Paris and New York. Hip hop culture made it popular in the 1980s.

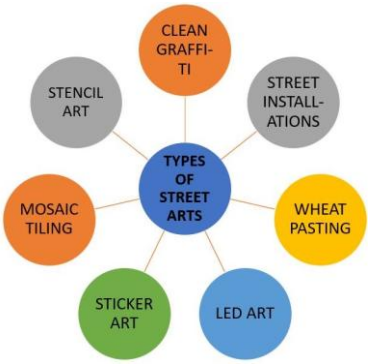

Diagram.1 Types of Street Arts

Fig.1 Street Art Spread in World

Literature Review

It has been said that "street art is a ―window into a city's soul" (Kendall, 2011). Street art can serve as a conceptual frame through which observations and interpretations of the urban cultural landscape may be developed and explored.

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This research is important for two reasons. First, the way people think about the use of space matters because the characteristics of places (e.g., design, accessibility, attractiveness, etc.) influence our understandings of the world, our identities, our attitudes toward others, and our politics (Massey, 2005). In other words, what people make of the places around them is closely connected to what they make of themselves as members of a society and inhabitants of the earth (Basso, 1996). Knowledge and perceptions of places are therefore closely linked to knowledge of self, to grasping one ‘s position in the larger scheme of things, including one ‘s community, and to securing a confident sense of who one is a person. Our sense of place, our sense of the past, and our sense of being are inseparably intertwined (Basso, 1996). In today ‘s globalized world, we must strive towards a forward-looking _progressive sense of place ‘that is open to difference, change, and global connectivity (Massey, 1994, 2005; Cresswell, 2004). Secondly, this research is important because no other studies have gathered the general public ‘s thoughts on street art in a systematic manner. Most accounts are anecdotal. It is essential to understand what people think about street art in order to evaluate if current policies reflect what people actually desire.

EFFECTS OF STREET ART

Street art is not just a spatial phenomenon; it is a complex social phenomenon that produces intense emotions for different people at different times and contexts. It plays a fluctuating in modern consciousness. Regarding the paradox of street art, the author says that it is considered by some to be a in the public realm that exercises our right to the city, and others see it as.

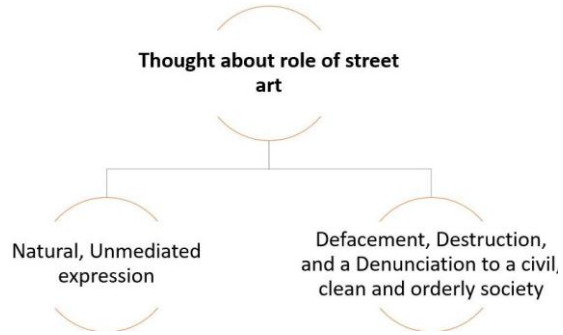

Diagram.2

Those who see it and react to it, acting either individually or as a community, judge the meaning of street art. The audience should not be viewed as a passive receptacle for these aesthetic stimuli. The perceiver, whether reading or looking or listening, should make an active contribution to the total communicative process (Wilson, 1986). This system of signs and symbols, taken together, are narratives that reflect, inform, and construct our collective identities and the places we inhabit. The general aim is to further an understanding of the relationships between people and the places they live by gathering information on what people think and feel about different forms of street art.

Graffiti vs. Street art: what is the difference?

STREET ART	GRAFFITI
Street art is seen in a more positive light.	Graffiti is still considered to be a negative term.
Street art is usually considered more cultured and a good form of expressionism.	Graffiti is associated with the vandalism that the government desperately wanted to erase.
Easy to understand.	Quiet difficult to understand.
Legally commissioned artistic expression.	A not legal art form.
Different mediums of paints are used.	Aerosol sprays are mostly used for creating art.
Street artists are known artists commissioned to design and produce something the public will appreciate.	Graffiti has a culture and language which is known by the artist and its followers.

Table:1 Difference between street art and graffiti (As per literature review)

Fig.2 Graffiti v/s Street Art

STREET ART IN INDIA

Urban street art is a powerful tool in reflecting the experience of the urban, provoking an engagement of urbanites with their environment, and in re-socialising public spaces.

Fig.3 Street arts in India

Street art has become a relatively inexpensive way for municipalities and developers to invigorate the built environment, says Lee Bofkin, the co-founder and CEO of London-based street art agency Global Street Art. “The modern street art movement has collided with, integrated and assimilated the local cultures of painting and muralism

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around the world," he says. It is a new way of urbanization through art and culture. It is helping in exploring new ways of showing creativity as well as enhancing the surroundings and preserving culture as well as spreading awareness.

METHODOLOGY

Collection of primary data is carried out. After the collection of primary data and literature review, visit to the places where street art can be seen is carried out. Data collected by observations, interactions and surveys conducted on the basis of questionnaire. How people interact with, experience, and are affected by, their environment can be explored by studying street art. The purpose of this descriptive research study is two-fold. Firstly, I will do the observation-based study and secondly, I plan to investigate the contexts of street art as a part of the visual culture found in urban areas, aiding in the identification of street art and how it differs from graffiti art. As street art gains popularity worldwide, it continues to borrow influences from the graffiti art revolution, but is also increasingly recognized as a distinct art form. While the general acceptance and understanding of street art is in an indeterminate state, this study intends to describe the position of street art by investigating their varying status in the art world, both problematic and successful. I will collect data through face-to-face dialogue. Each participant will be asked a series of questions that attempt to locate commonalities. After the survey the analysis on the basis of questionnaire is done and the outcome will be obtained on the basis of the observations as well as surveys. This methodology will help in gaining the required outcome and results with a proper data.

STREET ART IN PUNE CITY

The Oxford city of India never fails to leave us awe-struck, either by its food, its gallantry heritage or its beaming art. The street walls of Pune are magnetizing with a spectrum of artwork ranging from city stories to abstract ideas. This is an initiative taken collectively by PMC, Pune Biennale Foundation and a pool of national and international artists students and citizens of Pune. Many other artists as well as NGO's are formed in the city for promoting the street art and enhancing the cityscape. We travelled across the city to capture such gems. Let's walk through the colours, shall we?

Fig.4 Street arts in pune city (Source: google)

CASE 1: BAL BHARTI WALL (INSTITUTIONAL)

Photograph.1 Courtesy: Self

Located on Senapati Bapat Marg, Pune, Maharashtra 411004. The wall is a collaboration of Pune Speaking Walls and Balbharti. Balbharti, with its vast experience and constant efforts in betterment of education, served as a platform for Pune Speaking Walls to work with children and create a beautiful artwork which signifies both of the institutions vision. The wall is painted by artist Abha Bhagwat who has a vast experience of working with children, she believes that hidden talent in children is yet unexplored. Over the years, Balbharti has created a culture of reading among the children. The ease of language used, the colourful, happy children depicting various cultures, tradition and situations make the learning experience a happy one! It helps children to think intensively and to think critically, creating a lasting impact in the lives. Through this artwork, Abha tries to catch this essence that Balbharti is! She has tried to imbibe the various books, art and stories in her work to create a sense of wonder. It would definitely make one nostalgic! The wall is painted upto a length of 370 feet. The height of the wall is 7.5 feet and the total area covered under the street art is 2775 sq. ft.

According to the survey conducted this street art is playing a major role in the enhancement of the entire street as well as the institute. It is depicting the different aspects of school as well as promoting education. It is also helping in

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changing the walking experience for people from that street. It is also making it easy to identify for people that the building typology is educational.

CASE 2: SHINDE SCHOOL (INSTITUTIONAL)

Photograph.2 Courtesy: Self

Located in Sahakar Nagar, Pune, Maharashtra, 411009. Ganesh specializes in city scapes in Oil colours and prefers large canvases. His keen observations on how the city has changed is represented in the art work he is currently doing on the wall of the Shinde School, Taljai, Pune. Along with the stark comparison of heritage Pune and contemporary Pune, the wall will highlight few prominent structures e.g. Mandai, University, Lal baug etc. which has also witnessed these changes through time. Through this artwork, he wants to explore the deeply ingrained images, feelings and thoughts that everyone feels with the old and the ever-changing architecture around them.

According to the survey conducted and the analysis, it is a type of street art which is depicting the culture of the city and cityscape. This street art is complimenting the footpaths and the streets. It is not making it easy to identify for people that the building typology is educational but its is certainly enhancing the walking experience and is depicting modernisation of pune city with a touch of culture of the city.

CASE 3: KASBA PETH, PUNE (RESIDENTIAL)

Photograph.3 Courtesy: Self

Located in the locality of kasba peth, the idea of street art project in pune was initiated by Harshvardhan Kadam (aka inkbrushnme). "In ancient times, Kasba Peth was the point from where the city of Pune started," he said. The street art starts from tilak statue towards the temple and following the lane of the temple we come across certain murals and paintings. The paintings were done by different artists from pune city as well as around the world. The people living in the area also shared their experiences about the art done on the walls and how they are feeling about it.

According to the survey conducted it is observed that the art's have given the space a new view it transformed the dull surroundings as well as lanes into new interactive spaces creating a healthy environment to stay. The origin point of street art is kasba peth and here the people supported the street art with full enthusiasm. It changed the aesthetical perspective of the locality. It adds a value to the place and improves the living by creating a healthy and interactive environment.

According to the case study analysis and the survey conducted the following observations are taken:

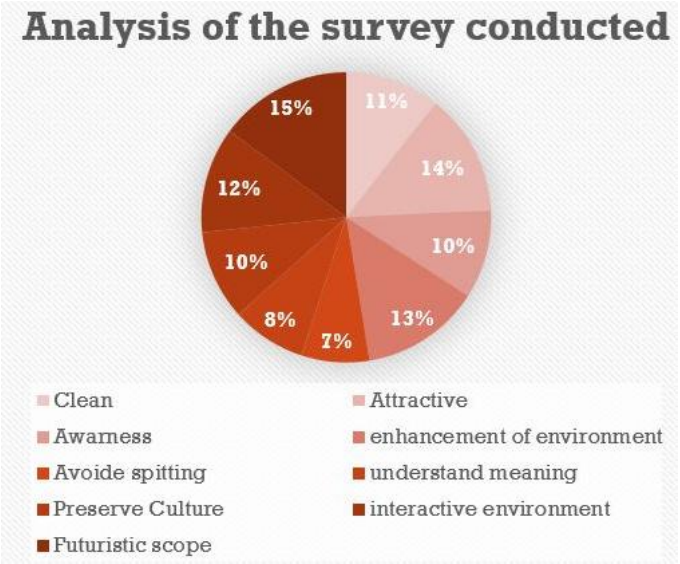

Table.2 Analysis of the survey

CONCLUSION

According to the interpretation from the conducted assessment, street art is viewed as physical, economic and social driver to successfully implement and transform changes to underprivileged places and communities. These being the part of urban enhancement art the cityscape looks more beautiful and add aesthetic appeal to the dull lanes. In order to reinvent, rejuvenate, occupy the city, building, urban space and community via adopting and improving quality of life, urban beautification, community participation, pedestrian networks, economic advancement and a cultural and lively community/city. Street art is a low-cost tool for urban regeneration/redevelopment inclusive of all stakeholders of a community or city as it can alter public perceptions and is a separation of art form and crime. Since urban regeneration is a process and an

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outcome, street art can be a key driver in urban regeneration/redevelopment. Therefore, I believe street art can successfully assist and encourage urban regeneration of cities, places and communities by socio-cultural development and adding value to the artists in the city.

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Mental mending and Mindfulness through Architecture

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Abstract: ***Growing technological developments have harbored the mental growth of human beings. Societal pressures to acquire a particular status in terms of materialistic ambition is seen as success, leading towards a downfall of physical and mental health. In this fast-going and digital age where there is a pressure of reaching somewhere, the meaningful and crucial information is being ignored.***

Increasingly an individual's inability to step away from technology can have serious consequences, one major effect being anxiety. Recent surveys have shown increasing cases of anxiety and stress with the growing and developing world. Along with the fast age, there is an increasing ignorance of self-awareness, human connections and personal well-being.

Here in the paper we will understand what the problem is, in the context of psychological conditions. What are the causes and consequences of the current situation of the society? What actually mental well-being and mindfulness is? Role of architecture in mental wellness and how it can act as a solution and therapy along with psychology and act of senses. Studying and analyzing case studies of such spaces will help understand the solutions to social and self well-being. Concluding factors and sense of designing for human well-being on a deeper level using Architecture and Psychology as tools for a better society.

Keywords- Technology, Social media, Anxiety, Mental well-being, Mindfulness, Mindful Architecture

1. INTRODUCTION

The evolution of social media has come to shape the technology sector as well as real-world social interactions. Social media platforms are some dominating fields today. Along with the birth of "Smartphone", social media seems almost unavoidable as it gets easy to connect to the internet anywhere. It is becoming difficult to separate men from their machine. As society's attention is focused on online praise or impending tragedy through a screen, the connection to the present moment and casual personal encounters are lost. Thus, the technology being so beneficial on one side, and on the other side, it is also deteriorating the mental health of today's society. People want online validation and to match the world they try to be updated as much as possible. And the inability to step away from the technology causes anxiety. In the fast pace and over-stimulation of our digital age, it has become increasingly difficult to focus on meaningful and relevant information. As we live life through a screen and more isolated from our peers and ourselves, adverse effects on our physical and mental health emerge. Human connections and self-awareness is important for maintaining interpersonal well-being and psychological balance where the community is grounded in meaningful experiences within the public and private domains.

Considering the current status of societal stress, the return on investment in mental health, and different practices that address these issues, there appears a marked lack of architecture designed to address society's changing needs. Architecture has the power to promote a sense of presence, forcing users to pay attention to the immediate environment or simply fading into the background to allow users to think on their own. Place influences emotions, which control our lives and could also impact behavior. By crafting mindful architecture, the need to constantly be connected to outside factors can be reduced. Through design, mental state and behavior can be influenced in a way that promotes wellness and therefore potentially reduces the anxiety the user feels towards things beyond his or her control. Mindful architecture is a method and practice of architectural discovery. It seeks to reverse this trend and redirect our focus back to the duality of the mind and body by focusing on the tangible and intuitive qualities of the physical world. Architecture can contribute to well-being as a

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form of therapy by evoking thoughtful states and heightened internal and external awareness through mindfulness.

The study can be further continued by considering a deeper understanding of human behavior and senses in different spaces designed considering various parameters in terms of physical, mental and emotional context. Here, in this research, I've limited the study analyzing some physical parameters for a sense of designing a space to achieve mindfulness. To understand the parameters of designing, Literature study, journals, books andcase studies of some spaces depicting the sense of design.

2. METHODOLOGY

The approach of the paper is to understand the role of architecture in improving the current scenario of the society facing mental illness because of the technological advancements. To better understand the sense of designing any space, the parameters of the study is limited to Materiality + Weathering and Light + Shadow.

The data for the study includes articles/journals, books, literature case study which is majorly collected and referred throughout the process of personal reading and understanding.

Other methods to approach the study can include live case study and interviews based on the parameters for designing the space for mindfulness.

3. LITERATURE REVIEW

The following research material has been structured in a certain way that allows for a better understanding of the different factors affecting the study. The scope of the study will be narrowed down to specific field of study. The literature review will be focused on theoretical study, the theoretical and philosophical bases from researchers that have been analyzed to build up this study.

3.1 THEORETICAL STUDY

3.1.1 SOCIETY INFLUENCED BY TECHNOLOGY AND SOCIAL MEDIA

The constant encounter of social media and technology makes a serious impact on one's mental health. Technology can be incredibly beneficial for connections to a sense of community, both local and global, and benefits users. But as the use of technology and social media is increasing at a fast pace, today's generation is getting more and more depended on it. As the lines between necessity and excess blur out, the connection to technology becomes similar to an addiction. People nowadays spend much less time connecting with their peers in person and more time connecting electronically, especially through social media. The rise in depression is evidence that the connections social media users form electronically are less emotionally satisfying, leaving them feeling socially isolated. The less you are connected with human beings in a deep, empathic way, the less you're really getting the benefits of social interaction. The intense social media use is correlated with anincrease in anxiety and depression as people compare themselves negatively to their peers and worry about missing out.

3.1.2 WHAT IS MINDFULNESS?

Mindfulness is cultivated by paying close attention to your moment-to experience while, as best you can, not getting caught up in your ideas and opinions, likes and dislikes. Mindfulness-Based Cognitive Therapy was used to help patients suffering from anxiety, this form of therapy uses mindfulness as a way to connect to greater awareness. Using aspects of mindfulness is proven to reduce anxiety and mood symptoms as it increases awareness of everyday experiences. Practicing mindfulness is beneficial to mental health and is used more often as a therapeutic means to help those suffering from anxiety disorders. In an effort to adopt alternative methods to mental well-being, the practice of mindfulness has become a popular way to meditate. Meditation is not about doing, but rather being. Mindfulness is about being fully present, on purpose and without judgment. By observing the moment as it exists, personal stress is reduced. Through awareness, mindfulness helps one shift from a doing mode to a being mode, changing one's understanding of self and well-being.

3.1.3 ARCHITECTURE AND MINDFULNESS

The way we look at our surroundings is influenced by the setting of those surroundings, as architecture fulfils the psychological needs of the user. And the diversity of users will impact the success of the design in influencing emotional response. An

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architecture of mindfulness would not only fulfil the needs of mindfulness meditation but also go further in establishing physical attributes that can then form an ideal environment to be present in. Different spatial qualities such as natural light, fresh air, circulation, privacy, scale and even the time of day can all contribute to the users' desire to spend time within the space in a mindful way.
For the purposes of establishing a baseline for a space to be considered mindful, certain physical and abstract qualities of the space must be achieved. There are essentially three different levels of a space that should be considered in designing a mindful space; the context of mindful space, with connection to nature, the architectural environment of mindfulness, including both natural and designed factors, and the humanity of mindful spaces, such as interpersonal relations and the individual's experience within the space.

4. CASE STUDY

4.1 MATERIALITY + WEATHERING/ SPACE + TIME

-The Pierre, San Juan Islands, Washington
Design principal-Tom Kundig

Fig.1 Weathering of stone with season

The rock projects into the space carved out of existing stone, left raw material, natural sinks in the existing stone.
A powder room is carved out of the rock; a mirror set within a sky tube reflects natural light into the space.
The architects were conscious to reveal the means of construction as the boreholes, used for dynamite blasting, create the texture of the walls and ceiling. Architectural materials go beyond their tangible forms and into the atmospheric realm to include sensual generators such as light and wind. Architecture should remain silent and let nature in the form of sunlight and wind speak. They can be chilling or gentle and pleasant. They activate space, make us aware of the season, and nurture within us a finer sensitivity. Material weathering gives architecture an authentic expression, marks the passage of time, the temporality of nature and the process of life and death. Weathering marks the life of a building and signifies human use. Time's passage in architecture includes a building's conception, construction and inhabitation. The project, too, endures through these phases. The building's regeneration and degeneration emphasize the temporality of nature as an order of beginning and ending or, more broadly, life and death.

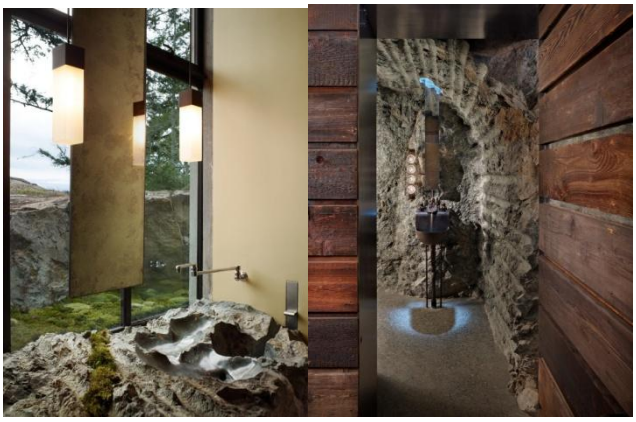

Fig.2 Natural sinks in the existing stone Fig.3 The texture of the walls and ceiling

Natural materials express their age, as well as the story of their origins and their history of human use. Furthermore, these processes allow experiences that surpass any individual life.Time and space are eternally locked into each other. Matter, space and time fuse into one singular elemental experience, the sense of being. It reminds us of nature's temporal power through material weathering and the fusion of time and space with the present. Weathering brings the virtual future of a building into dialogue with its actual present, as both are entangled in its past.

4.2 THE PLAY OF LIGHT + SHADOW

-Colline Notre Dame du Haut, Ronchamp, France
Design principal- Le Corbusier

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Fig.4 Selective opening in the form wall

Fig.5Light entering through thick

Le Corbusier's chapel at Ronchamp, the darkness and weight of the space under the hanging curved roof of concrete is heightened by the rich illumination through the punctured south wall. Mindful architecture intends to harness light and shadow for the entire body. We feel the warmth of the sun on a cold winter day or the relief of shade in the desert. Light and shadow include bodily sensation that influences the spiritual strength of architecture, driven by the quality of light and shadow.Light reveals architecture and architecture reveals light. The integration of light within the built environment has the potential to change the way we perceive and experience space. Using highly textured surfaces, colors and filtration of light provide never-ending stimulation. Roofs, walls, openings and materials are expressed as optical instruments, providing a variety of different lighting effects that change in relation to solar orientation.

The three design treatments that help support the expression of light and shadow within Ron champ are: increasing the wall depth to allow light to mediate through;

the filtration or screening of light; and the use of selective openings throughout the architectural form.

With light comes shadow and together they create a play through which we experience time and space. All life on earth revolves around access to light and shadow. Light and shadow place us in the daily and seasonal transitions of the earth and connect us with the universe. Natural light connects us with cosmic dimensions and brings life into architecture. This connection gives light both permanent and temporal qualities. We experience light at the present moment or light exists eternally as it may have travelled for millions of years to reach our perception. The dynamics of light and shadow allow the senses to experience atmospheric qualities. Space can be manipulated by the architect through the control of light and shadow to achieve spiritual awareness and perceived weightlessness.

5. CONCLUSION

The present scenario and working of the society where media and technology is adversely affecting people's mental health. Architecture can play a crucial role in bettering the quality of emotions and thoughts making the generation mindful mentally healthy.

The study unveiled the possibilities of utilizing architecture as a major tool in improving public health on a large scale. Further for deeper research, this study can be continued by understanding human senses reflex in different spaces with different factors affecting mindfulness.

6. ACKNOWLEDGEMENT

I'd like to thank my parents for making me capable to reach this level of platform by proving education to me.

To my studio director **Ar. Yogesh Kawade**, my research guide **Ar. Kanchan Yadav**, subject professor **Ar. Aparajita Kaushik** and my mentor **Ar. Shruti Hippalgaonkar**.

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Location of Market Places with Respect To Accessibility

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"People make places, as well as places shape people. The way people adopt shape, use and manage the spaces around city will determine the meanings of space".

-Journal of Urban Design, 2018 Vol.23

Abstract : Locations of the marketplaces are affected by accessibility and number of users. The farmers travel from different villages to the city market which solely depends on the road networks and nodes from which people enter in relation with human settlements. The market access environment keeps on constantly developing and changing, a focus on actively changing means of entries along the market should be taken into account. Roads are the crux of the human civilization and social interaction along with activities. Improved accessibility would save on time but unplanned roads lead to sprawl of human settlement which impedes traffic flow and connectivity. Hence, having a resolved access is an important aspect of the markets.

INTRODUCTION- Markets are an important aspect of our lives, in urban, semi urban and rural settings. Most people regularly visit markets as buyers and sellers. It is important for an architectural student to understand how a market functions to be able to design them well. This research explores what aspects affect efficiency of markets.

HYPOTHESIS- The usability and functioning depends on the number of openings for the place which is decided by the means of accessibility.

SUBJECT- To study and analyze the effect of accessibility on the location and efficiency of market places and how does the pattern o of human movement affect the design of market place. The study aims to examine individual accessibility experiences in space, through developing a new accessibility measure using spatial and journey data.

CONTEXT- Research will be in the context of rural area like Baramati where in all the nearby villages depend upon, and people travel from and outside the town to the market on weekly or daily basis. Accessibility to markets, services and infrastructure is a major determinant of economic status. However, some accessibility measures do not have a clear dimension and must use indexing for the purpose of comparing nodes.

Markets link local activities to larger regions through trade. For farmers, markets are the means to sell their goods while at the same time they provide incentives for investments and production choices and hence Accessibility plays an important role in functioning all these activities. Transportation facilities largely determines the access people have to the markets and its maximum utilization. The quality of transport infrastructure in terms of connectivity, capacity and travel distance along with speed affect the market's accessibility which will determine its location.

AIM- To explore the importance of location of Marketplace in the city and understand the importance of location with respect to accessibility of Markets for local communities as well as people visiting the place from other towns.

OBJECTIVE

- To study the location of the local market.
- To study the parameters on which the location of the marketplace is decided.
- To study and analyse the flow of humans into the market including the local as well as people visiting from nearby towns and villages.
- To analyse the problems of accessibility of the market and its causes to increase the potential of the place.

SCOPE

- To analyse the various parameters which play an important role on deciding upon the accessibility of the marketplace.
- To understand the circulation pattern of the market place.
- To analyse the direction of human movement in the market.

LIMITATION

- The study is limited to Baramati Local Market.
- The study will be conducted only on Thursdays which is a market day of Baramati.

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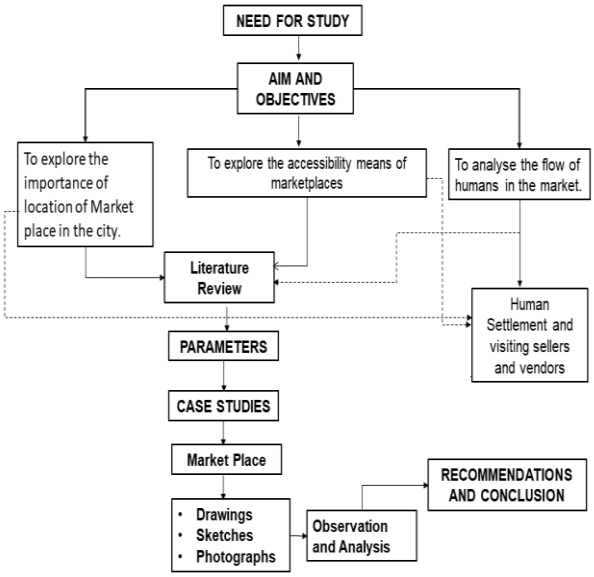

- The study is limited to only temporary Sellers, vendors and visitors and will not include the people visiting the permanent shops.
- The data collected and analysed may not apply to other local markets other than the Baramati local market.

RESEARCH QUESTION

The location of the market has a huge correspondence with human settlements and flow of humans along with the users into the market and, all these factors depend upon the accessibility means, and vice versa. As market influence grows, the paths and journey and circulation pattern changes or we could simply say that shifting of location of the market. So the major aspect considered is the accessibility of the markets.

RELEVANCE OF TOPIC

Markets influence the worldwide patterns of Urbanization, deforestation, agriculture and other allied activities. Yet market influence is rarely incorporated into spatially explicit global studies of change largely and thanks to lack of consideration of accessibility. The market access environment keeps on constantly developing and changing, attention on actively changing means of entries and roads along the market should be taken into consideration. Roads are the crux of the human civilization and social interaction along with activities. Human settlements are though heterogeneous but involve interactions among themselves. It is observed that availability of a suitable location for market places serves or activities like buying and selling which are the major traffic attractors and circulators that tend to concentrate more along road corridors for easy access. Improved accessibility would save on time but if the roads and pathways are unplanned it leads to sprawl of human settlement which impedes traffic flow and connectivity. Hence, emphasis is to be laid on the pattern of structures and accesses to promote ease of access and convenience and maximum utilization of the space. Improved accesses lead to economically viable and attractive place and economics is the major aspect of the market. The complete functioning of the market is based on the circulation pattern inside as well as outside the space and in the Baramati market there are too narrow entries at the front side which do not allow the vehicles to enter and people need to take a long route to enter the market else the only option is walking too long. Hence having a resolved access is an important aspect of the markets.

RESEARCH METHODOLOGY

Table 1

The data for this research was obtained from both primary and secondary sources. Literature Review was the method used for collecting the primary data like parameters which were then used to collect the secondary data from the case studies. Listing down the parameters of the market place gave the parameters like **Location, Accessibility, Human Settlements**, Traffic Congestion, Range of Goods and Socio-Economic Character. Taking into account the Accessibility as the main parameter and listing down the sub parameters of Accessibility **like Number of Openings**, Services and Goods, **Human Settlements**, **Flow of Humans** (Circulation Pattern/ Journey). The data collected would in form of photographs, sketches and drawings which would show the footfall and the journey/circulation pattern of the users as well as the sellers. Questionnaire and physical surveys were used to collect the secondary data. The data was collected between 9am to 1pm on Thursdays and 7am to 12pm on Sundays. The interview was conducted with the sellers and vendors and the visitors as well.

15 respondents were interviewed for the study. They consisted of two groups. The first group: market stakeholders, who were the main research respondents,

a) 5 selected vendors from the market

b) 10 selected buyers

For vendors and buyers, the selection process began with collecting information on what types of goods people normally want to buy when they visit the local market. For this, I asked seven friends of mine, and most of them said that they usually buy vegetables and fruits when they go to a local market. The data collected would be in form of sketches, drawings, images and the observations together with the answers received from the users.

DATA COLLECTION

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To begin with the foremost data to be collected was different typologies of buildings, complexes or public spaces where the culture of the place is defined. A mind map was generated which listed down the various parameters and typologies of the buildings from which some parameters were chosen for my study.

1. Market Places-

Market Places have a spread of activities occurring with different categories of individuals with different age groups and different standards of living which decides upon the place's culture and decides the overall look of the place and these places not necessarily have the built structure rather it is an area where the huge public space junk is converted into the space which sustains the culture of people.

2. Coffee Shops/Hotels/Plazas-

It has been observed that people love to have the coffee, dinner, snacks seating comfortably in the presence of nature rather that an enclosed AC space and watching the dead walls. The culture of people is to sit on a couch or a platform and enjoy the food having a pleasant scenario of the nature.

3. Streets

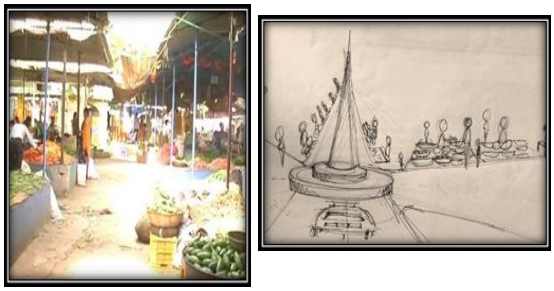

Figure 1(i), 1(ii), 1(iii), 1(iv)

For example, In Mumbai the fashion street is not just the street, but they are being used for having a ramp walk and other such activities which the culture of people residing over there. They need not have a built structure but have converted the public space to sustain their culture.

4. Theatres

Having vendors outside the theatres where people wander around and enjoy the crowd and where the children have a horse ride or so is the lifestyle and culture of the place where in the structure plays a very minimal role and the heart is the streets and the public space outside the theatre which is the attraction point for the visitors and it is that space which sustains the culture of the place and not the built structure.

Case Study at Baramati local Market (refer figures 1(i), 1(ii), 1(iii), 1(iv)) was done on Thursday and journey of visitors was marked wherein it has been observed that people enter from all the 6 gates randomly but the front two gates are used maximum by the local people residing in the main core of the town whereas the rear gates are used by the people residing at the outskirts of Baramati.

Farmers, sellers and all the goods and services were accessed by the 2 side gates. Though there are 4 gates for service entry and farmer's entry only 2 gates were used and useful and many people entered through these gates and no protocol has been followed where the visitors were restricted.

Questionnaire- The answers mentioned below are the average answers received.

For sellers and vendors-

1. Where do you come from? Local or other Villages
   - Other villages like Bhigwan, Nira, Malegaon, Limtek etc.
2. What goods do you sell?
   - Vegetables and fruits
3. Is it feasible for you to travel to the market and whether the roads are useful or not?
   - Not really but do not have an option as selling of goods in hometown is uneconomical and Baramati bears a good amount.
4. Do you find the pathways and roads useful? If not, what inconvenience do you suffer?
   - Yes. They are useful as they connect to the main road connecting are hometown and carrying the goods is easy due to segregated openings for the market and no hindrance is created by the public due to different service entries and public entries.
5. Which gate do you prefer to enter from and why?
   - The side gates are preferred as carrying the tempo and making it stand is convenient and do not create traffic issues.
6. Does the location of the market have potential and bear you enough earnings?
   - Yes, the location of the market is very convenient as it is the centre of the city and all the residents visit in large number being near and accessible and being near the bus stand attracts the travellers too which adds on to the potential.
7. If the market is shifted to some other place would it cause any effect on your economy and trade?
   - No, the market was shifted once but created problems for parking the tempo, even the users reduced due to long distance and served to be uneconomical.

For buyers-

1. When do you mostly visit the market?
   - Thursday and Sundays

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2. Are you local or visited the place from some other place?

- Local as well as visitors at the bus stand.

3. What type of goods do you purchase most of the times?

- Vegetables and Fruits

4. How long is the market from you home?

- At a distance of 2 km and I can come walking too and need not have a vehicle necessarily to visit the place. Even if I need something other than the market day I can walk and get the goods from the local sellers in the market.

5. Which gate you prefer to enter the market? Why?

- The front two gates as they are near the main road which is connected to the home.
- The rear gate as we live outskirts of the city and coming to the market from the front gates is really inconvenient though.

6. Is the market accessible?

- Yes, very well.

7. Do you face any inconvenience in reaching the market? If yes, what and why?

- No we do not face any inconvenience as such the only issue is the traffic congestion, being located near the bus stand and the node.

8. Will the Shifting of market cause any trouble or inconvenience to you?

- No, the market was shifted once but created problems in reaching the market as it had only one gate and we needed to visit through the lane and no main road connected the market.

9. What location would you prefer over the current location of the market?

- We prefer the current location itself and if the market needs to be shifted we would prefer it near the Panchayat Samiti, Ashok Nagar as the city is developing Ashok Nagar is becoming the center of the city.

DATA ANALYSIS

Transformation of urban spaces, their active and creative use-

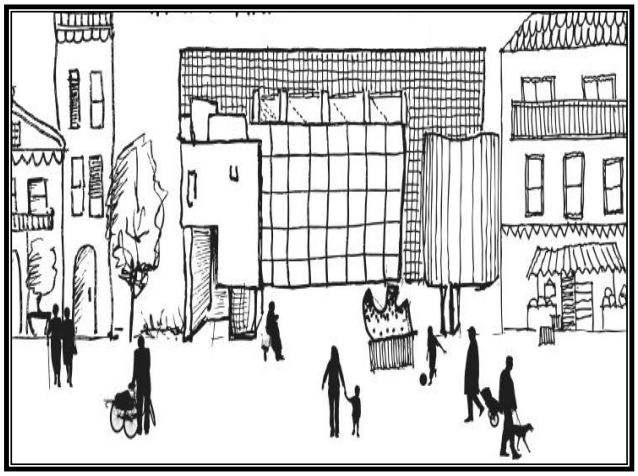

Figure 2

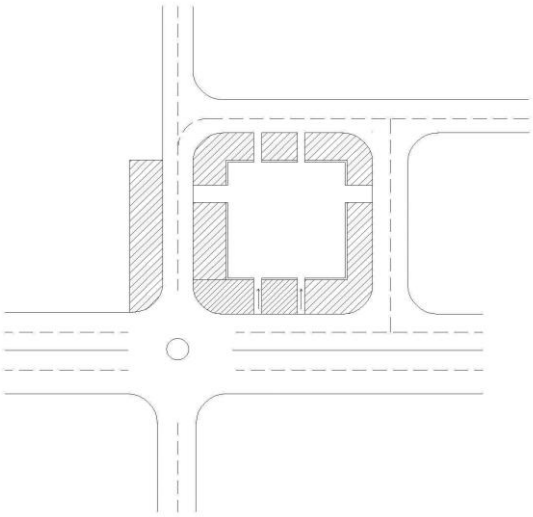

Figure 3

Spontaneous transformation of place and its active and creative use is influence on factors that are close to the terms of the creative city.

Open social climate, Informal social groupings-

1. People of different categories according to their economic status, age groups and occupation settle in to the market and accordingly are their goods and ultimately it decides upon the buyers and the visitors and their flow and their journey in the market and all this is dependent on the number of openings for the market and indirectly the road networks. The maximum vendors sit along the main road connected to the city and connecting villages from where the farmers travel for selling their products and they do not have a permanent place in the market and most of the customers prefer buying goods from these vendors and hence the main access for is the Indapur road.

2. The redesigned market had only one entrance and which created a huge accessibility issues for the visitors as well as the sellers to get their goods all the way through the small streets and then take them into the market and hence created a big issue of accessibility for the users and visitors as well and hence the market was re-shifted to the original place.

Effect of market on the traffic has been depicted in the graph below on Thursdays, the market day. From the graph obtained it can be observed that the market's location and accessibility highly affects the other places. Having openings located on the sides where there is maximum probability of people to enter from is must and to have these opening along those sides need a road or street to make them accessible and having roads and streets depends on the location of the market itself, if the market is located between the congested area it is not

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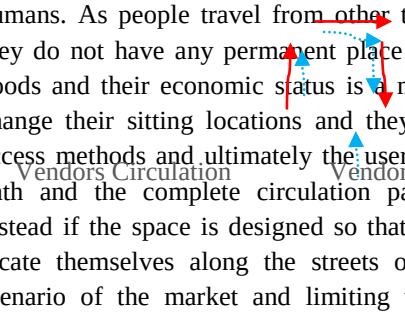
possible to have roads on the periphery of the market and it disturbs the accessibility for the market.

The data from the field observations (refer figure 2) conducted, showed that most vendors and buyers went to the street markets compared to the other market which is outskirts of the city being inconvenient and long for them.

The circulation diagram (refer figure 3), represents the journey pattern of the sellers and vendors and how the number of openings to the market change the circulation pattern. It also represents the journey pattern and footfall of the users of how the number of openings to the market change the circulation pattern and how people enter the market and human settlements around the market and this diagram represents the effect of human settlement on the location of the market and effect of openings on flow of humans.

RESULTS

Though, the entries get restricted or changes people do not follow them and find their own paths into the space so there could be no specific path created to resolve the accessibility issues. But at the other hand if we limit the number of openings it is possible to direct the flow of humans. As people travel from other towns and villages they do not have any permanent place to sit and sell the goods and their economic status is a major factor which change their sitting locations and they create their own access methods and ultimately the users create their own path and the complete circulation pattern is sprawled instead if the space is designed so that no vendors could locate themselves along the streets or just change the scenario of the market and limiting the entries to 2-3 would resolve the accessibility issues. The human settlement being slum on one of the sides changes the means of access, due to location being at the centre surrounded by the slum, residences, main road and bus stand and commercial complex people tend to enter from all the sides without following a specific path. The age factor also plays an important role in defining the path followed by the users and even this parameter needs special attention which has to be considered.

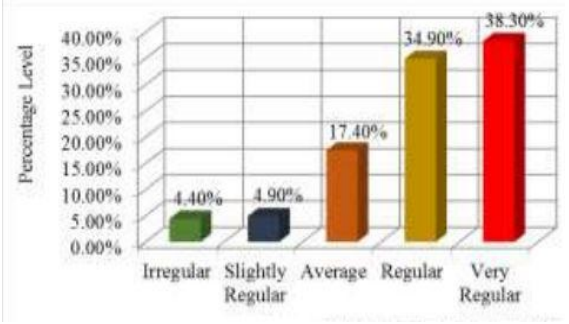


The zoning plays vital role in the functioning of the market as well as it helps in deciding upon the users and their circulation pattern as people with higher economic status would not go and buy things from the vendor and their circulation pattern and journey would be completely being different from the poor people. Not only this the human settlements around the market would decide upon the positions of openings and not only the position but the number of openings as well.

The accessibility integrates three components:

- The transportation component, which deals with mobility
- The spatial component that deals with activity location
- The temporal component, which deals with the timing of activities

From the study it has been observed that market place which is located near residential or business centers, facilitate both vendors and buyers, specially the lower-income group to participate. Due to centralized location of the market, vendors know where they are going to sell their products while, buyers do not have to wander in search of the goods. The poor would find it difficult to spend any transport fee, and hence location of the market should be such that it is centrally located and accessible by



all the people of different age groups as well as different income groups.

CONCLUSION

Accessibility is important for market development since location with better access gets more response of buyers and sellers. The location of the market should be such that the villages and cities from where all the products are sourced are easily connected to the market.

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Status of Universal Access in Shopping Malls in Pune

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Abstract: India is an inclusive country where people with different religion, caste, race, economy reside together; but are distinguished by physical barriers. Many people are deprived of using public buildings like malls, theatres, commercial buildings, etc. only because of physical inaccessibility and space design. The research paper aims at identifying the status of universal access to Shopping malls in Pune through case studies; to create an inclusive environment through ease of accessibility. The case study was conducted for malls as mall is a place that has activities like shopping, movie theatres and food court, games, café, etc. all under the same roof.

Keywords: inclusive, differently abled, barrier free, access with dignity, wheelchair, universal access, shopping mall.

Introduction: The universe is a home for a diverse population. There are people of different age groups, gender, functional abilities etc. Universal design is the design of buildings, products or environment to make them accessible to all people regardless of age, disability or other factors. The term "universal design" was coined by the architect Ronald Mace to describe the concept of designing all products and the built environment to be aesthetic and usable to the greatest extent possible by everyone, regardless of their age, ability, or status in life(ii, 2013).

Census 2001 has revealed that over 21 million people in India as suffering from one or the other kind of disability. This is equivalent to 2.1% of the population. Among the total disabled in the country, 12.6 million are males and 9.3 million are females. Although the number of disabled is more in rural and urban areas. Such proportion of the disabled by sex in rural and urban areas. Such proportion has been reported between 57-58 per cent (iv) for males and 42-43 per cent females. The disability rate (number of disabled per 100,000 populations) for the country as whole works out to 2130. This is 2,369in the case of males and 1,874 in the case of females.

Among the five types of disabilities on which data has been collected, disability In seeing at 48.5% emerges as the top category. Others in sequence are: In movement (27.9%), Mental (10.3%), in speech (7.5%), and In hearing (5.8%). The disabled by sex follow a similar pattern except for that the proportion of disabled females is higher in the category in seeing and in hearing (iv)

The Universal Accessibility Act "(EqualOpportunities, Protection of Rights and Full Participation) Act, 1995 under Sections 44, 45 and 46 categorically provides for non-discrimination in transport, non-discrimination on the road and non-discrimination in built environment respectively. As per Section 46 of the PWD Act, the States are required to provide for –

1. Ramps in public buildings;
2. Adaptation of toilets for wheel chair users;
3. Braille symbols and auditory signals in elevators or lifts;
4. Ramps in hospitals, primary health centres and other medical care and rehabilitation institutions (i)

The Centre for Universal Design at North Carolina State University expounds the following principles:

1. Equitable use
2. Flexibility in use
3. Simple and intuitive
4. Perceptible information
5. Tolerance for error
6. Low physical effort
7. Size and space for approach and use (iii, 2014)

Each principle above is succinctly defined and contains a few brief guidelines that can be applied to design processes in any realm: physical or digital.

These principles are broader than those of accessible design and barrier-free design.(iii, 2014)

Many buildings are constructed by taking these norms into consideration, but the real question is that are these buildings really accessible. A comparative study is conducted at 2 malls in Pune city, viz. Kumar Pacific Mall, Shankarsheth road and SGSMall, camp.

Material and Methodology:

Data Collection and Analysis:

Primary Data Collection: Primary data is collected through interviews and questionnaires of visitors in mall and observing the scenario.

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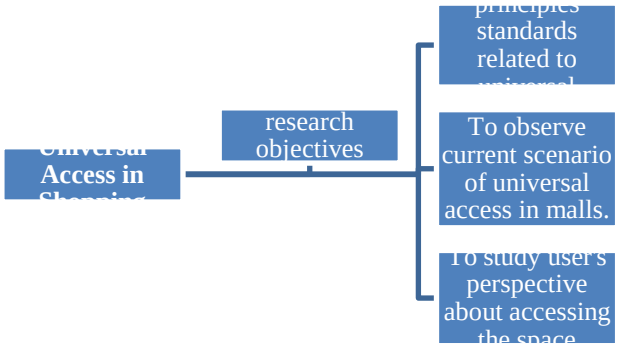
Secondary Data Collection: It is made by studying articles, research papers, journals, other sources related to the topic.



Data Collection and Analysis:

A comparative analysis is made on basis of 7 principles of universal design. The table shows whether the design principles were followed or not in the mall design. It is marked 'yes' if they were followed and 'no' if they weren't.

Design Principle	Kumar Pacific Mall	SGS Mall
Equitable use	**yes**	**yes**
Flexibility in use	**yes**	**yes**
Simple and intuitive	**yes**	**no**
Perceptible information	**yes**	**no**
Tolerance for error	**yes**	**no**
Low physical effort	**yes**	**no**
Size and space for approach	**yes**	**no**

Apart from this, observations were made on basis of accessibility with dignity, accessibility to the toilets and personal assistance services.

	Kumar Pacific mall	SGS Mall
Accessibility with dignity	yes	no
Accessibility to toilets	yes	no
Personal assistance	yes	no

People's perspective:

Kumar Pacific Mall: It was found that the mall was accessible with ease and dignity to babies, adults, youngsters, senior citizens and wheelchair users from road side through ramps as well as basement from lifts.

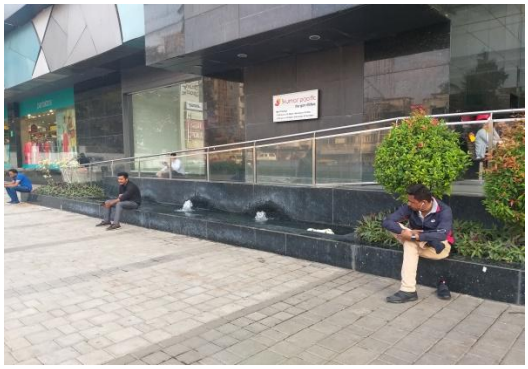


Figure 1: separate toilets for wheelchair users on every floor

Figure 2: ramp at front/roadside entrance.

Figure 3: wheelchair and baby strollers' service provided by the mall.

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SGS Mall: The mall was not accessible to wheelchair users and baby strollers from road side as there is no ramp provided for the same though they are accessible from basements via lifts.

Figure 4: no ramp provided at the entrance

Limitations: Only physically variable people are considered for the study and emotional or mental well-being of the user is not taken into account.

Results: Kumar Pacific Mall created an inclusive environment for all kinds of people. SGS mall had barriers for accessing the mall.

Figure 5: a scene from Kumar pacific mall of a wheelchair user

Conclusion: It was found that it is very necessary to provide barrier free access to all kinds of people. It is very important that these accesses should be with dignity and ease. The design should be in a way that makes sure that no user is hurt physically or emotionally due to inaccessibility.

Acknowledgement: The research is guided by respected Principal, Dr. Rajendra Koli, APCOA, Pune and Faculty guides are Ar.ShilpaIngawale and Ar. Shailaja Bhagwat, APCOA, Pune.

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Enhancement of Roundabouts in Nashik city

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Abstract: The research paper focuses on enhancement and design strategies of roundabouts in Nashi City. Nashik has number of circles to which three to five lanes are connected. They are designed to reduce the vehicular conflict points. This paper also includes evolution of roundabouts and impact to the city. Also planning and design strategies of roundabouts are studied in this research paper. Planning of roundabouts, location, size and shape, and landscaping these factors are studied w.r.t the city. The primary data is collected on the basis of case studies done in Nashik city. Planning of the city is studied to see the location of intersection points where roundabouts are planned. These in intersection and circulation are analyzed w.r.t flow of vehicles during afternoon and evening. Secondary data collected was from literature and books. At each point of roundabout observation and analysis is done and proposal of enhancing the poorly performing roundabouts is given.

Keywords: **roundabout, vehicular flow, lanes, Nashik city, enhancement, circulation, etc.**

Introduction: A road junction at which traffic moves in one direction round a central island to reach one of the roads converging on it is called Roundabout. Now-a-days roundabouts have been an important aspect of cities as the number of vehicles has boosted and at the same time raised to conflict at intersection points. These roundabouts are spreading all over to reduce the conflicts at intersection points. It also gives beautification to the city with minimum maintenance cost. There are numerous roundabouts in Nashik city, which connects three to five lanes at a point, creating a smooth and zero conflict points at a junction. Generally roundabouts are classified in three basic categories according to the size and number of lanes: traffic roundabout, single lane roundabouts and multilane roundabouts (3 to 8 lanes). Nashik has three to five connected to a single roundabout as shown in figure below (fig 1.1) .

Author 'Mo Zhou, Lili Yang, Hoong Chor Chin in article- The Evaluation an Improvement of roundabouts in Changchun' has defined that roundabouts are often designed to connect the main road because of their ability to reduce conflict points and making them safer than other intersections. The author in this article has shown the process to evaluate and improve roundabouts using microscopic simulations to model roundabout. After studying the above mentioned article and the roundabouts in Nashik city , poorly performing roundabouts are proposed for enhancement. This article evaluates all roundabouts in Nashik with the aim to understand its enhancement and performance.

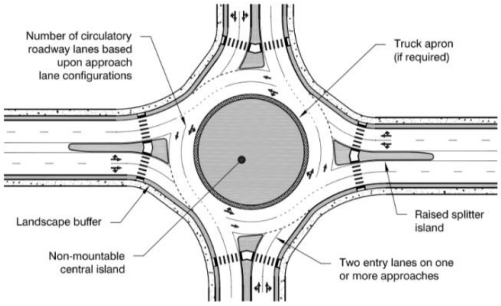

Fig 1.1 Features of two lane roundabouts

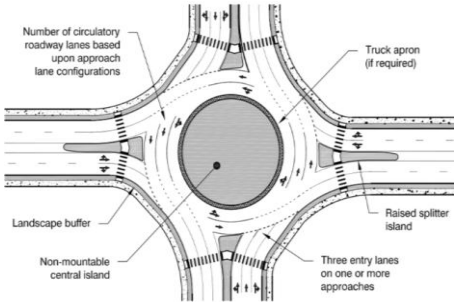

Fig 1.2 Terminologies of Roundabout

Background: Roundabouts were mainly rooted from United States. The basic shape was done all the way back from 1790s, when architect and engineer Pierre L'Enfant proposed a number of circular intersections in Washington, D.C. Columbus Circle, was widely considered to be to country's first circular intersection designed for automobile era. It was revived by American businessman William Eno from 1905 for New York city. Before the roundabout circular junctions already existed including the Circus in the city of Bath, Somerset, England, completed in 1768, part of a world heritage site. Like modern roundabouts, these junctures feature one-way traffic moving around a central hub and connecting roads branching out like spokes on a wagon wheel. But the central circle is much larger, and connecting roads enter at abrupt right angles, requiring drivers to significantly slow or stop before entering the intersection. They're what engineers call traffic circles. In the 1930s American road departments began

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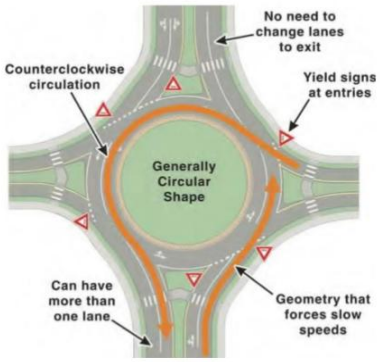
building rotaries, the next step in roundabout evolution. In the United States modern roundabouts emerged in the 1990s. Municipalities introducing new roundabouts often are met with some degree of public resistance, just as in the United Kingdom in the 1960s. As of December 2015 there are about 4800 of these modern roundabouts in the United States. As an example, Washington State contains about 120 roundabouts as of October 2016, all having been built since 1997 with more planned. In beginning of 21st century roundabouts were in widespread use in Europe, France had more than 30,000 roundabouts where as there are more than 10, 000 roundabouts in



United Kingdom.

Planning and design strategies of roundabouts: A roundabout or a rotary junction consist of a central island surrounded by the roads forming a junction as shown in figure below. The shape of central traffic island is elliptical. But it can also be made circular or rhombus diamond shape. The provision of a roundabout junction introduce uni-directional (clockwise direction) circular movement at the intersection. Some planned and classified roundabouts example are taken from a "roundabouts and informational guide" are as follows -

Wisconsin Rapid, Wisconsin

Bend, Oregon

Material and Methodology: The study done for this research is a qualitative and case study based. In which Primay data collection of 13 roundabouts in Nashik City is done. Depending on factors of planning of roundabout, its location, size and shape, Landscaping and planning of city w.r.t roads and lanes observation and analysis are noted. Traffic survey were conducted at intersection points by manual methods. Secondary data is collected to study Panning and design stratergies of roundabouts.With the help of analytical drawings and photographs analysis and conclusion are noted.

Literature: Due to increase in population and number of vehicles major conflicts are seen at the intersection points of lanes. To reduce these conflicts many cities have aopted planing of roundabouts and now needed to be enhancd because of the vehicular flow and increase in conflicts.Rounadbouts in Nashik city are planned but they need to get more enhanced as number of vehicles are increasing day by day. To explore more and clarify the topic 3 relevant other research papers were studied.

1. Evaluation and improvement of roundabout in changchun – This research paper gives a detailed information about the roundabouts in changchun, china. Literature says, that roundabouts are often designed to connect the main road because of their ability to reduce conflict points in making them safer than other intersections. This article

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also satates that roundabouts can also beautify the city whn central island are landscaped. In this researchh paper author has studied typical roundabouts in Changchun, china and their performance and based on this enhancement is proposed. This areticle uses V/C ratio and microstimulatio of roundabout is studied. At last Author ahs concluded the paper showing the process to evaluate and improve roundabouts. The use of microscopic stimulations to model roundabout ia an efficient way to experiment with different improvement strategies.

2. Performance evaluation of roundabout considering traffic conflicts – This research paper talks about the performance evaluation of roundabouts considering Traffic conflicts. A methodology for the performance evaluation of at- grade junctions is proposed. Paper also states the reasons why roundabouts have been positively implemented in several developed countries recently.The study focuses on the gap acceptance maneuver at at-grade junctions, assuming delay and conflict as disutilities. Author concluded the research paper by saying it is necessary to examine the pedestrian volumes to which the introduction of roundabouts is appropriate. Moreover, the influence of the geometric structure of roundabouts to capacity and safety should also be investigated.

From the above research paper studies, importance of roundabouts its need its impact on surrounding area is seen. Also while studing these papers how roundabouts decreases the rush of vehicular flow is seen.

Case Studies and its Observations: There are many roundabouts in Nashik city amongst which 13 roundabouts are been studied as live case study. Amongst these 13 cases there are some roundabouts to which enhancement is needed. To study these first Nashik city planning was studied, where intersection points are seen. And impact of roundabout is studied at the particular intersetion point. 3 roundabouts in Nashik are larger in diameter having multi lanes connected – Maylan Circle , Sarada Circle and Dwarka Circle. These roundabouts are well enhanced and maintained. Other small roundabouts seen in the city are not so enhance aesthetically and are quit poor performing – Vidya vikas circle, Jehan circle, Prasad circle, R.K. circle, Shahid Chowk.

1 Shahid Chowk Circle – Well beautified circle is about 6 m diameter, which is connected with 6 lanes having heavy vehicular flow during evening. This circle has some conflict points at point of intersection which should be enhanced.

Mahatma Nagar Circle – This circle is connecting roads from college road, Mahatma Nagar and Gangapur road. The circle is about 8m diameter, around which heavy vehicular flow is seen during 12:00 pm. As this circle has a lots of space around there was no conflict points were seen. Each turn had a footpath for pedestrians which reduces conflicts of vehicle and a walking person. This circle became a center area for all three lanes connected to it and a landmark too. It should be beautified for better impact on surrounding.

2 Prasad Circle – This circle is also well beautified with diameter of 6 m again. This circle is also connected to total 6 lanes 2 of 12 m wide two ways service road and other two are 6 m wide two ways lanes. The intersection points are to be enhanced same as Shahid Chowk Circle.

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Shahid Chowk circle, Prasad Circle, Sakal circle, Vidya vikas Circle are all in a single stretch which has similar issues and same vehicular flow along the road. Oher roundabouts Maylan circle, Sarad Circle, Dwarka circle are very well beautified and maintained cicles in Nashik having traffic signals for control of vehicular flow and zero conflict with smooth movement of vehicles seen there.

Analysis and conclusion – According to the above study, ita is seen that some roundabouts in Nashik are well developed in aesthetic as well as in planning fcator. Some roundabouts are to be improved as the vehicular flow has increased and conlficts can be seen around roundabouts aswell. Two three person around were questioned- what issues they face while driving around (poorly performing roundabouts) ? solution got was to place tarffic signals at each lane connecting to the roundabout so that the vehicular flow from each lane becomes smooth and zero conflict is seen. Also the roundabouts must be aesthetically enhanced and beautify the surrounded area.

3 Sakal Circle – This is a circle with 4 m diameter which is connected with 6 lanes same as prasad circle.

4 Vidya Vikas Circle – 6m diameter circle with 8 lanes intersecting at a point. They are two way lanes, double lane roundabout, with 6 m wide roads.

5 Ravivar Karanja – this roundabout is beautiful landmark of Ravivar Karanja area. It goes through many different type if vehicles heavy vehicles, buses, two wheelers, auto, 4 wheelers, cycles etc. this area is jammed with traffic as many hawkers sit around the roundabout which leads to less space for vehicular moment and raise to conflicts.

Acknowledgement-The author wishes to thank to subject faculty Ar. Pranoti Lad, Ar. Shreyas Paranjape and Ar. Lily Roy for giving this opportunity and their valuable guidance, inspiration and encouragement throughout the semester.

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Temporary Structures creating Permanent Bonds : Architectural Impermanence in the City of Pune

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Abstract: This is a new interpretation of spaces which are temporary in nature among a dense urban fabric. Khadda vegetable market-Camp and Sawai Gandharv Utsav-Mukundnagar, are captured in terms of their processes, routines and unique features of operations. The process shows that the establishments, though they are ephemeral; have a relationship with the locality, the physical elements and the people. They touch the ground lightly, are economical and also sustainable in terms of its methods of construction and materiality. The study throws light on the importance and need of such open spaces and encouragement of temporary structures in cities.

Key words – temporary structures, open spaces, temporal changes, space optimization, reusing materials

INTRODUCTION

Cities are growing faster than ever today. Each new day land is taken up, utilized for some or another need and is filled up with the heavy built masses. In India, considering the population, land is used for kinds of activities ranging from the very basic needs of food and shelter to the spaces of leisure. But there is this one peculiar aspect also present in the Indian Culture. It is the art of building temporary structures for a specific need or a social gathering in a community. It is the art of using and reusing something to its fullest potential. Throughout time it is been associated to the less fortunate people but maybe they can be looked now as the future of construction technology.

In cities such as Pune, there is always a need for spaces to cater a certain gathering /function/ritual etc. During this process permanent solutions are made without giving a thought whether if the need for which something is being built may still prevail in the future? Shopping malls, stadiums are some of the examples which come up in a city infrastructure citing need of the society. But once the purpose is served or if something new comes up in the vicinity this infrastructure is left defunct and becomes just a dead load on the society with no fruitful returns.This provokes a thought whether if these solutions should have a certain amount of resilience to them? Cities should optimize each and every space and rather spaces should be used which may in turn could be given back to the city after its use.

Temporary structures may be the answer to this problem. They touch the ground lightly, cater to the everchanging needs and vanish once the purpose is served. This form of structures, formally or informally, have been a part of our traditions for a long time and it is rooted within our people; the idea of using something for/on multiple occasions. They may not come under the architectural terms but rather in terms of spaces and patterns of occupation. Thus, there is a dialogue formed between the temporary establishments and the people. E.g.: A mother goes to the same vegetable vendor every day in her vicinity. The vendor may not have particularly a shop, but operates through a temporary setup. This setup serves to both the stakeholders and just vanishes at the end of the day. The wedding pandols, festival decorations, hawkers sand street vendors, all create a dynamic streetscape which in turn starts giving a character to the city. Hence the question arises if whether permanent solutions are necessary for temporary problems?

LITERATURE REVIEW

The figure 1 below represents the transformation of Manek Chowk in Ahmedabad, India on a single day from the morning till evening. Manek Chowk is one of prime examples of a dynamic public space at a heart of the city. Manek Chowk transforms from a parking lot in the wee hours of the day with some street hawkers to a hustling bustling *'khau-galli'* or food street by the night. The cycle lasts for a day and thus this repeats itself every day. This is being done for over many years and even if it is seen as a very informal type of a setting; it is seen that a very complex level of planning and handling of situations is done to create a conducive setting for people to reside and eat. It is seen that people have attached to this locale and it is not just a commercial space but an entity with many different relationships.

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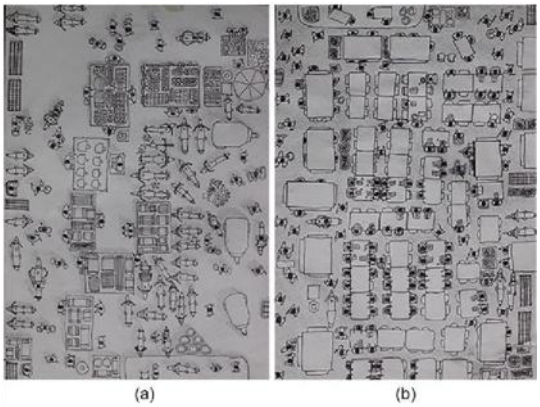

Figure 1: Drawings showing two setups of the Manek Chowk (i)

This one single piece of land acts as a parking space for the customers in the morning when the markets are open. During the night-time, when the shops are closed, hawkers literally set-up a hotel for the people.Thus 'Multi-use' is seen at a very direct level in terms of place-making and social engagement. Though this space vanishes by the end of the day, the identity or the image it has is so strong that it is the major attractions for the people in the city of Ahmedabad even in front of the other built compatriots Ahmedabad has to offer.

Something similar also takes place at the Goa 'tiatr' performances(Vaz, 2013). These are basically a traditional way of performance dramas to give a strong social and political message. It doesn't happen at the urban level anymore but it is still active at the rural level. An open ground is chosen in the village either near a chapel or a landmark and according to the availability either a stage only or a whole semi-open structure is set-up. A temporary auditorium to put it in perspective. As the main motive is to create a politically/socially connected environment, the space is built in a very simplified and a humane way so that the informality stays and there is a dialogue between the community due to this gathering. Thus, there is a bond which is there and also the function of a performance space is also catered with the help of a temporary structure. A formal auditorium, with heavy volumes and a strong built character, may provide amenities and comfort but this study shows that the informality and lightness of the structure helps to bring the people together unlike the formal divide which happens in a auditorium; a spectator and an entertainer. The two cases which we have seen right now are almost for a scale for 500-2500 people. But temporary structures cater to a lot more.

Figure 2: Satellite images showing the Ganges plains before and during Kumbh Mela setup

Kumbha-mela, it is the largest public congregation in the world. It is an event that is celebrated every 3 years and 4 different locations and every 12 years in Allahabad (Purna Kumbh Mela). The 2019 edition happened in Allahabad. This happens over six months of time (3 months for setting up the makeshift city and 3 months of the actual festival) and on an expanse of over 32 sq.km. Refer to the aerial image above to understand the scale of this mega-event. It is been termed as the *ephemeral megacity* by Rahul Mehrotra(Rahul Mehrotra, 2019)
. This example celebrates expansion and reversibility in the most pragmatic and sustainable manner in a dense urban situation. The whole city is set-up only for this one purpose when the Ganges river recedes after monsoon and after the Mela (festival) is completed each and every thing is easily dismantled; most of the material is recycled or either reintroduce them into the regional economy. The materials used are bamboo, jute, steel columns, aluminium sheets for roof covering and a skin to enclose the structure. All other infra-structure is shifted and put to use somewhere in the state. The purpose is served and also no harm done to the environment, no wastage of resources too. The river bank is offered back the same way it was. This isthe beauty of this temporary mega city and its characteristics. The cycle of materials and the way the land is, as if it is untouched; it is so important for us to look at this example and imply those similar principles to our cities all over the country.

A city consists of 2 parts; the Static City and the Kinetic City(Mehrotra, Kinetic City, 2019). A static is everything that is the built. The permanent and formal parts of a city regulated by the governments etc. On the other hand, the kinetic city is the temporary city. The one which reinvents and modifies itself and it is always in motion. The Kinetic city, *bazaar* like in form, can be seen as the symbolic image emerging from the Indian urban conditions. It can rather help in understanding spatial limits and how to optimize built form in the dense urban fabrics. Mumbai is

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a Kinetic City. It is a fast-moving city and the spaces there too, shift their uses at a higher rate. It doesn't have to be a specific location or a demarcated boundary but it rather transcends to the idea of space-making, to the idea of one's needs, one's requirements for a particular time being or maybe a certain community's aspirations which in turn lead up to an occasion which makes the City a Kinetic city.

RESEARCH METHOD AND METHODOLOGY

The study investigates the idea of temporariness of a structure in terms of its materiality and spatial organization. It also studies the impact of the structure on the land it is been situated. The relationship between the space and the public engagement is also looked upon and commented. 2 live case studies are done in detail; an informal and a formal type of setting is chosen to understand various aspects w.r.t to scale, public engagement, function, economy, etc. The temporal changes here are studied for a course of one whole day and one month respectively. These findings are viewed through a critical lens w.r.t its impact on the land and the people. These are documented majorly as visual components with the help of photographs. Also, quantifiable data is presented with the help of infographics.

Figure 3: Use of the space during different timings (Courtesy: Author)

DOCUMENTATION AND DISCUSSION

The first example looked upon here is the Khadda vegetable Market in Camp, Pune. As the name suggests this market is setup in in a Khadda i.e. a depression along the main road. Around 75-90 vendors setup their stores every morning in this place and stay there till the evening.

The first half here shows the condition at 12:00pm on a regular day and the second half is that of at 6:00pm in the evening. It can be clearly seen that the dense market which was setup is dismantled and vanished once the day's business is over. Each hawker only 2 materials to

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setup his stall, sometimes 3; uses 'vasa' or a bamboo support, a 'tadpatri' or the skin acting as the roof and 'dori' or jute strings to tie up the structure. The same material and same setup are done the following day. Hence no new need of resources, one-time investment and reusing it for a number of times. There is no harm done here to the land, no carbon footprint generated, no wastage, in its own sense it is an economic and a sustainable model. The space in the evening gets back to the community where children play, women gather around and also acts as some amount of parking. People in the vicinity by their groceries from here itself on a daily basis. And that level of engagement is also there even if there may be a point where the shops doesn't even exist. This the permanent bond with the temporary structure of a place. And even though the whole system is light weight it runs all year round and in all seasons. Certain additions maybe done during severe conditions but the level of engagement it has is always maintained in the community.

The second study taken here is of the Sawai Gandharv Music Festival which happens in December every year at the Maharashtra Mandal Ground, Pune. It is one of a kind classical music festival with aficionados coming from all across the country. This a very formal structure and is a state sponsored enterprise. It spreads on about 75000 sq. Ft. or a whole football pitch for comparison. It is a one whole performance area which is setup and can cater to almost 15000 people seating at a time.

Figure 4: Timeline showing Construction of the Pandol (Courtesy: Author)

Predominantly, the whole structure is setup using only 6 of the materials;

1)Bamboo 'Vasa'- The supports
2) Steel stanchions
3) Trusses for spanning members
4)Aluminium sheet for roof
5) Cloth- as a skin covering

Jute 'Dori' is used to tie the members to each other. This the basic palette used by the contractor for erecting this megastructure. Skilled labour is not required and hence daily wage labours also contribute to this. The cost of setting the structure up is around 35-45 Rs. Sq. ft. which is way less compared to the general 1200 Rs. Sq. ft of a RCC structure.

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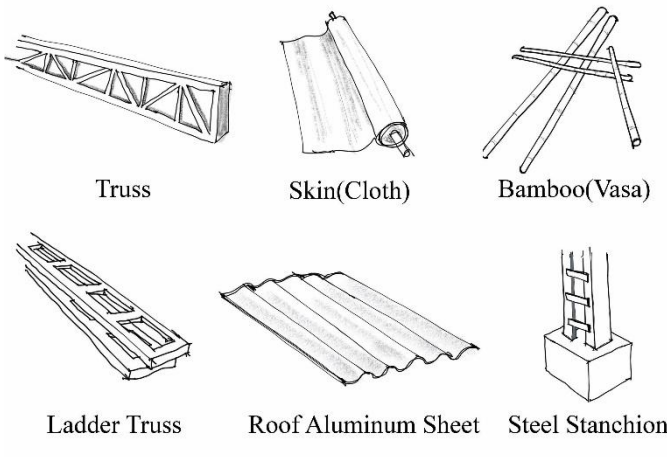

Figure 5: Basic set of materials used for construction

It is the same technique used for so many years, assembling and dismantling. A months' time is taken to setup the pandol, after which the festival happens over a week and then the dismantling process takes a week. All of the material used is stored in a shed or taken to different site to be used for a different function. Though design parameters wise it may not be the best-in-class in terms of its services or aesthetics; but rather this quality of informality helps the user engage more with the performer and in the end gives them a better experience. The ground is given back as the football field it originally is for the community to use. No wastage of materials as well as land resources happens. No embodied energy whatsoever as there is no need of building anything new. All the stakeholders are satisfied as well as the Nature itself.

CONCLUSION

Temporary structures are need of the hour and so are the open spaces in a dense urban city. The above examples have shown that these traditional systems are in fact more sustainable, economical and also do not harm the environment. These methods can be adopted by us for future needs as well as the technological advancement today can further strengthen this idea of temporary construction.

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I would like to express my deep sense of gratitude to Ankush Navre (Contractor for Sawai Gandharv Festival) for giving me information about the whole process of construction. I would also like to thank my guide Ar. Aarthi Chandrasekar for her valuable guidance, inspiration and encouragement throughout.

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Analysis of Fractal Geometry in Dravidian Temples

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ABSTRACT : Architectural composition is progression from large spaces to intimate details. Fractal geometry is the formal study of such progression of self-similar detail and serves as framework to broaden the perspective and understanding of art and architecture. The case in study for this research is Indian Dravidian temples. Dravidian style temples originated in the Pallava Dynasty who ruled the present-day Tamil Nadu. In Dravidian temple architecture the existence of self-similarity has been observed and fractal geometry is seen to play an important part in understanding the structure and composition of these temples. Fractal analysis of these temples will help understand the deep relation between geometry and the temple architecture. This research paper aims to study Dravidian temples and the significance of fractals in the field of architecture. It also corelates and analyzes the Dravidian temple architecture through fractal geometry with respect to the fractal sets it is composed of. It aims to understand the benefits of using fractals and draw inferences based on the comparative analysis. In conclusion the paper also suggests some design implementations of fractal geometry in present day life which incorporate the environmental and aesthetical aspects in the design.

Keywords: Fractal geometry, Dravidian temples, Fractal design, Design principles, Fractal analysis, Design architecture

1.0 INTRODUCTION

1.1ORIGIN

The presence of fractal principles in nature, art and architecture has been a phenomenon in all times and it is not restricted to the period after the mathematical understanding and analysis of fractals.

The term 'fractal' was created by Benoit Mandelbrot in 1975 to describe the geometry of fragmented forms of nature that were perceived as amorphous such as clouds, trees, etc and were not easily represented in Euclidean geometry. He coined the term fractal set to collect together examples of mathematical ideas and apply it to natural phenomena like clouds, coastline, branching of blood vessels, etc.

The origin of the word is from the Latin term 'fractus' which means broken or fractured. Fractals are self-similar patterns composed of the same sets in different scales. Fragmentation of these sets tends to recur identically at different scales.

Fractals can be found everywhere from natural rough lines to clouds, plants, art forms and also in architecture. There are many types of fractals like natural fractals, abstract fractals and geometric fractals based on their formation and shapes (as shown in figures a).

Figure a. Nature Fractals, Abstract Fractals, Geometric Fractals

Fractal geometry has been applied in architecture widely in ancient times**.** Fractal principles are also observed in the traditional arts and crafts, in the ancient civilizations, gothic structures and temple architecture of India.

1.2 HISTORY

Construction of temple architecture started in Southern India in the early 2nd A.D. century during the Pallava rule. The architecture of these temples was inspired from the Buddhist architecture. This type of temple architecture was named the Dravidian architecture and originally took root in Tamil Nadu. The state was subject to rule of four great dynasties: Cholas, Cheras, Pandyas and Pallavas and all these dynasties greatly influenced the temple architecture of the state. These evolved from simple rock cut temples to complex townships and temple cities.

The Pallava dynasty was an Indian dynasty that existed from 275 CE to 897 CE, ruling a portion of southern India. The first stone and mortar Dravidian temples were constructed during this period and were based on the brick and timber prototypes. Some of the best examples of architecture are: Kailasanathar Temple, The Shore Temple and the PanchaRathas of Mammalapuram present day Mahabalipuram.

The Pandya Dynasty, also known as the Pandyas of Madurai, was a dynasty of south India. They contributed immensely in the field of architecture. Gopuras, Prakaras, Vimanas, Garbagrahas (as shown in figure) are the special features of the Pandya temple architecture. Some examples of Pandyan architecture: Madurai Temple, Srirangam.

The Cholas were another dynasty of South India. They were prolific temple builders. They built the largest and tallest of all the Indian temples of their time. They promoted construction of a large number of temples that were spread over most of Chola Empire. Brihadisvara temple located in Thanjavur is one of the greatest architectural marvels in this era.

Analysis of Dravidian temples elaborates on the uses of fractals in the following ways:

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- Repetition of shapes in the planning of temples.
- Repetition of geometrical towers
- Mirror images of similar geometrical towers at various levels and different scales.

Repeating these distinct elements in different scales gives a sense of infinity and an illusion of an object as a whole. Fractals give a sense of universal appeal and a virtually satisfying sense of scale. This research aims at studying fractals and Dravidian temples individually and analyzing the relation between them and understanding the advantages of fractals and using the principles of fractals in present day scenarios to increase high performing structures which incorporate psychological environmental as well as aesthetical aspects in the design of a structure.

2.0 Methodology

This research paper aims to understand about concept about fractals and their usage in the architecture. Also aims in using quantitative and qualitative methods to analyze the fractal geometry in Dravidian temples. Fractal analysis of Dravidian temples helps in finding out the techniques and methods which were used for implementing fractals in these temples. And also understanding the benefits of fractals and how it can be implemented in present day structures to gain the utmost advantages of the fractals.

3.0 Relation between Dravidian Temples and Fractal Geometry

Ancient Indian architects were very skillful in geometry and they used this knowledge to derive many conclusions. It was realized that the concept of progression could be applied in real life and the outcome of this progression was aesthetically beautiful structures. This progression later came to be known as the fractal geometry. Fractals when used in architecture acts as mode of expression to reveal the beauty in complexity. Early Indian architects followed these principles in their temples and the results can be seen in the case studies discussed below.

3.1 Case studies:

3.1.1. Pallava dynasty:

Pallava architecture represented an early stage of Dravidian architecture. The first stone and mortar temples were constructed during this period and based on brick and timber prototypes. The Pallava architecture shows the transition from the rock cut temples to the stone built temples. The monolithic temples gave way to structural temples like the Shore temple in Mammalapuram. Shore Temple is granite made temple at Mahabalipuram built during this period. This group of temples is a UNESCO World Heritage Site and is one of oldest structural temple in India.

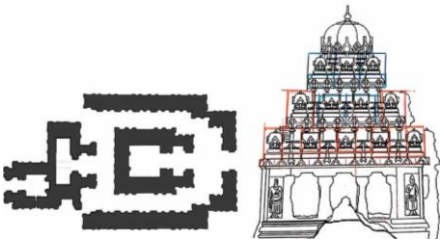

Figure b. Plan and Elevation of the Shore

3.1.2. Pandya dynasty:

The period of the Pandya rulers saw the development of elegant Vimanas, Gopurams and Shikharas in the temples. Pallavas used bricks as the main material for their construction of temples.

Meenakshi Amman Temple, also known as Minakshi-Sundareshwara Temple, is one of the oldest and most important temples in India. Located in the city of Madurai, the temple has a great mythological and historical significance.

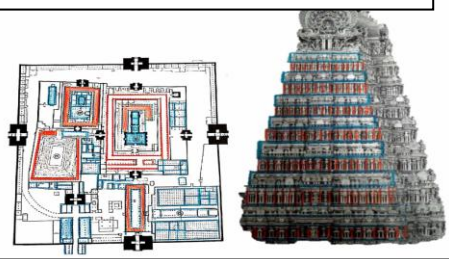

Figure c. Plan and Elevation of the Madurai Temple

3.1.3. Chola dynasty:

The Chola kings built many temples throughout their kingdoms. These Chola temples reveal the gradual evolution of the Chola art and architecture. They earlier built brick temples and later moved on to build stone temples.

The greatest landmark in the history of South Indian architecture is Brihadeshwara temple at Thanjore. It has a great architectural significance. This is the largest and tallest temple in Tamil Nadu.

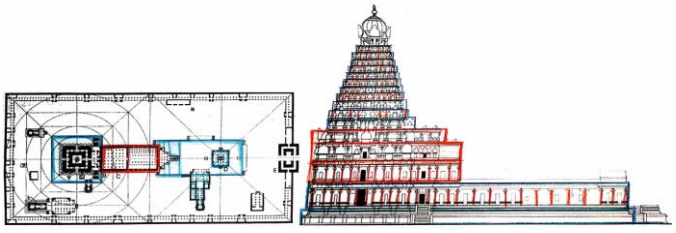

Figure d. Plan and Elevation of the

3.2 Analysis:

The geometry of the plan starts with a line forming an angle and then evolving into a triangle. Then triangles then combine to a form a square and distinctly into a circle thus deriving the complex forms (as shown in figure e). This

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results in self-similarity and further leads to the occurrence of fractal geometry. The fractal geometry gives a feeling of spaciousness because it helps optimizes space without increasing the dimensions.

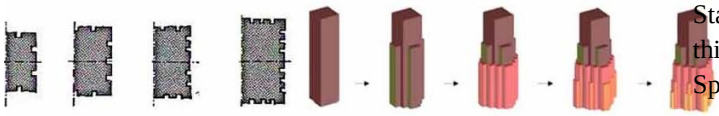

Figure e. Progression of the shapes, forms in the Plan and Elevation

Considering the visual language of the elevation of the temple, the gradual progression starting from the base to the top of the temple is seen prominently. The elements have been repeated in different scales forming a pyramid like structure (as shown in figure m). The elevations of these temples give off a character of harmony and rhythm leading to the aesthetical beauty which is due to the proportional relationship of the geometry of the elements and forms.

Fractal geometry was so vastly used in the temples as they brought a sense of completeness to the structure. It generates an identity of elements and forms and brings strength structurally and visually. It brings modularity in the structure which saves time and resources and offers ease of construction. The geometries used help create aesthetically enthralling elevations and build timeless structures.

4.0 Implementations of Fractal Geometry

Fractal geometry is a design process which can be used in different ways to build aesthetically beautiful structures which give a sense of completeness and adopts most of the design principles like harmony, rhythm, balance and shows movement in these structures (as shown in figure f,g).

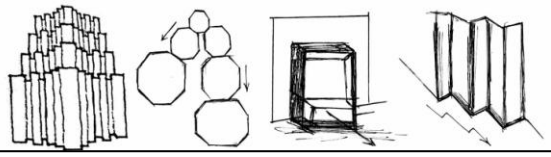

Figure f. Progressive Multiplication, Expanding Repetition, Projection, Staggering

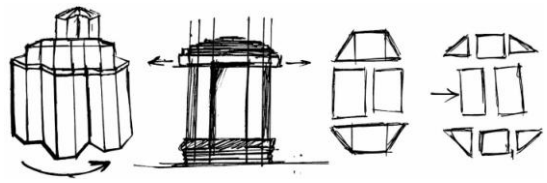

Figure g. Gyration, Bursting of boundaries, Splitting

Progressive Multiplication: The elements or forms are multiplied in progression in either in the vertical direction or the horizontal direction.

Expanding Repetition: Using the same element, shape or form and repeating it in different scales.

Projection: Projecting out the elements or forms from the surface of the structure typically above ground level.

Staggering: The elements and forms are staggered; usually this helps in showing movement.

Splitting: Splitting up of elements and forms into smaller components and repeating them.

Bursting of boundaries: The elements are projecting out of the outer boundaries of the structure.

Gyration: Rotating the forms and elements in different directions and repeating them.

These are some ways in which fractal geometry can be implemented in the structures. One important aspect of fractal geometry is the use of hierarchical scales, without the use of scales it will create a disconnection from the environment. Balance and harmony can be achieved through proper composition of the elements. There are certain rules of proportion and geometry which helps the structures look as one with the environment. The basic concept of fractal geometry is to create complex structures using simple forms and shapes.

5.0 Examples:

A) Palmer House, F L Wright

Palmer House is designed by Architect F L Wright. In fractal architecture, usually one module is considered as the main element. In this house, equilateral triangle is considered as the main conceptual building block and the whole planning and elevations are based on this block.

In the planning of the house, the equilateral triangle is repeated in the floor plan in at least 7 different scales. Progressive multiplication and staggering of triangles can be seen in the planning.

The elevations and the roofs of the house have interesting use of triangular forms. The triangular building block is rotated, expanded and projected out.

Palmer House is a very great example of using fractals in architecture. The house is very aesthetically beautiful and very unique due the use of triangular blocks and fractals (as shown in figure h).

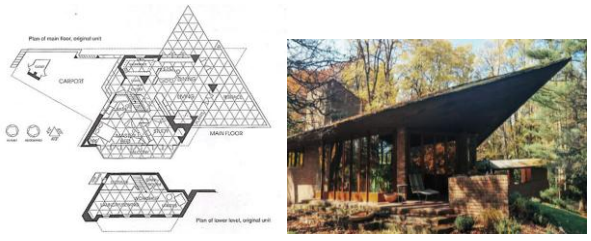

Figure h. Plan and Elevation of Palmer House

B) Habitat 67, Moshe Safdie

Habitat 67 is designed by Architect Moshe Safdie. In this residential complex, the building block is a simple square

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block where two building blocks are combined to build an L-shaped blocks. The L-shaped building blocks are a module and then the modules are placed one above the other. The modules are rotated and progressively multiplied to give the whole residential complex a unique balanced composition and in sync with the environment. This can be seen in the elevations and as well as in the plans of the complex (as shown in figure i). The modules when used here give ease of construction and saving of the resources.

Figure i. Elevation of Habitat 67

The above studies show that fractal geometry can be implemented in the present day strutures too using the fractal techniques and principles.

6.0 Conclusion

Fractals have always present in the nature and the surroundings. Fractal geometry when used in architecture can help the architects build complex structures using simple elements, shapes and forms. From ancient times, fractals were used in various architectural structures and Dravidian temples is one such example.

Various techniques of fractal geometry were used in the Dravidian temples to make the structures more appealing, have a balanced composition and be structurally strong. The use of fractals made the construction of these temples easier and also saved on a lot of resources.

Fractal geometry contributes to a progressive transformation of the building and optimization of spaces. Also using fractals helps avoid monotony and dynamic facades with visual balance can be created. Architects can build organic and complex structures which fit harmoniously in the natural environment and interact with it. This increases the efficiency of the structures built using the fractal principles.

This is seen in the modern day examples which use the fractal geometry and its modularity to build structures which are aesthetically beautiful, very efficient and high optimization of spaces. The fundamental concepts and properties of fractal geometry is very essential to architecture design and its implementations in the structures will strengthen the building visually and structurally.

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Safety of Women on Urban Streets: Case Study of Aundh, Pune

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Abstract: Women safety has always been an issue of concern in India. From 2000-2012, the crime against women has gone up by 200% thus making India a global leader in crime against women. The research focuses on making urban streets safer for commute of women and aims at identifying parameters for street design that impact the perception of safety for women on streets of Pune. The research is a comparative study based on observations made on 3 streets emerging from Bremen chouk.i.e. Spicer CLG Road, Aundh Road, New DP Road in Aundh, Pune. These case studies are analyzed on the basis of 4 factors that are light, distance, activity and functional zoning and sets parameters of consideration for future street design to make the city a safer space for all its citizens.

Key words – Women Safety, Safe Street Design, Safe Commute, Smart Urbanization, Safety, Streets in Pune, Eyes on street.

INTRODUCTION

As the cities are growing bigger and undergoing an urban boom, safety and security of its residents needs to be taken care of. With ever growing boundaries and expanses of cities, the residents are exposed to newer, unfamiliar areas and surroundings. This may lead to people being exposed to unsafe circumstances. In the past couple of decades, the issue of women safety has been observed more prominently. This research looks into the design aspects of safety. However, the culture and perception of people play a an equally important role when it comes to safety. While the design parameters will ensure factors of space making, the context may nullify the expected results at times. This research intends to study an urban problem and come up with design strategies to solve this probing issue of women safety.

LITERATURE REVIEW

Women safety has always been an issue of concern in India. From 2000-2012, the crime against women has gone up by 200% thus making India a global leader in crime against women. "*Previous research and literature show that Women particularly feel unsafe in public spaces and single women feel threatened in almost every context* "(Nag, 2016). Stanley (et al. (2012) found that "*The form and function of public space vary based on particular cultural arrangements, but still having similar features. It needs to be inviting, lively, attractive and comfortable*." Bright lighting, presence of police and presence of several shops and establishments along streets would enhance their perception of safety. (Jehangir Bharucha and Rita Khatri, 2018). Streets as public space are populated area; therefore, they should be designed with safety aspect in mind. Findings showed that majority of respondent (70%) agreed that physical elements in the area affect safety perception among women. These elements were visibility, land use mix, lighting, accessibility, orientation, signage and presence of vibrant activities. (Suhaila Abdul Rashid, Mohammad Hussaini Wahab, & Wan Nurul Mardiah Wan Mohd., Rani, 2017). Safety planning and design also involves more than just the concrete, physical features of a space, although interventions at this level may occur first in safe cities for women programmed (Zarabi, 2013, 47). Hence, 'Empowerment' refers to movement where Women's rights to public spaces, as citizens equal to men, must be protected—if India's cities are to truly shine. (Meher Soni, 2016).

All of the above research shows that factor affecting perception of safety have been studied, ways in which these parameters can be integrated into street design principles is missing. The above research brings into picture the 4 affecting parameters of study chosen for this paper.

METHODOLOGY

The cultural context and character of any street cannot be generalized. A detailed study of the city needs to be done to derive the affecting parameters and streets should be designed accordingly. Hence, the question of women safety on streets of Pune is a topic of concern. The question has been further subdivided to understand parameters of design that enforce safety on streets with the following factors: Light, Distance, Activity, Functional zoning. The scope of research has been narrowed down through 3 case studies observed in Aundh, Pune. These case studies emerge from one chouk however have varied characteristics. The research is a comparative study based on observations made on 3 streets emerging from Bremen chouk .i.e. Spicer CLG Road, Aundh Road, New DP Road in Aundh, Pune. It is a qualitative study. The study is justified and analyzed through surveys and interviews that will give quantified terms for analysis. A sample size of 50

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Case Study Understanding

women who use the street has been selected. The age group of the sample size ranges from 20-50 years of age. Economically, the sample size belongs to the middle- or higher-income group.

3 streets originating from Bremen chouk with different characters and typologies have been selected. They are as follows:

STREET 1: NEW DP ROAD- This road falls between Bremen chouk and Parihar Chouk. It is a 1km long stretch. The street has retail shops on structures adjacent to the walkway with housing on top floors.

STREET 2: AUNDH UNIVERSITY ROAD- This 3km long stretch lies between Bremen chouk and university junction. The Adjacent plots belong to various institutions. The structural density is very low and has heavy forestation on both sides the street.

STREET 3: SPICER COLLEGE ROAD- This stretch ranges from Bremen chouk to khadki station road. This is a 3km stretch. The initial part has institutional plots with heavy forestation and the second half has ground floor retail shops with housing on top.

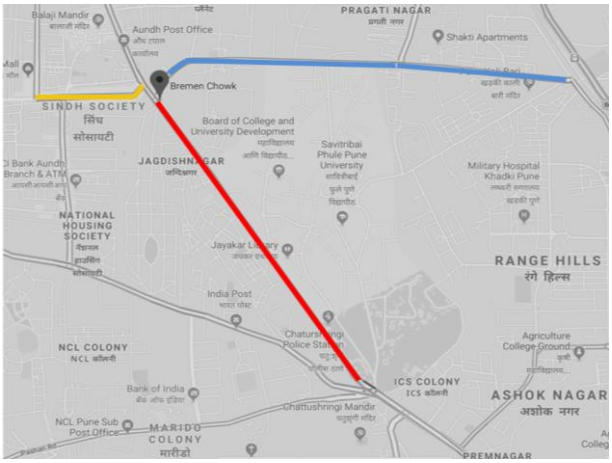

Figure – 1. Three roads originating from Bremen chouk, *Source: Author*

SAMPLE SIZE DESCRIPTION-69.8% are residents of the area. 26.4% use the space as a place of work. 17% use it for recreational purposes and 3.8% use it as place of study. The most commonly used timing is from 10am-4pm used by 62.3% people, followed by timings from 4pm to 8pm with 52.8% of users. Only 30.2% women use the space from 6 am-10am. The least amount of activity is observed from 8pm-6am.

The survey also showed that 60% women prefer to travel on their scooters/bikes, 21% drive and only 22.6% choose to walk. 66% of the sample uses the area daily while the remaining 40% use it from 3 times a week to once a week. The survey showed that 77.8% were faced with road accident/harassment.5.6% cases of sexual harassment were recorded. And almost 22.2% were confronted with crimes of theft. The analysis is done based on their user experience survey.

- LIGHT: Light plays an important role in the perception of safety. Most of the recorded crimes occur in places of poor or no lighting. It contributes in visibility of surroundings which in turn affects the user perception of safety of space. On urban streets, most primary roads are provided with street lights. However, the secondary and tertiary roads are left unlit.
- DISTANCE: Proximity of safe spots on the streets and last mile connectivity are two major aspects of consideration. It specifically talks about distances between assumed shelters in case of an occurrence of crime and include units like ATMs, Medical shops, Police Stations, Chai tapris, Temples, Restaurants and Hospitals or clinics. This parameter is important for users that walk to their destination.
- ACTIVITY: The activity on a street affect the concept of perception of safety. The more the number of people, larger is the on-street activity and points of human interaction. A lot of these activities are brought in due to activity magnets like seating areas, hawkers, jogging tracks, play areas etc. These spaces encourage human interaction and hence contribute to safer neighborhoods.
- FUNCTIONAL ZONING: The building land use of structures adjacent to the street play an equally important role. Mixed use buildings may create a scenario of activity magnets and promote the eyes on street concept. In case of specific use structures, huge compound walls create a scenario of silent walls and blank roads. Furthermore, the proportions of these compound walls may have an effect on the user perception.

Figure – 2. New DP Road for light and activity

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Figure – 3. Aundh Univ. Road for light and activity

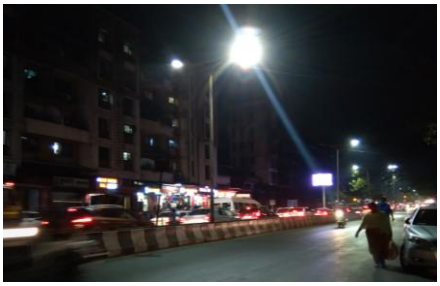

Figure – 4. Spicer Clg. Road for light and activity

Results and Tables

LIGHT:

In this research, light has been studied based on two factors- color of light and presence of light. There are two types of streetlights observed in Pune .ie. bright white and warm yellow. Both lights have a different impact in the user's perception of safety. The survey results showed that 94.2% of the women perceived bright white light safer as compared to warm yellow. The second part surveyed the response of users towards presence of lighting in the following three scenarios- Streetlights + vehicular light, No streetlights + vehicular light, Streetlight + No vehicular light. The response received showed that the first case was preferred by 92.3% of the users. The second case was not perceived as safe by any of the users. The third case was preferred only by 7.7% of the sample. This shows that Streetlights along with a regulated influx of vehicular traffic is perceived as the safest scenario by most women.

- DISTANCE:

This parameter focuses on the concept on safe distances in a user's mind. It was studied for distances that women feel safe using and junctions/places on a street that are 24 hours working that can be possible refuge/rescue areas. The results of the survey conducted showed that 47.2% ,45.3% and 7.5% women felt safe in a 3km, 1km, 0.5km radius from their place of work/residence respectively. 90% of the women that felt safe in a 3km radius had New DP Road belong to the area covered in the radius. The survey also showed that on an average 80% of the women had ATMs and Medical shops in close proximity and they also identified these spaces as safe spots for possible refuge/rescue areas. Other facilities like chai tapris, restaurants and hospitals were also identified, however they weren't as many in number and weren't considered as safe spots.

- ACTIVITY:

The survey conducted showed that 96.2% women identified New DP road as a safe street because of its activity during various times of the day. This activity was mostly pedestrian activity. 13.2% women considered Aundh-university road as a safe street in terms of activity. This activity was majorly vehicular activity. Only 1.9% of the women found Spicer college road as a safe street. This was majorly because of a lack of vehicular as well as pedestrian use.

- FUNCTIONAL ZONING:

New DP Road which has a mixed building use with no compound walls adjacent to the walkway was considered the safest among all three study areas. Spicer college road has institutional buildings and hence the street becomes a ghost street post 6pm. The users hence perceive the street as least safe of the three. Aundh university road again has major institutional buildings with high compound walls on both sides with no activity magnets on either side. In spite of all of these drawbacks, due to the availability of light and fast moving heavy vehicular traffic, this road is perceived as a comparatively safer street.

CONCLUSION

The streetlights used should be bright white in color and should be placed taking into consideration foliage of the surrounding trees to avoid dark patches on the roads. 24-hour open units like ATMs, medical shops, Chai tapris, restaurants, hospitals and police stations should be placed at regular intervals along or near the streets. This would create refuge/rescue areas in case of an incidence crime. The streets should create opportunities and places for activity magnets like hawkers and chai tapris and this should have designated spots along the road. These areas again should be uniformly placed along the stretch to have uniform densification of people. This means that they should have large, well-lit walkways along with road crossings at regular intervals. All major roads should have mixed use at least on the ground floor along the main street and minimal to no compound walls. This would increase the porosity on the street and chances of escape. The streets should also have minimal or no setback policies thus enabling the eyes on street concept. The above considerations during street design will contribute to safety of women on streets and help build safer neighborhoods.

Along with above mentioned factors, traffic plays an equally important role in determining the factor of safety. The speed of traffic and road crossing experience of the

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user can determine safety based on transition and mobility on the street.

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	LIGHT	DISTANCE	ACTIVITY	FUNCTIONAL ZONING	OVERALL ANALYSIS
NEW DP ROAD	• Bright white street lights are used. • Additionally because of the mixed use typology of buildings, the pedestrian walkway is also well lit. • This road is a condition of streetlights + low vehicular traffic and hence, according to the survey, is perceived as a safe option. • The streetlights are positioned in the centre of the road and hence are not covered by any foliage thus preventing any dark spots on the roads.	• This road has mixed use building typology hence creating an opportunity for various activities to take place. • It has 2 medical shops at the two ends, 3 ATMs, 1 24 hour chai tapri, a hospital within 1km radius. • This street also showcases the eyes on street concept, thus making it the safest of all three. • The survey conducted shows that women find this street the most comfortable in terms of distances.	• This street has mixed use buildings and spaces for hawkers and other public magnets. • These facilities generate activities throughout the day thus resulting is safer streets. • The survey shows that women would use this space in spite of no activity just because of quality of lighting and character of the street.	• This road has mixed use buildings that make it a lively and interactive space at all times of the day. • The road does not have any compound walls on any adjacent edges hence making it porous and bringing in the concept of eyes on street. • The entire stretch is functionally uniform and hence has human activity throughout.	• According to the survey, this street was determined as the safest street. • It showcases the concept of eyes on street and is always buzzing with activities. • Post redevelopment of the street, the compound walls were brought down to create an integrated street function. • The light quality on the road is extremely good and hence adds on to the feeling of security.
AUNDH UNIVERSITY ROAD	• This road has bright white street lights. • This is a condition of streetlight + vehicular light. • In terms of lighting, this street is considered safest of all three. • The streetlights are positioned in the centre of the road and hence are not covered by any foliage thus preventing any dark spots on the roads.	• This road has institutional buildings adjacent to the road with single entry points after large distances. • This street lacks any 24 hour units except police station on one extreme end of the 3km stretch. • This street is activity free after 8pm except heavy vehicular traffic. • The survey shows that this is the least safe of all three.	• This street lacks human activity at all times of day. • Its is an extremely fast vehicular traffic heavy road thus leaving no scope for any human activity except occasional fruit vendors. • This road has huge blank walls that overwhelm any pedestrian activity. • Survey shows that women consider this to be unsafe.	• This road has institutional building with huge plots and singular entryways. • It has huge stretches of compound walls with no opportunity for human interaction. • While the stretch is functionally uniform, it doesn't have any human activity throughout the day.	• According to the survey, this street was determined as the most unsafe. • The street lacks any human activity. • Its is an extremely traffic heavy road. • While the road is well lit, the large characterless walls add to the perception of being unsafe. • In case of an occurrence of crime, the street holds no chance for the victim to call for help or take rescue in any 24 hour safe spots.
SPICER COLLEGE ROAD	• This road has bright white streetlights • This is a condition of no streetlights + vehicular traffic and streetlights + vehicular traffic at varying junctures. • In terms of lighting, the survey showed that this road was the least safe. • The streetlights are positioned in the centre of the road however due to dense foliage, this street has a lot of dark patches.	• This road has institutional buildings adjacent to the road with single entry points after large distances and mixed use after a certain point. • This road doesn't have any 24 hour spots except one medical shop at the Khadki end of the road. • This road has porous exits onto secondary roads which are not well lit and lack basic facilities. • The survey showed that this was comparatively safer.	• The initial part of the road lacks any pedestrian activity post 6pm. • The second half of the road has mixed use buildings and hence has huge pedestrian and vehicular traffic at almost all times of day. • This road very occasionally has human activity post midnight and hence the survey shows that this is considered to be unsafe.	• The initial patch has institutional plots and buildings. This road hence becomes free of activity after 7pm. • The second half has mixed use buildings which create opportunity for human interaction. • The stretch doesn't have uniform functionality and hence creates scenarios of major variation in the density of human interaction.	• This road is lively and green during the day, however these same positives create dark patches on the road does creating an opportunity for occurrence of crime. • The ununiform functionality has varied activity distribution not contributing to safety of women. • Due to lack of basic pedestrian walkways, the pedestrian traffic overflows onto the carriage way thus reducing the safety of the users. • The secondary roads are dark and reduce the porosity of the street.
OVERALL ANALYSIS	• Bright white light is perceived as safe. • Streetlights should not be overshadowed by foliage. This creates dark patches on the street making it unsafe. • Streetlight + vehicular traffic is considered the safest.	• Having 24 hour spots at regulated intervals creates an opportunity for refuge/rescue points. • The streets need to be more porous in nature with better designed secondary streets and adjacent structures.	• Activity on street has a direct correlation to the safety of that street. • Any street design should create opportunities for activity magnets to take place.	• The road should have uniform distribution of function to create a safer street. • Having long stretches of blank walls can add to the feeling of not being safe in a surrounding.	CONCLUSION

Table – 1. Analysis of all three streets along with overall study, *Source: Author*

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Designing With Colours for Hospice

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Abstract:Hospice is a special care system designed to give patients and their families security, support and dignity when a life-limiting disease no longer responds to cure oriented therapies.The purpose of a hospice is having a barrier-free environment to inspire the comfort and well-being of the patients, thus creating a house where there are perfect conditions to accomplish life.Among the five human senses, vision is the most powerful in providing information. It also informs us about the environment around us, not just in an objective way by determining things such as room's shape, size and colours but by creating a psychological sensation which can induce feelings of comfort, security, stimulation and much more. Colour has a vital role in enhancing the environment and providing information and spatial orientation, helping occupants of hospice make sense of their surroundings. Most patients in a hospice have stigma about their condition because of the society's negative evaluation. So, it is obligatory for a hospice to build an environment which can help patients cope up with such stigma. The application of colour and design to healing environment should take account of the emotional and psychological factors which can affect patient's well-being. Terminally-ill patients can go through emotional upheavals which are more receptive to emotional stimuli of colour.

Keywords: Hospice, Colour,Barrier-free, Spatial Orientation, Terminally-ill, Healing Environment.

I. INTRODUCTION

Hospice is a setting where the relatives and terminally-ill patients seek refuge from the sickness and anticipation of upcoming feelings of loss and sorrow. Hospice care centres bring together a team of people with special skills - among the nurses, doctors, social workers, spiritual advisors and trainedvolunteers.Unlike other medical care, hospice care focuses not on treating underlying disease.A hospice requires an optimum level of physical and emotional care for patients as well as their relatives. Colours can have an impact on people's perceptions and responses to the environment and also affects the recovery rates of patients.

The use of color and design to suit patients should take into account the emotional and psychological factors affecting their well-being. Colours cannot directly heal, but it abets the healing process and also provide a sense of well-being. There are no specific rules to prepare a colour design manual. In healing environments cost and maintenance are the important issues related to colour design. This led to use of single colour irrespective of the use of spaces. For more stimulating environments that help benefit users can be achieved with the help of creative colour schemes. Colour design is ideally included in all areas starting from materials, colours in building exteriors and also accommodation of patients. Coordinating colours of all finishing materials helps achieve colour harmony. Appropriately used colour schemes create a visual interest and distraction which is essential for terminally-ill patients. Overusing one particular colour can lead to depressing environments.

AIM

- To study the positive impact of colour design and colour therapy on terminally-ill patients.
- To understand the basic colour theory and its psychological bearings on resident patients in a hospice.
- To study the difference in healing environment with the help of patient's experience and interaction with spaces treated with colour therapy.

OBJECTIVE

The present paper constitutes following objectives:

- To prepare a guiding document on the use of colour design as a strategy for a healing environment.
- To study the patient's comfort achieved with the help of colour therapyin terms for environment, the research was restricted to the major areas where patients spend most of their time. These were
- Wards
- Bath and W.C Facilities
- Nurses' Workstation
- Dayroom

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- To use the guiding document for better orientation and wayfinding for patients in a hospice

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II. METHODOLOGY

This paper is perceived by obtaining reliable information of a hospice care centre and colour psychology from literatures related to the topic. The research is based on knowledge of existing works on subject and by formulating a personal understanding on colour therapy. The data analysis is done by referring journals and research papers and the outcome is based upon the literature review.

A) Colour Design for Patients:

Patients require a quality environment. They wish to be easily visible and also see staff and key facilities. Colour and contrast are the most economical and effective tools for designing functional environments that are easy to use. Use color contrast may help patients understand the spatial orientation of surfaces such as staircases, floors or doors. It is a good practice to maintain a sufficient difference in wall, ceiling, floor and door colours. It is necessary to limit the use of reflective surfaces as they not favour easy navigation for elderly people. Reflections of glossy floors creates glare which is disturbing for older patients when they walk around. Use of matt floor finishes aid navigations. Small details like door handles, finger plates should be of significantly different colour. These colours should be such that it contrasts the door itself. Potential obstacles like corridor seating can be threat so they too must be finished in contrasting colours. Young patients also have particular requirements of colour design scheme. Children can find hospice centres stressful. Good color design will make the therapeutic environment look less bureaucratic, and a place to be more fun and relaxing.To understand the designing of environment for children scale and perspective are crucial. Very young children are much more aware of colour and shape than form. Colour design help children by providing visual interest and an emotional outlet thus, helping to overcome the fear of hospital environment. One age group who needs special attention are the adolescent as it is difficult to cater them because neither adult nor child spaces are entirely appropriate.

B) The Colour Schemes:

There cannot be any set rules for colour schemes. The locality, existing materials and context plays a major role in deciding colour scheme. So, it is necessary to build the palette from the analysis of existing colours including building and finishing materials. Colours should be such that use of appropriate lighting can enhance the final appearance of the space. “Pale colours should account for around 80% of the interior colour to reflect the available light.” [i]. These colours could be opposite harmonic colours such as blue and yellow. It can be useful to use a theme for creating a colour palette. White should not be ruled out of colour palette even if a typical problem is that white is seen as hygienic and clinical so,is sometimes desired by users.Evidence suggests, however, that an allwhite environment can cause visual understimulation, and thus create tension.“Neutral environment produces anything but neutral effects” [ii]. Colours like beige, grey and cream can be very functional and useful colours for interiors[v]. Particularly floor and ceilings are important reflectors of light and hence should be finished in light colours over most of the area. Lighting has a considerable bearing on choice of colour. Colours of objects and surfaces behaves differently under light so it is important to view all the material samples underneath the types of light sources that will be used.

C) Colours for Orientation:

Colour is not only an aesthetic component of the environment; it can be a powerful tool for easy navigation around a structure. It can improve the functionality of a space especially a healthcare facility. Patients use cues other than signage to find their way around. Colours can help reinforce the hierarchy of spaces, landmarks and prominent features. Thoughtful implementation of colours in healing environment can aid intuitive way finding and also cognitive mapping. Patients need to find their way in and around the hospice centre that can be complex. Good design of wayfinding components with calming environments will relieve many of the major sources of frustration. To do this, people require well-designed, strategically placed information to assist them during a stressful and difficult time. Colour design can play a big part in helping people to find their desired locations in a hospice centre.

D) Wayfinding

Wayfinding is the best tool for navigation in healing environment. The goal of successful wayfinding is to provide information in the right way for users of a structure. “Vision is typically used to make sense of our surroundings as we seek distinctive forms to create sense of location” [v] In a hospice, patients are prone to develop anxiety if they are disoriented or uncertain of their location. This creates a setback for developing a quality healthcare facility. “People need information to have confidence in making the right decisions about the right routes to take to avoid losing their way to a desired

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destination." [v] Comprehending the way spaces relate to each other and being able to see the underlying organisational principle of the circulation system are vital. Colours are able to simplify the graphical representation of site layouts, plans and charts, emphasising the primary routes.

E) Colour-coding

Colour-coding can be used to make sense of the environment and help simplify the site into wings and blocks. This helps users of building to find their way around and differentiate between areas and departments. Color-
coding can be used in a number of different ways. These c an be included in site maps and guides and repeated in fini shes on the soil. Walls and flooring can be available in var ious departments in different colours."One of the most important aspects of colour-coding is in the design of signage." [i] Colour coding is one of the most difficult applications of colour design in healing environments. It is best if one implements it at planning stage and must be kept very simple. Colour coding is often misunderstood by the people for who it is designed. Hence, it is essential to identify why and for whom the colour-coding is being used. Basic fundamental of colour-coding is that it should be easy to comprehend and should not be more than few colours. "Over enthusiastic colour-coding can dominate the environment." [i] Placement of colour-coding and zoning needs to be well-considered. Being simple and consistent with the convention is also vital so that people expect or anticipate the information they require.

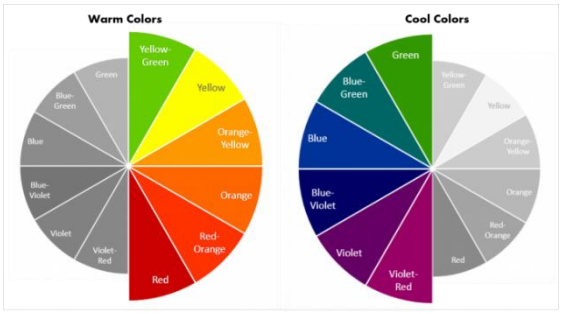

Figure (a) Warm and Cool Colours

RESULT:

COLOUR DESIGN STRATEGIES:

A] WARDS:

Wards are the care areas where patients spend most of their time. Appropriate application of colour and corresponding lighting can contribute to the efficiency of the rooms. "A delicate balance is required; an environment should make the patient feel that they are under modern and highly skilled medical care yet be comfortable and relaxed." [i]Colour schemes could have variations in wards depending upon the type of patients. But the common spaces of ward units like patients' bed bays, toilet facilities, nurses' stations and relaxing areas may help patients to relate with one another in a coordinated way.

Natural light is one of the imperative outlooks in ward designing. Thus, use of brighter colours for these areas can augment the room experience and also it maybe obliging to compensate for any lack of natural light. "Wards should be harmonious with variety of luminaires to give the eyes a chance to rest." [iii] The colours of the wards should be different from the circulation areas to help confirm the arrival at the ward with ease. Appropriate colours can provide intuitive cues for entering the ward and can be a major part of wayfinding.From the workstation of the nurses to the hosp ital, it can be helpful to slowly disperse the pastel version of a stronger shade. "Flooring should be pale and fairly light to reflect and avoid hiding dirt." [i]

B] NURSES' WORKSTATION:

Nurses' station can be a part of ward unit itself. Each ward consists of one nurses' station. This area needs to be visually prominent as the area is one spot which carries more than one activity. It also functions as a reception desk for patients and visitors and also for visiting medical staff. Use of stronger hue is preferable to highlight this area. "Experiments in the USA with the colours in office environment found more mistakes and stress occurred in offices that were totally white without any relief from other colours." [iv] "A nursing station can at the same time be both a happy and a very stressful place. The quality and design of the nurses' workstation can affect the efficiency and morale of both staff and patients. Hence soft and lively colours like greyed blues, greens and yellows should be used" [i](fig. a)

C] DAY ROOMS:

"A dayroom should be an oasis." [i].This needs to be restful, clutterfree zones and should all ow
patients who are outpatient to be involved if necessary.Thi s area must have a homely appearance and can be creatively designed with play of light to make the room visually clutter free. Like all the other major habitable spaces dayroom must also be day-lit. "Visual distractions, art works of some kind make a sensible strategy for these spaces." [ii]

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Colours of dayroom should stimulate the minds of the patients. Use of warm colour scheme can create a sense of activeness. (fig. a) "The hues used should e of high reflectance value but include harmonious combinations followed through with upholstery, textiles or carpets." [i].

D] BATHROOM AND W.C FACILITIES:

These facilities are purely functional spaces and are not given much attention when it comes to aesthetics or colour schemes. But keeping these spaces neat and attractive suggests healthy and lean environment of a healthcare facility.

"The colour scheme should provide adequate colour and hue contrast and bring a varied colour palette to the area." [i] Colours of these area could be of warm colour scheme. (fig. a) Also, the sanitary ware in the bathroom is advantageous if it is in contrast with the rest of walls and flooring. These can assist visually impaired people to use the facility.

III. CONCLUSION

There has been contrasting opinions about colour design impacting the psychology of patients. But it is evident that a properly designed visual environment with appropriate colour schemes will have abiding benefits on patients as well as staff and visitors. Articles and papers on the use of colour in environmental design have shown that: there are some demonstratable, replicable, behavioural and perceptual effects from colour that justified their use in certain ways of design.[iii] Terminally-ill patients or even visitors are most of the times overwhelmed while trying to orient themselves in a new environment like hospice. Hence, colour can act as a powerful mechanism for wayfinding assisting the users of hospice. A warm and restful environment will also help the correlation between patient and staff. A hospice is usually a complex building with lot of functions. So, it is necessary to derive a proper colour scheme with limited colours for easy maintenance of spaces. The appearance of spaces is vital and a good colour scheme in addition with appropriate lighting makes the spaces look lively and hospitable. These benefits of colour design could reflect much more if these decisions are taken at much earlier stage than currently.

IV. ACKNOWLEDGEMENT

I would like to express my gratitude to my primary supervisor Ar. Mukta Latkar Talwalkar, who guided throughout the research.

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Vertical Farming : Implementation And Benefits Of Vertical Farming In Urban Context

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Abstract*: Cities are trying to cope up with rapid population growth adding 2.5 billion dwellers by 2050. Due to this increasing population food is the major problem that can be faced in the future. Planners and architects have become increasingly interested in vertical city. Big vertical structures are generated in the cities due to scarcity of land. As there is increase in population deterioration of quality has been observed, Climate change is also a major aspect in quality production. Vertical farming is the solution for the problem. Vertical farming is the urban farming inside a building where floors are designed to grow crops in a city or urban centre. These heights will act as the future farm land and as architects we can shape these high-rises to sow the seeds for the future. This research is an attempt to implement the techniques in Indian context and study the impacts. This study aims to spread the awareness of importance of this technique which can revolutionize farming in Urban areas.

Keyword: Vertical farming, Farming systems, Issues of farming, Implementation and benefits.

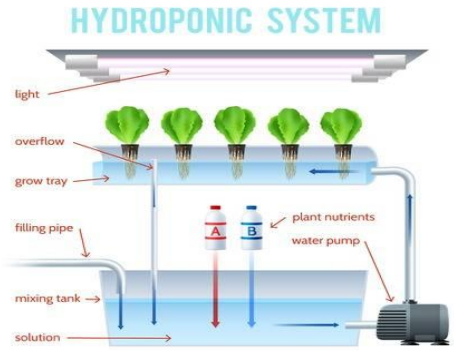
I. Introduction

World population has increased to 7.8 billion in 2020, and adding more 2.5 billion till 2050.Over 3.4 billion population resides in cities and are predicted to increase to 6.6 billion till 2050. Buildings are growing vertically to support this haphazardous growth of population. Due to this increasing rate in the population, requirement of land is increasing and so fertile land which should be used for agriculture is used for urbanization. Food is also a measure aspect necessary for growth. Quality of food is decreasing, as there is increase in production in lesser time. Use of pesticides and other chemicals is increasing which affects the health. Climate change also affect the food industry in many ways. Our traditional methods of farming will not be able to support the demands of this growing population. There are also issues related to traditional farming like irrigation problems, soil degradation, lack of mechanism, improper transportation and storage facility and fluctuating agriculture market. All of this concerns have led to a new approach to farming.

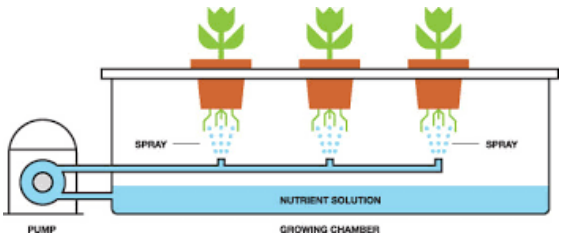
Vertical farming is the solution for all the concerns. This method was developed by Prof. Dickson despommier in 1999. Vertical farming is a methodused to grow crops in city or urban context. In this method where the farm is stacked on a top of one another which reduces space horizontally. One indoor acre of land can be converted into 4-5 outdoor acre or more depending upon the crop which is grown. A building is designed where the floor acts as plates where different crops can be grown at different levels.Modern vertical farms use controlled environment agriculture (CEA)technology where all environmental factors like light, humidity, temperature, and gasescan be controlled as per the requirements. These soilless farms use systems like hydroponics, aeroponics and aquaponics. With help of this techniques it allows the farm to grow fresh and nutrient rich food. It also cut downs the transportation cost andcrops can be grown locally.Using this technique many urban properties can be converted into food growing centers.Therefore, there is a lesser carbon footprint and more efficient use of water and land. It also helps create new urban employment opportunities.

II.Systems of vertical farming

i)Hydroponics: It is a method in which plants are grown in water using minerals and nutrients without use of soil.



ii)Aeroponic: It is a method in which the plants are tied to a support and all the necessary nutrients and minerals are sprayed.



iii)Aquaponic: In this method Aqua culture and Hydrophonic system is fused with each other.Nutrient rich waste from the fish tanks is usedto fertilate the plant beds.

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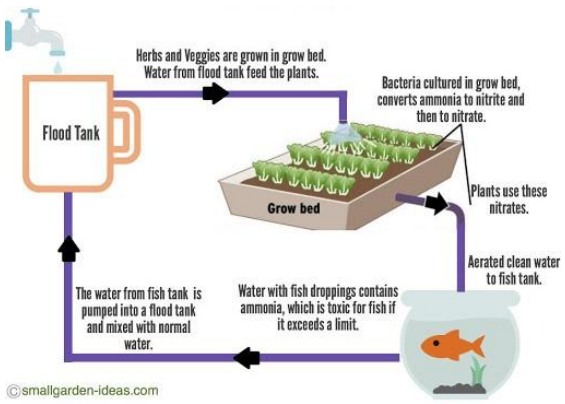
Plants beds functions as the bio filters that removes gases and chemicals from the water.



III. Methodology

Thisresearch has a descriptive study based on primary and secondary data. One Literature case study of a conceptual project showings its implementation on site and its production. Live case study of a farm in Indian context its implementation and parametric analysis. Various research journals, websites & reports were studied related to vertical farming to draw the conclusions.

1) Case study's- literature case study

Introduction

The living towers is conceptionally located in Rennes, France. Designed by Architectural firm SOA Architects. This building was designed as both residential and commercial. It was proposed in year 2005.

The Aim is to serve living spaces and agriculture production in a vertical space. It can grow over 63000 kg of tomatoes, 37,333 feet salads, 9,324 kg of strawberries per year.

It has a Sustainable featurelike wind mill which is located at the top in the direction of wind flow which produces200 to 600 kWh electricity produced per annum. Rain water is collected and stored in the tanks which is filtered and re-used in offices, residence and hydroponic system. Black water produced is recycled and reused in agriculture in the tower. South facing photovoltaic panels of 4500 m^2 are Installed in facade and the roof generate electricityfrom solar energy of 0.7 million to 1 million of Kw/h per year.

Prototype program table:

SPACES		FLOOR	AREA(Sq.m)
Residential	130 apartments	2-15	11045
Offices	-	16-30	8675
Hydroponic Cultivation	-	1-30	7000
Shopping	Shopping center and Hypermarket	-1,0,1	6750
Amenities	Library and Nursery	1	650
Parking	475 parking space	-4, -1, -2	12400

2) Case study – livecase study

Texcellance hydroponic farms. Located in Kandivali, Mumbai. It is a Hydroponic indoor farming.Project started in2019.

TheTechnology used is Hydroponics system. The Total area is 150sqm. And the Productive areais 80 sqm.Its Initial investment for the setup is 40 lacks. Estimated Cost per sq. ft- 560/-(Without LED) and 3500/- (with LED). Setup of 4 AC to maintain 20 to 23-degree Celsius.

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Minerals used is Vertigrow (Combination of Micro-Mcro).Products produced there are 3 types of lettuce which are Oakleaf, Roamine and Lollo green. The process is followed as 3 days for germination 15 days for nursering and 35 days for NET (Nutrient fill tech.). Energy consumption cost is around 35000 per month.

IV. Benefits drawn from the case studies.

Implementation of vertical farming are producing extremely higher quality and quantity per available land. It has year-round production. Transportationcost is reduced as the plants are grown locally and supplied. No soil is used for production. It uses 70 to 80% less water compare totraditional farming method.It also helps reduce rising temperature in urban areas.Is not affected by seasons and any climatic hazards. The yield is 5 to 6 times better than traditional farming. Soil-less cultivation so no use of pesticides, and fertilizer in agriculture which are not good for health. No use of non-renewable energy consumed by the agricultural engines. Creates employment oppocties

V. Feasibility of vertical farming in India

India is known as the largest producer in agriculture sector. Concept of vertical farming is new in India. Many startups have come up over the time period and taking roots all over the country. *Herbivore Farms* in Mumbai Andheri is a project in which the grow over 2500 plants in 1000 sq. ft.*Letcetra Agritech* in Sattari, Goa use only 20% water than the traditional method. Delhi has *Triton foodworks*; Noida has *Natures miracle*; Chennai has Sriram *Gopals Future farms*. Investors are taking huge interest in this concept. ICAR (The Indian Council of Agricultural Research) are working on this concept to implement it multistory buildings in metropolitans like New Delhi, Mumbai, Kolkata, Chennai etc. Reports also show some problems like lack of proper storage, lack of expert's advice on crop management and future planning and also Lack of proper delivery methods.

VI. Conclusion

Agriculture is the main factors which directly link with Economy and Health of India. Considering all the crises in traditional agriculture like lack of produce, overuse of pesticides and fertilizers and also degradation of soil, vertical farming is definitely a solution not only for Indian farmers but also farmers worldwide. It has revolutionized the method of farming which can be beneficial in future for both Agriculture and also Environment.

VII. Acknowledgement

I would like to express m deep sense of gratitude to my Guide Ar. Seemantini Nakil, for her valuable guidance, encouragement, inspiration, and useful critique. In additional I'll also thank my friend Abhilasha Bhavar for her direct and indirect help and assistance during my research.

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Space Impact on Off School Education in Pune

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Abstract:A street child is the child for whom street has become his or her habitual abode and/or source of livelihood; and who is inadequately protected, supervised, or directed by responsible adults". The street children in India choose to leave their families and homes for strategic reasons: urban poverty, aberrant families, and urbanization. Education system in India leads to contributing development of nation through healthy habits , attitude and quality character of a disciplined citizen of the country. Street children education in India constitutes one of the most neglected factor. Deprived of adequate and appropriate protection , education and health care , street children survive in unsafe environment of city streets. The research scope is to identify various causes and conditions of off school education in Pune.

Keywords : Street children, causes , education, deprivation , UNICEF, quality character, right to education , act.

Introduction: The Right to Education Act 2009, also known as the RTE Act 2009, was enacted by the Parliament of India on 4 August 2009. It describes modalities of the importance of free and compulsory education for children aged between 6-14 years in India under Article 21 (A) of the Constitution of India. This act came into effect on 1 April 2010 and made India one of the 135 countries to have made education a fundamental right for every child.

1. The benchmark mandate
2. Special provisions for special cases
3. Quantity and quality of teachers
4. Zero tolerance against discrimination and harassment
5. Ensuring all round development of children
6. Improving learning outcomes to minimise detention
7. Monitoring compliance of RTE norms
8. Right to Education Act is justiciable
9. **Creating inclusive spaces for all.**

The increasing number of street children in Pune , especially around markets or shops in city centre, might have been a concern for many people . These children deserve a decent education to upgrade their knowledge and time to play and gather around with their friends, but due to financial concern, they could not obtain what they are supposed to get. Instead, they are more concerned about . Some street children make a living by working as bearers, parking attendants, street musicians, and even beggars.Beside the above phenomenon, lack of knowledge about a significance of an education in their life is also one of the reasons for the lack of awareness to attain a decent education. One way to resolve this problem is to approach them personally.

Objectives to study :

1) To enumerate the number of children in street situations in Pune city in a reliable manner.

2) To understand the socio economic profile in terms of age, gender, education , occupation.

3) To recommend interventions strategies, policy and program initiatives required for the rehabilitation, care, and reintegration of children in street situations.

Literature review:

Education system in India leads to contributing development of nation through health habits attitude and quality character of a disciplined citizen of the country. The deprived groups of street children education is somehow lagging behind due to which the vulnerability and decreasing the progress rate due to moral values is been losing its essence. Street children education in India constitute one of the most neglected thing. Deprived of adequate and appropriate protection, education and health-care, street children survive in the unsafe environment of city streets. The research scope is to identify various causes and conditions of street education in Pune.

Issues Identification: For economic reasons, children are forced to choose between domestic violence at home and public violence on the street. Children move to and fro between these two worlds.

These children are so mobile and not permanently in the same place: they may also spend time in juvenile homes or in institutions, they may go back to their families for a short time, they may take part in project activities, or they may move from one town to another or be forced to move.

Current scenario in Pune: This presents the findings of the census undertaken in Pune City. The provides estimates of the number of children enumerated in street situations in the city and also provides broad profile based on the information collected by the way of census enumeration. It gives details of information such as, categories of the street children, sex and age distribution, marital status and

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religion/caste, place of origin and mother tongue of the children in street situations.

Challenges and Limitations: Street children have a very high mobility. It was often difficult to keep atrack of their movements to collect the information**.** In some sample locations street children were not found because of this mobile nature of their living and working conditions. In such situations the team moved to other neighboring locations to interview the remaining sample units. Majority streetchildren worked either during the daytime or in the evenings. Due to this, the field surveyors had to revisit every ward at least two to three times to interview the children at their convenient time. On top of that, the survey team had to cover long distances walking within the larger wards to administrate the survey. Similarly, certain areas in the maps did not match with the sample locations selected and hence the survey team had to struggle to reach those places to administrate the survey. These are the factors influential to take a longer time to complete the process

Material and Methodology :

The survey methodology consisted of three stages.

1. Census enumeration according to the area selected.

2. Detailed survey

3. Focus Group Discussion (FGD)

In the first stage, a census enumeration was conducted using a census questionnaire, during which each street child was identified as per UNICEF definition. In addition to enumeration, some basic information and demographic characteristics of the street children was also obtained.

In the second stage, using the census as a listing exercise, a detailed socio economic profiling of a sample of street children who were enumerated in the census was conducted using a detailed questionnaire consisting of closed and open ended questions The detailed questionnaire captured the details of socio economic condition, stay, place of origin and reasons for migration, schooling, water and sanitation, food, illness and disability, earning and spending, abuse and assistance of the children. The questionnaire was administered using one-on one interviews in Marathi or Hindi to the selected street children.

In the third stage, based on the census findings, specific vulnerability mapping was done through FGDs capturing occupational characters and types of migrations of the sample surveyed.

Case Study Analysis: The public areas of Pune like Railway Stations and bus stands were been selected for the case study purpose along with user consideration.

Area 1: Pune railway station:

Fig: 1 Google Location for Pune Junction

Pune Railway station is the main railway station of Pune .This station has three footbridges with a skywalk. Elevator service is available on footbridge.

Accordingly the selected areas are been selected where street children vendor and roam around. A questionnaire was been asked to these children related to his/her name , gender, age, about schooling activity if any, can he / she read or write , family background and reasons and causes for ending up on streets . One of the main reason which came into conclusion is the utility of the spaces. How learning spaces are created and utilised in each of the area. In case of Pune railway station, **few spaces can be utilised as a learning environment** for these street children which can enhance the space quality in and around the area of Pune railway station, also can improve the life quality of these children .

Area 2 : Swargate Bus Stand :

FIG 2: Main porch of Pune junction

Fig 3: swargate location with connecting spaces around

Table 1: Percentage distribution of street children by type of child, classified by sex of child

Swargate is the main bus stand of Pune city. It is one of the busiest place in Pune . The reason selecting this as the case study is Street-centered intervention, refering to the act of personally approaching the street children who was centered in the "street" where they usually work.

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The increasing number of street children in Pune is a social phenomenon that needs serious attention from various parties. Same questionnaire was bee n asked to the working or non working street children . In this case study of swaragte, **the void spaces under the flyover**, many street children are been venturing . Hence there's a scope if we can make these void spaces as an learning environment for these children.

Category of street children	Boys	Girls	Total (Percent)	Total (N)
Street Living Children (Alone)	5%	1%	3%	313
Street Working Children	18%	10%	15%	1564
Children of Street Family	77%	89%	82%	8550
Total (Percent)	100%	100%	100%	...
Total (N)	6053	4347		10427

Table 2: Percentage distribution of street children by sex and age

Category of street children	Boys	Girls	Total (Percent)	Total (N)
Street Living Children (Alone)	5%	1%	3%	313
Street Working Children	18%	10%	15%	1564
Children of Street Family	77%	89%	82%	8550
Total (Percent)	100%	100%	100%	...
Total (N)	6053	4347		10427

Results and tables :

The increasing number of street children in Pune is a social phenomenon that needs serious attention from various parties. This attention is not solely driven by the large number of street children, but also because of the situation in which the right of the poor street children is often violated. Given that "street children" refers to those aged less than 16 years old who spend most of their time on the street by doing particular activities to earn money in order to survive. Based on the general characteristics, it is known that poverty is the main cause of their presence in the street. They come from low level education background and undergo financial problems. Therefore, they prefer to be street children and work to meet their day-to-day needs.Based on the interview result, the street children need affection and are willing to have a decent education parents. Street children hardly receive these kinds of things. They grow up in difficult circumstances and living conditions.

According to the interview result, there are some factors influencing street children to work, including both internal and external ones. Some internal factors are; a) they had low interest in studying at school. They thought that school is such a waste because school did not provide any benefit for them compared to working on the street as the latter allows them to get money to pursue what they want; b) they got neither appreciation nor encouragement from school that they were able to attend other examination to just pass; and c) They have some future ideas such as becoming a doctor, teacher, and civil servant, but they did not get enough support and knowledge for those ideas. Some external factors include (a) socio-economic conditions. Most parents work as construction workers, security guards, motorcycle taxi drivers, cleaning service and some who did not have regular job with low incomes. The figure below indicates the parents' perception then do something negative like smoking or other negative acts. In addition, (c) some parents thought that education is less important because attending school is such a waste of money and energy, and that education is only for those who can afford it. The government seemed not to give a hand to the poor family. Children cannot help their family if they choose to attend the school, and they have low parents' education level. Apart from the factors above, street children who got off working on the streets are willing to go to school to make their ideas come true.

Conclusion and Recommendations :

Based on the above discussion, it can be concluded that:

1. The education problem is still regarded as the responsibility of the government and schools.

2. Cultural factors and lack of parents' attention to the importance of education cause street children to help their parents work for a living, leading them to dropout. **If some areas in public spaces can be utilised as the teaching and learning space for these street children which can empower the children to survive on its own and can also enhance these public spaces with the help government by providing scholarships.**

3. Some street children still want to attend school to get a decent education.

Acknowledgement :

This research was supported and guided by our faculty guides Ar. Shilpa Ingawale, Dr. Rajendra Koli, and Ar. Shailaja Bhagwat.

Also a NGO named Robin Hood Army Pune who works for these street children has been an important source for data collection.

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Landscape As a Part of Sustainable Streetscape

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Abstract - Sustainable streetscape ensures that spaces are long lasting and function as a part of the greater ecosystem implementing technologies that reduce carbon footprint. Sustainable streetscape plays an important role in development of urban areas. The streetscape inurban areas which are built for the public interaction, physical activities, traffic control etc. In this context, the research aims to create sustainable streets with the use of landscape elements to provide an attractive and healthy environment. In Pune, many streets in core of the city are very crowded and have heavy traffic flow, so with the help of landscape, making street more user friendly and sustainable is necessary. The research consists of the study of different streets with different character and the study of landscape elements useful for making streets more sustainable. The research concludes the importance of developing urban environment in Pune by creating sustainable streetscape through landscaping.

Keywords - sustainable – streetscape –landscape - ecosystem- urban development – user friendly.

Introduction - Nowadays, urban development is increasing rapidly. It majorly affect to climaticchanges. Streetscape is an important part of urban development. And by making streets more sustainable with the help of trees, shading devices, planters, water features .etc.one can help reduce pollution and carbon footprint. The research paper focuses on how does landscaping help in making streets more sustainable. As an answer to this question, the case studies have been selected from Pune. Case study includes J.M road and D.P road as sustainable streets.

Sustainability means use of natural or recycled materials, application of energy efficient methods in our design that is beneficial for public and also for future generations to live with healthy environment. Sustainable streetscape means the spaces we are designing are sustained or long lasting, user friendly, functional for all age groups andhelps to reduce carbon footprint.Sustainable streetscapes are beneficial to create better places and environment for present and future development.

Research Objectives –

- To study the advantages and principles of sustainable streetscape.
- To study the different landscape elements and their effects on climate tomake street more sustainable.
- Toidentify design principles for landscaping to make street sustainable.
- Formulate design recommendations for developing street landscaping of one street in Pune.

Research Methodology –

The research based on the study of sustainable streetscape and providing conceptual design for one street in Pune. The details of methodology of this paper given below:-

- Primary data - Collection of all the theoretical data required for the study of landscape elements used in sustainable streetscape.
- Secondary data – Collection of data through live case study and interviews and then list down the observations of case study. Case study of four streets includingtwo streets with landscaping and two streets without landscaping.
- Analysis of collected data –Analysing the data to understand the climatic conditions and design elements used in street design. Which will help to develop the landscaping of street in Pune.
- Design recommendationfor making street sustainable through landscaping.
- Conclusion.

Advantages of sustainable streetscape:

- Sustainable streetscape creates healthy environment for user.
- It helps to create interactive public and gathering spaces.
- It creates a visual image of particular area.
- It helps to reduce heat effect, glare and improve air quality.
- It helps to reduce air and sound pollution.
- Improves stromwaterrunoff by increasing permeable/ porous surfaceand landscaping.

Principles of sustainable streetscape :

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- Liveliness and attractiveness.
- Healthy environment.
- Sustainable materials/ energy efficient materials.
- Reduce heat effect.
- Improves air quality.
- Reduces glare and sound pollution.

Landscape elements and their effect on climate :

- **Trees** – 1.Trees can be used to address the pedestrian and vehicle movement. Trees provide shade and screening. Trees can also be used to modify the microclimate of area and helps to reduce heating.

2. The vertical angle of the sun changes seasonally and hence does the area of building subject to the glare of reflected sunlight. Plants of various heights can screen sun glare from adjacent surfaces. [fig.1]

3. Large masses of plants physically and chemically filter and deodorize the air and reduce air pollution.

4. Evergreen trees are beneficial in both summer and winter. Trees obstruct and filter the radiation from sun, cooling and protecting the surrounding.

5. A combination of deciduous and evergreen trees and shrubs reduces sound more effectively.[fig.2]

- **Landscape strips**– This strip is an effective option between sidewalks and streets to create a buffer from vehicular movement and provides comfortable walking along the street.

- **Rain garden**- It is a bed which is designed to treat stromwater. As water falls onto bed and enters garden it is passed through a filter media which is planted with vegetation. This treated stromwater is then goes into drainage system.

- **Sustainable materials** – Using sustainable materials reduce energy use and conserves natural resources. Sustainable materials are made from natural and renewable resources. Paving material should be porous, durable and locally available.

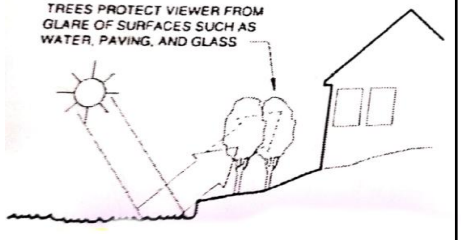

Fig.1 – Glare protection.

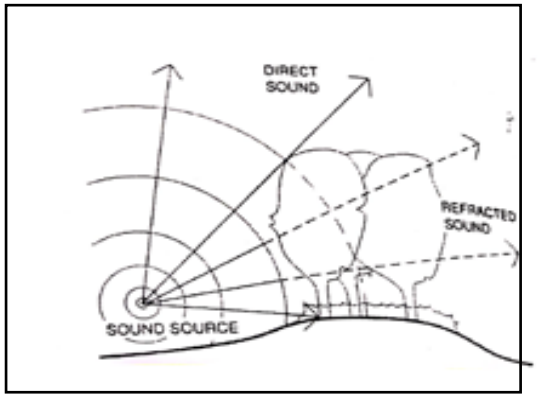

Fig.2 – Sound reduction

Design principles for planting

Scale and Proportion– Tall buildings require large scale trees to provide the necessary relative proportion of mass. With the proper selection of trees, the visual mass of the plants can conjoin with the building mass into harmony and proportion.

Human scale– Trees can function to provide comfortable feeling of human scale. The sequence can be established, starting with shrubs near building entrance, next ornamental trees followed by large shade trees, as a person proportion outward.

Balance – The design components of both the landscape and architecture work together to achieve an equality in design. Large trees will effectuate the necessary visual to coexist with the building's mass.

Mass Planting– Plant groupings in sweeps or masses rather than individual species works more effectively. Placement of trees in groups should respect the importance of safety and signage.

Case studies of streets with landscape and without landscape

Two cases were selected for the comparative analysis between the streets in same climatic condition to prove the sustainability.

The selected case studies were –

1. J.M road, Pune.
2. M.G road, Pune.
3. D.P road, Pune.
4. Vimannagar road, Pune.

Fig.3 – Graph showing Temperature difference on streets caused by landscape.

A research through an interview was carried out where

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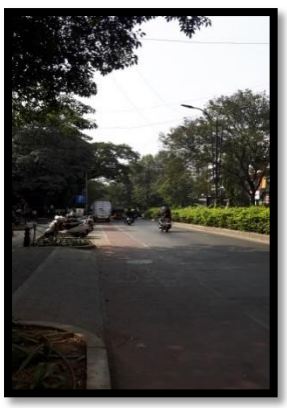
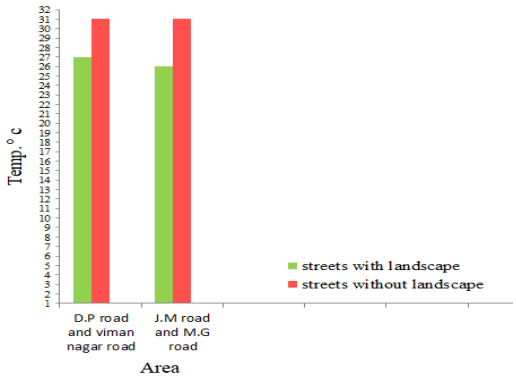


people were asked to give their opinions on the basis of climatic conditions and how they feel about that street. Along with the interviews, observations were made on the basis of materials, plantation, street furniture, light, spaces etc.

Observations of J.M road are compared with M.G road because the density and use of both the street is same, only difference being M.G road does not have proper landscaping. Similarly, D.P road and Vimannagar road have same density and use but Vimannagar road is without landscape.The factors selected for interview questions states the sustainability of street. These factors are as follows -

1. Glare.
2. Shading .
3. Air quality due to landscape.



4. Comfort caused by landscape .
5. Temperature difference.

Glare - Because of planting shrubs on dividers it helps to reduce glare of surfaces such as glass, paving. And also trees along the road reduce direct sunlight coming on street and this is more comfortable in summer while walking on street.

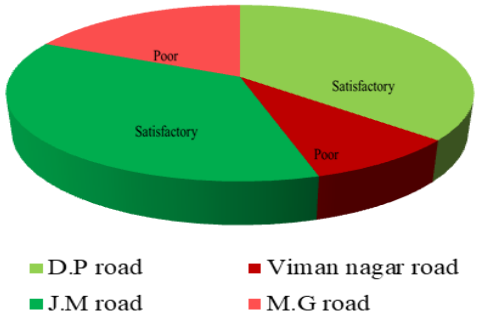


Fig. 4 – Pie chart showing the reactions of people for air quality.

Image 1 and Image 2 shows the street landscape of D.P road and J.M road.

Image 3 and Image 4 shows the very less amount of landscape on Viman nagar road and M.G road.

Table 1 – Comparison of streets based on density, widths, vegetation and climatic effect

Location	DP road , Aundh	JM road , shivajinagar	MG road , camp ,pune	Viman nagar road,pune
Zone	Commercial + residential	commercial	Commercial	Commercial + residential
Traffic flow	Less	More	Heavy	Heavy
Street width	18m	24m	18m	24m
Vegetation	Dense Trees were large enough to provide shade for parking and pedestrians. And helps to reduce glare.	Very Dense Trees were large enough to provide shade for parking and pedestrians. Dense. And helps to reduce glare.	Less	Very less
Effect on climatic condition	Reduces glare and heat. Improves air quality.	Reduces glare and heat. Improves air quality.	There is no landscaping which increases heating and does not help to increase air quality.	There is no landscaping which increases heating and does not help to increase air quality. Negative effect on traffic movement.

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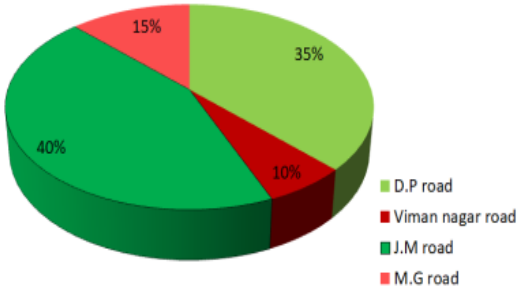

Table 2 – Comparison of streets based on general observations.

Analysis of case studies

From the case studies and interviews the research conclude that the street landscaping is important to reduce heat effect. Streets with landscaping are more user-friendly than streets without landscaping. Due to vegetation along the street it helps to improve air quality and a user walking on street feels fresh and comfortable. Shrubs are planted for street division and it also helps to reduce glare. The street landscaping and spaces like sitting areas, play areas created on the street attracts people to visit again. The streets without landscaping majorly affects climatic conditions like increased heat, pollution.

Recommendations –

1. Selection of street –

From the case studies, it states that the Vimannagar road and M.G road are comparatively less sustainable than J.M road and D.P road in terms of landscape. Therefore for street landscape recommendation Vimannagar road has been selected. The street islocated near Pune Airport. The urban development is rapidly increasing in this area and this area has been formed as a youth hub as various institutions and IT parks are located nearby.

The traffic movement on this street is more and the division for traffic is improper. The widths for pedestrian movement is sufficient i.e 1.5m. There is no vegetation and greenscape on the street this results in increased pollution, glare ,resulting in unpleasant atmosphere. Users do not feel comfortable while walking on the street because of less greenscape on the street. Therefore providing street landscape is necessary in order to provide shade for pedestrians and to ease traffic movement, thus helping reduce carbon footprint. Adequate street landscape would attract people to use the street efficiently and effectively. This street landscape would not only serve the aesthetic purpose but also impact the mind-sets of the users.

Fig. 7 - location map of Vimannagar road.

2. Design Recommendations –

The recommendations are based on the primary data and data collected from case studies in terms of sustainable streetscape. The design aims to make the Vimannagar road sustainable with a landscape.

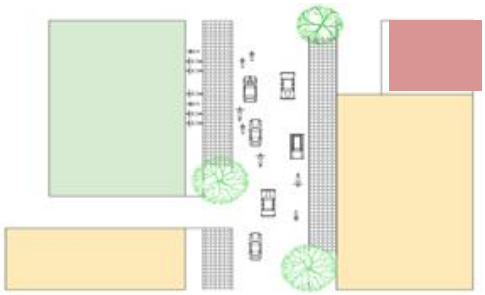

Fig. 8 – Existing plan of Vimannagar street.

Fig.9 – Image shows the landscaping on Vimannagar street.

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Fig.10– Image shows the live depiction of Vimannagar street at 12pm.

Fig. 11 - Image shows the live depiction of Viman Nagar Street at 3pm.

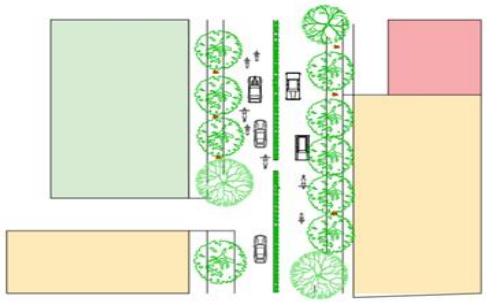

Fig. 12 – Proposal plan of vimannagar street

Conclusion

Sustainable streets are essential in urban context. So to form a sustainable streetscape, principles of sustainable streetscape with respect to landscape should be taken into account. Therefore providing necessary landscaping improves sustainability of street.As shown in the applied study research concludes the recommendations for making street more sustainable with the use of landscape.

Acknowledgement

I would like to thank Ar. Seema Paulzagade who guided for completing the research paper and to achieve the research aim.

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Factors Affecting the Architecture of Hindu Temples in India

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Abstract : Hindu temples are seen as a portrayal of social structure of relevant times in history.They are not only considered as abode of God and places of worships but are alsocentre of knowledge, art and culture.This paper presents the study of several factors which influence the architecture of Hindu temples in India.The data will further be analysed and compared between two styles of Indian temple architecture namely Nagara style and Dravidian style. The objective of this paper is to study the importance of above factors in temple architecture during their evolutionary process. This study will helpful to give detail description and analytical comparison based on principles which will govern the architecture of Hindu temples.

Keywords : Hindu temples,worship, temple architecture, Nagara style, Dravidian style.

Introduction

From ancient times to today's modern era architecture has been playing considerable role in shaping the society. The term temple signifies a place or structure devoted to perform practices of various rituals followed by society also having a role as one of the most sacred buildings. Hindu temples are seen as a portrayal of social structure of relevant time. Hindu temple architecture has played an important role in ancient Indian architecture. Temples were the sign of dominance religion and the culture of the dynasty who ruled their respective time. The organizational structure of Hindu temple is an important part of their design. The philosophy, beliefs, sacred geometry and religious concerns of the people also affected the planning process of temples

The architecture is also influenced by the various stages of temple construction and techniques that have been adopted in temple construction since ancient times. At the ancient times philosophical and geometric aspects govern the planning of a Hindu temple. The role of light and shade is also the most critical factor which affects the temple architecture.

This paper proposes to study how the spatial configuration, organizational principles, philosophy, light and shade, material and construction techniques influenced the architecture of Hindu temples and how they were implemented at that period.The study is mainly focusing the planning rather than form and elevation of the temple.
Early temples were developed from monolithic rock and later on in about 8th century the Dravidian style of temple architecture was emerged and later on the Nagara style. The Nagara style of temple architecture belongs to temples situated in the northern part of the India whereas the Dravidian style belongs to temples situated in the southern part of India. The study is focuses on only Nagara and Dravidian styles of temple architecture.

Objectives

The objective of this research paper is to find out why is that even after centuries Hindu temples in India have retained their energy.To study the factors which have rendered them ageless and also their importance during the evolutionary process of temples. To find out can these factors can interpret in contemporary times.

Methodology

The methodology will include to find out the factors affecting the temple architecture in India. The influential factors have been analysed and compared between Dravidian style and Nagara style of Indian temple architecture. The required data is collected through secondary sources.

Literature Review

Casestudy 1-The Sun Temple at Modhera, Gujrat.

The temple complex built in 1026-27 during the region of Bhima I of the Solanki dynasty and it is dedicated to Lord Surya. The temple is the best example of Nagara style of temple architecture.

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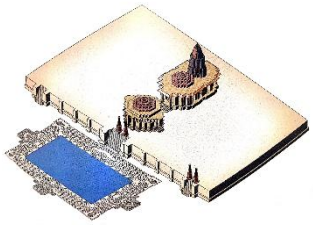
Influential factors

1)Spatial configuration

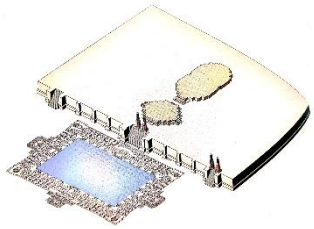
The temple complex comprises of following parts,

A) Kund (ritual water tank) B)Torana (entrance arch)

C) Sabhamandapa(pavilion) D) Goodhamandapa (prayer hall)
E) Garbhagriha (sanctum)



Kund-The kund the large rectangular water tank forms the first part of spatialsequence punctuated by sub shrines of 60 minor deities.



Torana-It is with the trabeated assembly of multifaced sculpted columns, ornate cross beams and flying arches.

Mandapa-The mandapa being perfectly symmetrical on both axes and itself sits on a small plinth. A small open to sky distance separate it from the entrance porch of the temple which creates detachment of two structures not far enough to fell scattered.

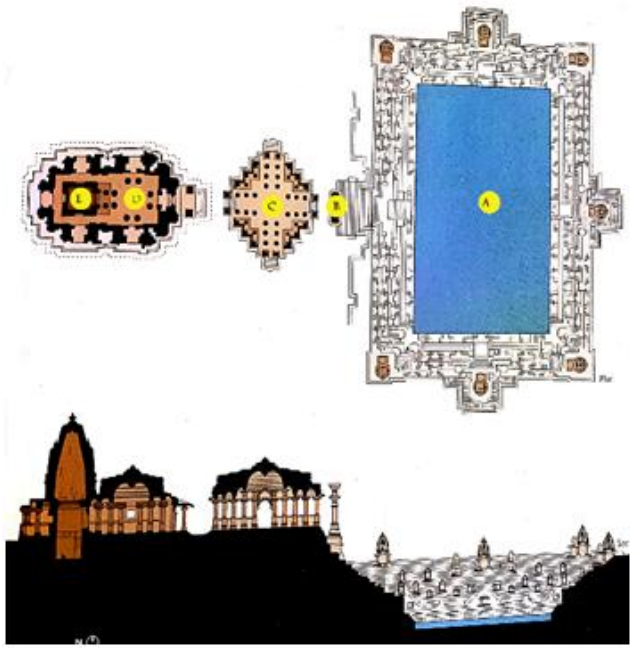


Fig 1-plan and section showing spatial configuration

The Temple-Within the main temple building there a two spaces goodhmandapa and garbhagriha both part of the same mass externally but separated internally by a construction of wall planes

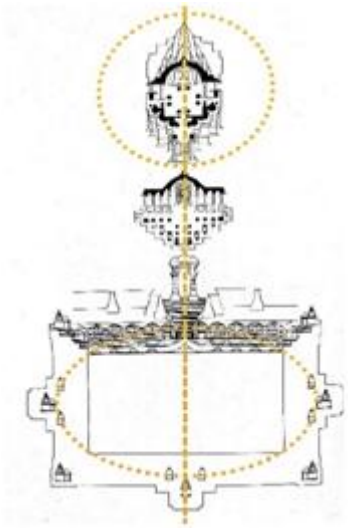


Fig 2-Formations of spatial configuration in roof plane and ground plane

2)Geometry and organizational principles-The temple complex is perceived as a consolidate composition along a single axis. The circulation route which determines the movement through the space guides the experience of the surrounding.The arrival to the complex is along the axis of its orientation, which offers in the visual frame from the distance only the outline of shikhara of the temple, the flat façade of the mandapa and the temple base.

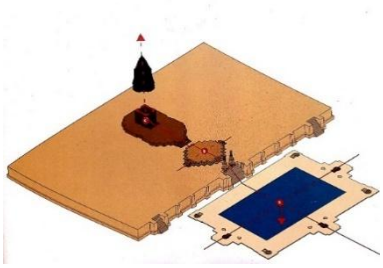


Fig 3-juxtaposing the visual axis with the movement path by miniature study

Each part within the entire complex though seen as acomprehensive composition and as a single integral unit but it is effectively grouping together as anindividual whole. The kund as a purification and domestic centre, the mandapa as a sacred gathering space and temple as an abode of god are themselves,complete architectural entities. They are connected together by visual juxtaposition and adjancy as well as the organizational axis.

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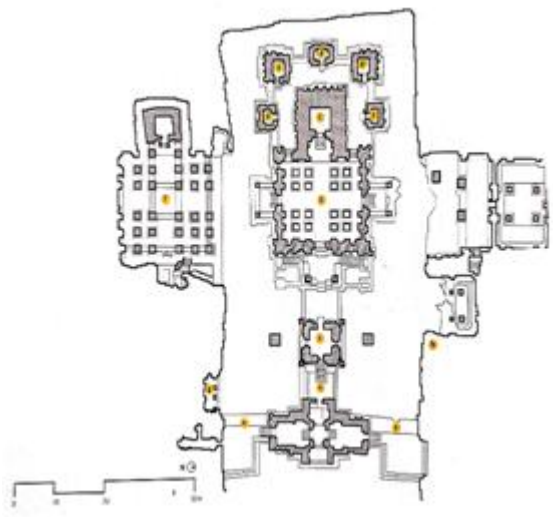

Fig 4-Various individual formations within the same complex

3)Philosophy - The kund becomes an altar to water while the temple is a shrine to the sun an embodiment of fire. This is the personification of Vedic myth that the sun arises from the dark inert of an ancient ocean as well as the concept of duality and contradictory co-existence. The pitha depicts the difference between the sacred domain of the temple and the profane world of human purification. The main route into the temple, as implied by the organization, is down into the kund and after purification, climbing un ascending towards the heaven through the torana, symbolizing the ritual purification of the person before entering the abode.

Fig 5- flight of steps through torana leading towards pitha

Fig 6-view of sabhamandapa from kund.

4)Light and shade - The goodhamandapa (prayer hall) lit by two windows on either side also. The garbhagriha (sanctum) is dark and unlit leaving perception to the imagination. Windows lighting the small passage between the sanctum. The cella is dark and the final point in the movement sequence placed axially to receive the first rays of the rising sun from the east.

Fig7-detached goodhmandapa marks the next transition through light falling on entry porch.

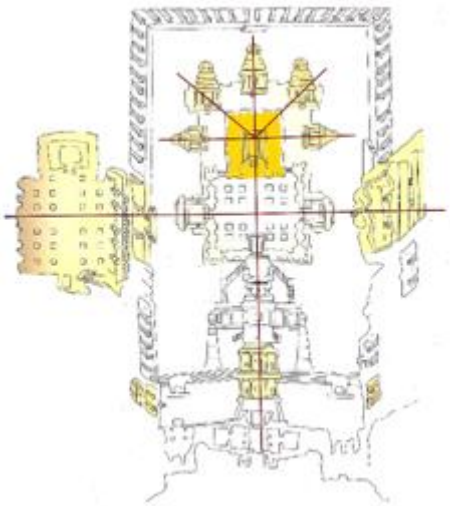

Fig 8-plan showing spatial configuration of the temple complex

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The variations of enclosures arefulfilled by the transition in light intensity, from the totally sunlit and bright kund tothe moderately lit hall leading up to the subtly lit interior hall and absolutely dark sanctum.

5)Materials and Construction techniques - The whole complex is built out of a coarse grained, buff sandstone, in some places changing to red brown. The stone blocks were set layer upon layer according to the dry masonry method that is they were not joined by mortar. Stability was achieved through a careful balancing of weights. The pitha (plinth) is filled by bricks and facing with sandstone. The organization of stone into composition gives shape to the pattern of art.

Case study 2-Kailash Temple, Ellora

The Kailash Temple at Ellora is magnificent example of Dravidian style of architecture consisting of both free standing and hollowed out forms carved out of the living rock of an entire hill side. The temple is dedicated to Lord Shiva and built between A.D. 757 and 773.

Influential factors

1)Spatial Configuration - The temple complex comprises of,

A) Nandi Mandapa B)Maha mandapa C) Garbhagriha

D)Sub shrines E) Bridge F)Lankeshwara cave

G)Shrine of river Goddess H)Yagnashala

Nandi Mandapa-It is the free-standingmass, housing the statue of sacred bull, the deity's vehicle.

Yagnashala-Space for rituals and shrine of the river Goddess.

The temple- The main temple comprises of mahamandapa which is covered by shallow dome and projected balconies and axially placed garbhagriha.

Sub shrines-They are housing varied forms of maindeity each capped with a small shikhara and kept on a smaller plinth.

Comparative Analysis Table

2)Geometry and organizational principles–

The Kailash Temple is organized around the geometry of centre and sub centres.This notation is physically translated through the circulation path where each sub centres become a pause points which helps to orient oneself in the temple complex.Visual frames further guide the circulation. One frame leads on to the other in a smooth transition but with emphasized expression at sub centres. The organization consists of various centres. The entrance portal is the distinct space in itself which acts as a primary transition from outside to inside. The connecting bridge to the plinth acts as veranda or open courtyard to the upper level.The main temple and Nandi shrine being at a higher level take the visitors above the ground plane.The formation of the spaces at the upper level create notes which demarcate and distinguish the main from the sub spaces.

3)Philosophy-Therising plinth detaches the person from the earthly formation and expresses the ascent to the sacred. The Nandi shrine placed up to the temple level to express the transition to the heavens.

4)Light and shade The use of light and shade is another significant aspect in this temple which is used as aperspective tool in the understanding of forms.The freestanding elements awash with light with every detail seen clearly and starkly. The open to sky spaces in between allows light to assists the appreciation of form and proportion.The transparent clarity and brightness of the open peripheral areas transforms gradually into dimmer introverted indoor spaces culminating in the mysterious dark space of sanctum.

5) Material and construction Techniques – The whole structure is cut and cut from one enormous bit of rock. The sanctuary is chopped down fit as a fiddle around 50 meters somewhere down in the back and sliding towards the lower level in favour of passage entryway. Three channels were made at right edges and chop down at right edges to the degree of the base of the slope. Initial a mass of rock 200 feet in length, 100 feet wide, 100 feet in tallness was secluded. At that point the mass was pounded into shape. The construction took 200 years and 10 ages to finish the development work of the sanctuary complex.

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Influential factors	**Case study 1 Nagara style - Sun Temple.Modhera**	**Case study 2 Dravidian style- Kailash Temple, Ellora**
Spatial Configuration	Evolution of main building of temple.	Evolution of temple complex.
Geometry and organizational principles	Organization of spaces based on vertical axis on ground plane.	Organization of spaces based on vertical and horizontal axes in ground plane.
Philosophy	Based on Vedic myths.	Based on Vedic myths.
Light and shade	Partially lit sabhamandapa by using colonnade. The garbhagriha is kept dark as it was related to earth's womb.	Partially lit mandapa by using projected balconies at the upper level. The garbhagriha is kept dark as it was related to earth's womb.
Materials and construction techniques	Sandstone (as it was considered as a sacred) and brick filling used for the plinth Dry masonry construction technique.	The massive basalt rock (as it was considered as a sacred) carved out from top to bottom.

Conclusion

The most prominent factor in temple design is philosophy behind it, followed by geometry and organisational principles which influences the Indian Hindu temple architecture. The light and shade as well as use of construction materials could be seen as secondary factor. The temple of nagara and Dravidian styles are based on a single philosophy and geometry. The special configuration varies by the intended use of structure and ideology of the organisational body.

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Architectural Expressions of Different Cultures on Maratha Temple Architecture During Peshwa Period

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Abstract : Maharashtra has been an important centre for the temple architecture activity since the days of early Buddhists rock-cut architecture in Ajanta- Ellora till the well flourished temple architecture till the 19th century. A productive phase of temple began in the 11th century under the Yadavas .This tradition of building temples in basalt flourished until the 13 th century when Muslims invaded from the North India(Sohoni, The Temple architecture of the marathas of Maharashtra, 1998). Many elements from the architectural styles can be seen on the temples during the Maratha period i.e. during the Peshwas from 18th century to the 19th century. A detail analysis based on visual surveys will be obtained in the further study , with the help of live case studies , to study Maratha Architecture and temples during Peshwa period and what were the various styles in India which were mixed with the Maratha temples during the Peshwa period. The paper aims to study the architectural expressions of different cultures on Maratha temple architecture during the Peshwa period .

Key words – Temple traditions, Temple architecture , Maratha temples , Marathas, Peshwas , cultures , etc.

Introduction :

The temple traditional architecture of Maharashtra has a vast history from rock cut architecture in 2nd century BC to late 19th century i.e. Maratha/Peshwa era , in which we can see many changes in architectural styles over the period of time i.e not in the planning of the typical temples but the aesthetical elements added in exteriors and interiors of the temples , different invasions by the rulers of other countries or architectural styles getting influenced by other styles of different states of India. These changes were done were for enhancing the typical temple architecture of Maharashtra since 2nd century , but most of the temples from that period till Maratha period doesn't exists or not well conserved , the temples from Maratha era or Peshwai period can be seen in Maharashtra in large no. . However, in Maharashtra, after initial persistence of Yadava patronage in the 14th century, Islamic rule in the Deccan was challenged by the rising powers of the Marathas. The Marathas ruled over most of Maharashtra from the mid 17th to the early 19th centuries. While focusing on the understanding of the architecture of Maharashtrian temples, the study investigates the impact of the two preceding traditions of architecture in Maharashtra. Maratha temples in Maharashtra are the product of a tradition in which certain forms underwent transformation while some new forms were created, stemming from the earlier traditions in the region. This study is the first to treat Maratha monuments as a part of a tradition(Sohoni, The Temple architecture of the marathas of Maharashtra, 1998).Along with the Islamic elements , Rajput and South Indian Temple Architectural elements can also be seen in the Maratha. The aims of this study are to record the formal characteristics of the temples at the various stages of development, in order to understand the evolution of the temple architecture. This study is to show how other styles of different cultures are mixed up in the indigenous Maratha temples of Maharashtra in Peshwai region.

- **The rise of temple architecture during Maratha period-**

Shivaji Maharaj , who was the founder of Maratha empire himself was deeply religious person. So it is quite likely that he built many temples in Mahrasthra .During the reigns of the Peshwas there was a gradual revival of building temples. The most famous temples builders of this period was the Guru of ShahuRaje and the Peshwas ,Brahmendra Swami and many other temple builders such as third Peshwa Nanashaib , during his reign it gave rise to the temple building activity . The next seventyfive years i.e. 1740-1815 witnessed the construction of large number of temples in Mahrashtra. The Shindes and the Holkars including Ahilyabai Holkar were one the greatest temple builders of the period . Along these people many rulers or important people such as V.M. Gadre ,G.Y.Chandachud , The Puranadares of Saswad, The Patwardhans of Sangli , Nana Phadanviw of Wai buiklt many temples around their towns. These greatest temple builders built temples at places of

their region and choices. The list goes on endlessly Here it would be enoughto consider as the temple building activity raised during the Peshwa period. (Mate, 1959, pp. 72-112).Naturally question appears that what was the style of these temples ? Were the materials and construction techniques used to built these temples same or vary from earlier temples ? What were the reasons for amalgamating the different styles with the Maratha temples ?

The research focuses on the few best examples of the temples around Pune having cultural influences and their architectural styles on the Maratha temples . The temples which reflects prominently Maratha elements as well as Islamic, Rajput and Dravida architectural elements. The study prominently focuses on the architectural elements of a style , but use of these elements can differ the materials and construction techniques for the same.

Methodology :

The study is based on qualitative research and case study based in which the live case studies are done as a primary data having observations , notes , sketches and drawings of the temples are done . Photographs explaining the compositional features of the monuments and the various architectural elements to be made in order to explain the anatomy of the selected temples . With the help of this analytical drawings and photographs analysis to be done. Book case studies to be done for comparison of different styles of the temples.

Following are the literature review on the literature -

The temple tradition in Maharashtra was same , but the architectural elements on the external facades of the temples changed or were mixed according to the rulers or cultures influenced.here are the research papers on the similar topic –

1. The temple architecture of the Marathas of Maharashtra, by Ashutosh Sohoni, 1998 , the thesis states the overall temple architecture of marathas of Maharashtra since Yadava dynasty (9^{th}-13^{th} century), in which he says the Maratha architecture was an addition to the yadava temple architecture , which was discontinuous after the Yadavas but started developing since Shivaji Maharaj in 17^{th} century who was the father of Maratha kingdom wich was flourishesd in many states until late nineteenth century, the architecture was military architecture the indigenous one ,but was enhanced later on because of safety or enhancement purpose was the revivalism in the Maratha architecture. He classifies the temple tradtion in two ways such as indigenous – the original style and the rivavilist architecture that the modifications done according to many other reasons, which was the high peak point of the Maratha Architecture.

2. Post Mughal Maratha architecture , by Sarvesh Kulkarni, the research paper states the changes done in the indigenous Maratha architecture after or during the Mughal invasions for safety of the temples or enhancing the temples . In this he says , any changes in structural planning was not done but architectural ornamental changes were done externally for the same purpose . The author has focused on the evolution of Maratha Architecture during and post Mughal era in Maharashtra. He studied the architectural changes in the structures such as forts , temples and typical housing named as wadas after Mughal era. The questions such as when did the Maratha period start and how their architecture start developing and what changes were done according to other rulers in the architecture lead to the research of this topic

3. MaratheshahiVastushilpa chapter 01 , by M.S.Mate , 1959, The author studies about the typical or Maratha architecture in Maharashtra.the study is done detail to understand the elements and building typology of the Marathas and their and different types of structures like forts, temples and typical houses named as *wadas.* The study focuses on the building style , materials and techniques used in this architecture.

4. Ganesh temple at Tasgaon- Apothesis of Maratha architecture , by Ashutosh Sohoni, 22 March 2011 , The article showcases the detail study of Ganesh Temple at Tasgaon, Sangli, Maharshtra . the research was done to study the building style of the temple which was the amalgamation of Maratha temple and south Indian temple architrecture and how was the planning was affected because of this and what their planning system. To study in which era the temple was built. The temple tradition and its architecture which was at development in Maharashtra during the

Peshwa rule , also evolved by mixing the different styles for enhancing and modifying the temple architecture of Maharashtra , he says.

From the above study we can see that the topic needs more exploration and needs to be put light on it , hence this topic is selected for the research.

Case Studies :

Live Case studies are done in and Around Pune in which features of different cultures can be seen in the Maratha temples –

- **VitthalwadiVitthalmandir , Pune-**

The temple is located on the banks of riverMula-Mutha in Pune. The date of the temple is quite unknown but the

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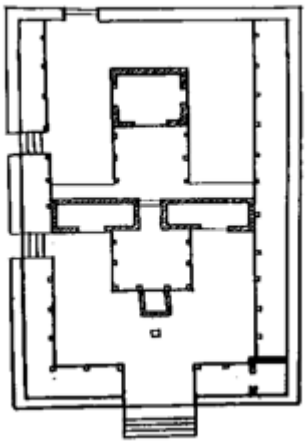
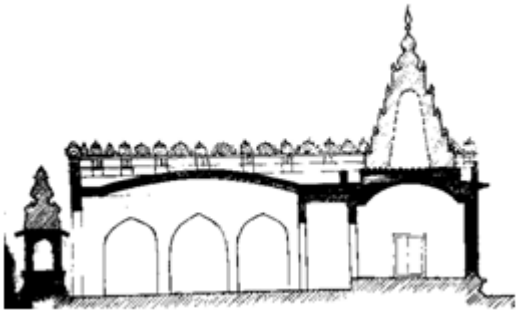
history saysthat the temple belongs to the one of the two temples built byShivaji Mahraj , temple has typical Maratha elements and was renovated in late peshwa period , the temple is dedicated to lord Vitthala and Rukhmini. The shrine is designed in square shape and faces east . The mandapa in front of the shrine is square and made of stone . The pillars in this mandapa are of the Yadava style.the pillars around the aisles around the shrines have same pillars having a flat ceiling. Mirror work similar to the Rajput style mirror can be seen in this mandapa. A small door in the front of this mandapa opens in another mandapa completely made of stone which has arches and vaults.

Typical Maratha shikhara on the top of Garbhabriha and gopuram on the entrance in east can be seen and *kelfulmahirapri*arches in the mandapa . Whereas the Dravidian style elements on the parapets of the terrace and boundary wall of the temple is seen.Types and styles reflected in the temple – Yadavapillars , Maratha structure and arches , Rajput mirror work , Dravidian style motifs





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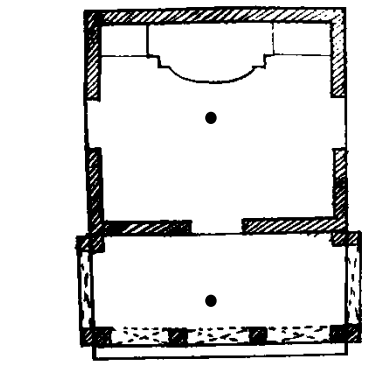
Khandoba Mandir ,Jejuri -

The temple is located in Tehsil Purandar , Pune . the temple is dedicated to Lord Khandoba and built in 1742-1770 by Khandoji and TukdojiHolkars. It is also said that the Bhonsales of Thanajvur renovated the temple in Dravida style. The temple is situated on a hill having a stone wall and a grand entrance , and the temple can be easily divided into two separate sections i.e Mandapa and Garbhagriha. Completely made of stone and have pointed arches of stone . Some of them have stucco canopies over them. The typical*dipmaal*i.e. the special features of the maratha temple architecture can be seen here in large number. The shikhara of the temple has a beautiful amalgamtion of two different styles i.e Dravidian and Islamic . the shikhara of the temple reflects the typical Dravdian style architecture whereas minarets from Islamic structures can be seen on the shikhara .Types and the styles reflected in the temple - Yadava pillars , Maratha structure , Dravidian motifs and Islamic minarets , arches and dome.



The shikhara completely made in Dravidian style and have Islamic minarets on it.

Photo Courtesy- Google **Khandobatemple ,Jejuri**

Khanoda

Tasgaon Ganesh Temple ,Sangli –

The temple is located in Tasgaon in Sanglidistrict . built by ParshurambhauPatwardhan , the king of Sangli.Raje Parashuram had fought more than 100 wars against the Tipu Sultan in South India. At that time he was impressed by the South Indian Temples. These construction was made by Hindu- wadar caste peoples from karnataka. Its architecture resembles South Indian temple construction. The temple as a five storeyed Gopuram at the entrance having typical maratha temple elements and Rajput elements such as umbrella like structure called as *meghdambari*and human sculptures of same styles. . The entrance gateway formed by a masonry arch surmounted by a tower of the form known as the Gopura The Gopur is a large and lofty pinnacle. It is seven-storied, gradually tapering to a ridge at the top. The lowest storeymeasures , the whole is and the kalasha and curved arms. Gopura is carved into images of gods and goddesses. The templeconsists of garbhagriha and a Mandapa of plain but finely worked stone. The garbhagriha has a spire , flanked by our smaller ones ,shorter making a grand composition. Mandapa has a flat roof of carved Stone slabs. The hall consists of a nave with three aisles made by two rows of pillars .At the hall's entrance are two shrines of

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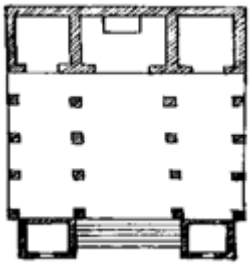
the bull Nandi and the Garuda including the typical maratha style shikhara.



Garbhagriha

Mandapa with Maratha arches

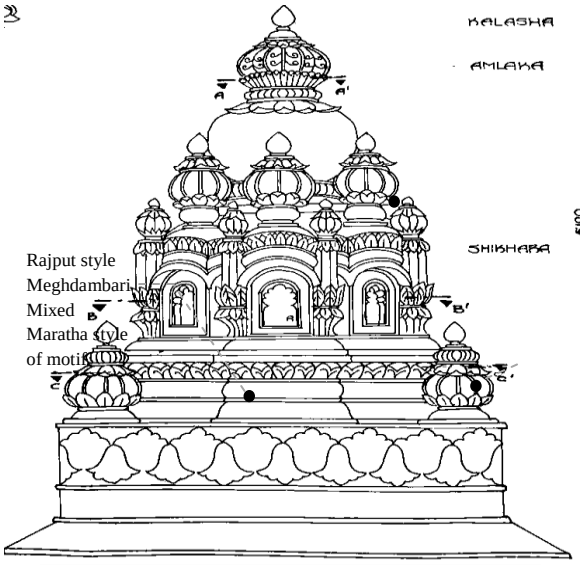
Another shrines

Photo courtesy – Author

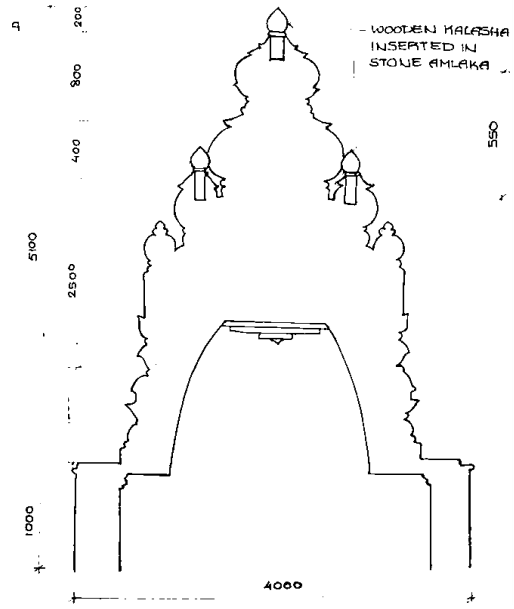
The*Rajputana meghdambari*

Between the Maratha mahirapi Arch.

Tasgaon Ganesh Temple



Rajput style Meghdambari Mixed Maratha style of motif



Elevation of Shikhara

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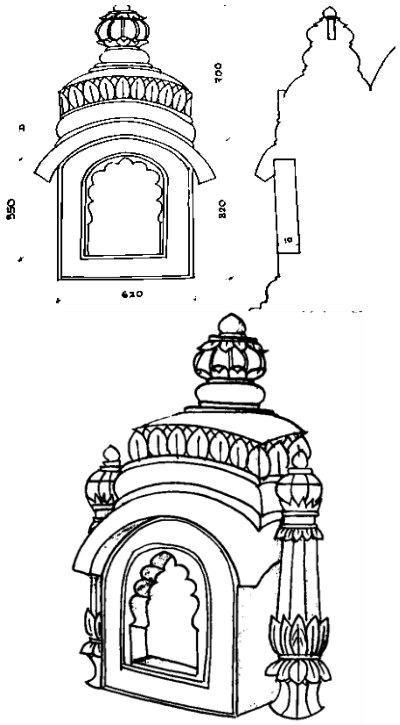

Analysis:

Case study 1 Case study 2 Case Study 3	Case study 2	
Period	Built by Shivaji Maharaj in 17th century and renovated in Late marathapriod.	Built by Khandoji and Tukdoji Holkar in 1742-1770

Section of Shikhara

The transition constitutes an important feature of all buildings both in their structural and ornamental aspects.

Conclusion:

It can be seen easily that by alternating relative proportions of the various features by giving prominance to some and by depriving some of their boldness and by changing the arrangements of the blocks and other motifs , innumerable varieties can be obtained. After studying temple architecture of a particular period , it shows how the temple architecture of a region can flourish gloriously by amalgamation of architectural elements of different cultures and their influences which helped to gave a rise to the temple architecture in Maharashtra during Peshwa especially the late Peshwa period. The study also shows how the evolution not only affected the civil works of the temples but also in the respect of elevations which enhanced the 'Maratha Temple Architecture'

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iv. *Article- **'Post Mughal Maratha Architecture'** by Sarvesh Kulkarni.*

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User Satisfaction in Housing Depending on Outdoor Variables: A Case of Housing in Pune

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Abstract: Housing is one of the primary needs of a human being and largest investment that a person makes in his lifetime therefore satisfaction in this investment is very important. Satisfaction not only comes from the internal space you reside in but also the surroundings variables that affect the space you are living in. A gap was observed, most of them speak on indoor but the outdoor variables are somewhere left out for understanding user satisfaction. The site of study was Hyde park housing society, Market yard, Pune.Interview method has been adopted for getting on to conclusions of the research. The purpose of this research is to understand the factors affecting user satisfaction and strategies for housing design for enriching the satisfaction.

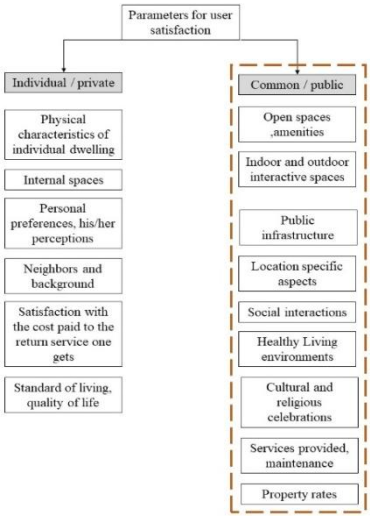
Keywords: Investment, User satisfaction, Housing, Outdoor variables, Pune.

Introduction

Pune has come across rapid increase in population in the last two decadesbeing the "Oxford of East" ("Truly Oxford of the East", 2017)and also cultural capital of Maharashtra since its existence (Joshi, 1996). Pune has its hub for education, manufacturing and information technology due to which a lot of displacement of population taken place. The first need of any individual is a place to live, hence housing development has become important.

Residential satisfaction depends on the difference between the households actual and desired aspired housing and neighborhood situations (Glaster, 1987). A close relationship between outdoor quality and outdoor activities, "Within certain limits - regional, climatic, societal - it is possible to influence how many people, and events use the public spaces, how long the individual activities last and which activity types can develop" (Gehl).The evaluation of performance of residential environment has traditionally been based either on physical monitoring or user satisfaction surveys (chandiwala, 2010)Users give their views and/or feelings about buildings-in-use based on their experience and interactions with buildings (vischer, 2008) as compared to the views of professionals who design and construct buildings and never use them (preiser, 1999) (Nawawi, 2008).

Table 1: Conceptual framework of study for outdoorParameters for user satisfaction
(Source: Author)



In the definitions to which an emotional component is significant, user satisfaction in housing means reflecting the sentiments of satisfaction and happiness to the housing place which also creates these feeling (Gold, 1980) (Weidemann S. &., 1985)Studies of residential satisfaction are basically of two types; those that consider residential satisfaction as a predictor of behavior (intention to stay/move from existing housing), or residential satisfaction as a criterion of housing quality (Weidemann S. &., 1982). Quality isn't expensive it is priceless hence that is what leads too satisfaction of user. (Varady, 2000)stress that housing satisfaction is related to satisfaction with dwelling unit (i.e. physical aspects and personal preferences), satisfaction with services provided, and satisfaction with the neighborhood and area, which also covers the location specific aspects. Satisfaction in the residential environment reflects people's responses to the area they live in. The term 'environment' is related not only to the physical components consisting of the housing

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and neighborhood, but also to social and economic conditions. If appropriate techniques are used in data collection and analyses, it is possible to measure physical, social and administrative factors that determine the level of user satisfaction in the housing area. This information can be used not only for establishing ways in which improvements could be made (Francescato, 1979).

Table 2: Number of families with people of age group of range specified. (Source: Author)

Age group	No. of families with people from age group (n=67)
0-10	16
10-20	55
20-30	52
30-40	35
40-50	55
50-60	40
60& Above	51

Image 1: Hyde park housing society, Pune
(Source: Author)

Looking on this one we can arrive on a point where there are different design dependent and independent variables that can affect the user satisfaction like user type, size of spaces, indoor environment, his or her perceptions; amenities,physical characteristics of the housing, location with respect to city, rate of property, neighborhood, infrastructure connectivity and so on respectively. Most of the times thesedesigndependent
variables are talked upon but the independent variables i.e. the outdoor variables affecting the satisfaction are not looked upon so often.

Methodology

A sample of nearly 67 households (n=67) was selected from a total of 200 housing units(N=200) within the Hyde park housing in Marketyard. The sample represents 34% of the total housing population. The data was collected by having self-administered interviews and discussions with 1-2 individuals from each household.The questionnaire was formulated in a multiple-choice question format so that a person could select the suitable option.The interviewconsistedof the demographic background of the household,frequency of visits to outdoors, play rate of the children in outdoors, environment surrounding the housing, city infrastructure and city amenities around it, location of the housing with respect to city and work place, community and cultural celebrations, maintenance and safety in outdoors satisfaction with the rate of property,preference for suggesting someone for residing in this housing or area surrounding.Within the interviews, individuals were asked to choose adjectives for the outdoor spaces from which surrounding spaces may me better

Setting, sampling and Analysis

All the housing units (N=200) were owner occupied and nearly 25% of the household interviewed (n=67) are residing there for 10-12 years. 5% of the interviewed households were residing for 14-15 years and 10% for 8-9 years. The above statistics states that families are satisfied with the housing environments they are living in. It was observed that out of total sample of households interviewed 75% of them were living in Pune before residing in Hyde park housing society.

The literacy of the households interviewed (n=67) included 79% of ‘n’ have graduate in families ,22% ‘n’ of post graduate in families, 9% of ‘n’ in high school, 3% of ‘n’ in Primary school and 4.5% of ‘n’ in preprimary school in families. It was also noted that maximum number of households had their working place within 5 km area.

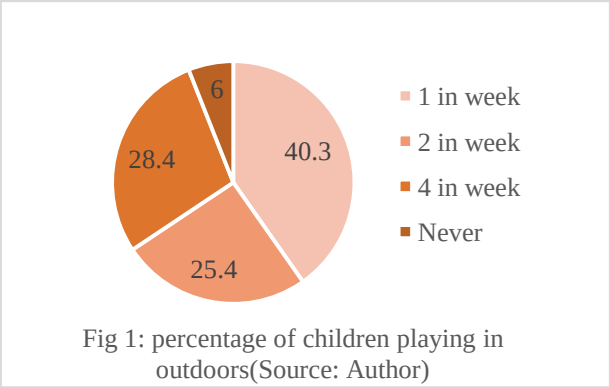

Fig 1: percentage of children playing in outdoors(Source: Author)

Figure 1 shows about frequency of children playing outdoors. It clearly states that 40% households from n=67 said that their child goes out to play once in a week and other times they play indoors and in the lobby in front.

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25.4% of the households stated that he/she goes to play outdoor twice a week and 28.4% households 4 times a week while it was significantly observed that children from 5% households never go outdoors to play. The discussions with households also revealed that there is hygienemaintained in the society. The above study shows a deficiency in children's play area in outdoor even though having a club house in the housing society. Children's like to play garden games usually in their older ages.

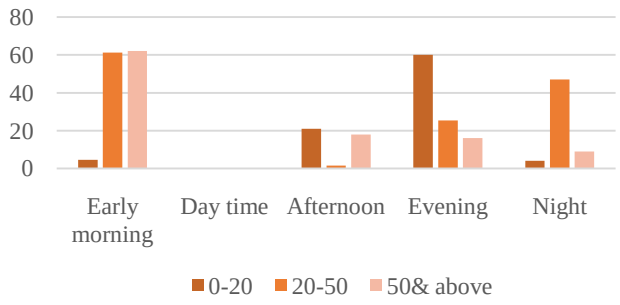

Fig 2: Frequency of different age group of people visiting outdoors(Source: Author)

Figure 2 shows frequency of different age group people visiting outdoors at different times of the day. It showed that people from age group 20-50, 50 & above come in outdoor in early morning hardly children as they are in rush to go to schools and colleges.

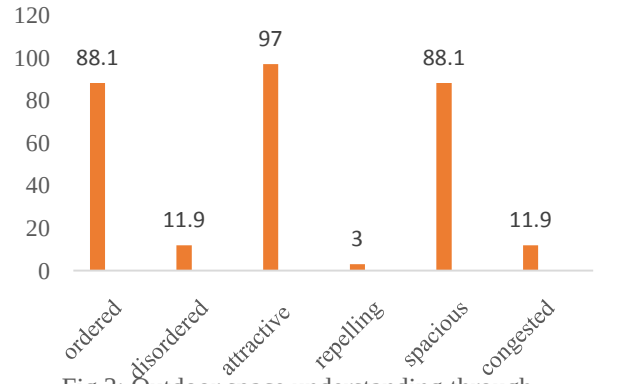

Fig 3: Outdoor space understanding through adjective pairs (Source: Author)

In day time no one visits the outdoors as all are busy in their respective works. While in after noon children and elderly people visit outdoors. And children's usually in the evening as they are back from schools. The frequency of age group 20-50 is high in the night as everyone once back from work walk downafter dinner with the neighbors for stress reliving interactions. Also, on asking for freedom of choice of space for different activities, 55% of the households were positive with this. It was also noted that30% of the households interviewed were on a point where the spaces are not adaptable to all age groups. Looking onto this some common flexible spaces near the housing can be planned where that space might be used by different people at different times of the day both serving the city and housing.

Discussion with households also conveyed that religious, festivals and some private functions take place in the open space around. Specific cultural festivals and private celebrations are celebrated in the outdoors of the society.

Interviews with the people also talked about missing safe outdoor space for elderly people and children play area. Also, with this, 30% of the households interviewed were saying about missing a grocery store in just vicinity, 41% for a school ,83% for a library ,54% for vegetable market and day care facility in the vicinity.

Figure3, the households were asked to choose from the three givenadjective pairs (ordered/disordered, attractive/repelling, spacious/ congested) to know their opinions on the outdoor.

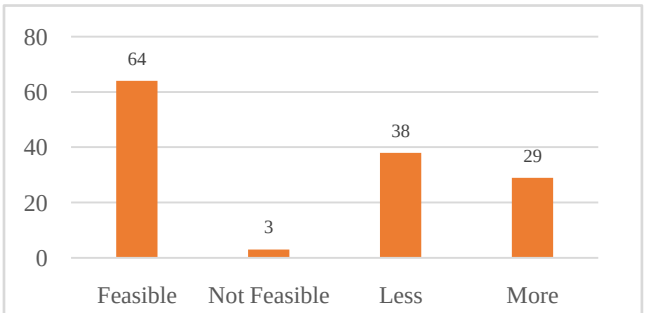

Fig 4: Number of households from (n=67) talking about public infrastructure connection options (Source: Author)

On similar basis, (figure 4) talks about public infrastructure connections of the housing with the city.

All the sample of households were proposed with a question 'satisfied Vs rate of property', the response rate was 80% were satisfied with this.

Nearly 80% from the sample of households were in a view that if they were tenant, they would suggest other to buy property in this housing or vicinity.

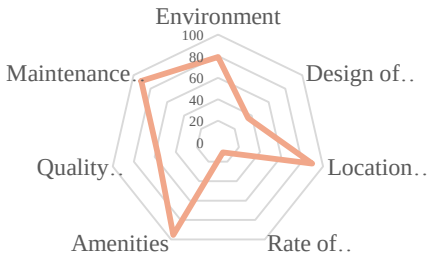

Fig 5: Thematic area inside showing the satiscaction of user with outdoor variables (Source: Author)

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In fig 5: the graph signifies that area inside the polygon is the cumulative of outdoor variables (environment, design of outdoors, location with respect to city, rate of property, amenities, quality infrastructure, maintenance and service) that leads to user satisfaction. The distance between the respective vertices of the two heptagon is the percent of the households prioritizing the variable for their meaning of satisfaction. Connecting all the points of each factor we get a polygon of which area inside it signifies the cumulative user satisfaction.

Conclusion

This paper examined about effects of outdoor variable for user satisfactionin housing.Satisfaction here refers to public convenience first. It was observed that for better satisfaction indoor factors cannot work in isolation but have to work in collaboration with the outdoor variables for achieving better satisfaction levels of the user.The seven factors stated above can become key principles for getting better results and the priorities on each variable can vary depending on the context of the housing.

Acknowledgement:

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Feasibility Study for Integrating Natural Ventilation Through Skylights in Pune

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Abstract :The earliest kind of skylights were the open holes in domed ceilings known as the Oculi. As domes developed, the Oculi disappeared replacing the same with glass skylights which would stop the rain from entering the interiors. These skylights continued through the middle ages and are still used even in the modern era. In this modern era, sustainable structures are an important aspect of architecture, making natural ventilation and natural light the most important factors in a building. The increase of migrant population to urban areas has led to growing urbanization all over the world. It is observed that many areas in urban conglomeration ,the buildings or houses are placed very near to each other due to which natural light and ventilation have no enough space to travel through the windows. Hence, the other source through which light can be explored is through the roof. Skylights can be used for daylight and also as a natural ventilator. These are one of the architectural elements which are less studied and practiced. This study checks the feasibility of integrating skylights and natural ventilation which would help to reduce the use of electricity and contribute to sustainability. By the experimental method, this paper gives the feasibility of the integration of natural ventilation and skylights in a room in Pune.

Keywords -natural ventilation , skylights , urban congestion, ECBC,Pune.

I. Introduction

The idea of creating openings in the roof and using sun as the source of natural light to light up a room was developed in ancient Rome and continued through the middle ages. Oculi was the earliest type of skylight that was used in Pantheon. Oculus were the openings in roofs that would let in light as well as rain. Thus the use of Oculus gradually stopped as it was not practical to keep this kind of openings in a building where weather conditions are not favorable. This led to use glass as covering for these openings. Romans were the first to use glass in architecture. Thus adding a lantern shaped structure on top of the building, provided some insulation and also gave the benefits of natural light. The light channeling through these openings would create drama in the interiors. As architecture progressed, use of roof openings in different shapes increased which were later known as skylights (ii).

Coming through the ancient ages to the modern era, people are more concerned of sustainability which could be achieved by using natural elements that are favorable for environment. Using less artificial light and ventilation, would take a step forward towards sustainability. Using daylight and natural air in a building by strategically placing the openings, have become an important factor while designing a building. Windows or openings could be placed anywhere in the structure including the roof to let the air and light inside. The areas where window to wall ratio is very less , openings in the roof can be acceptable mode of natural ventilation and daylight. This includes the use of skylights in the ceilings or roofs which will give diffused light into the interiors and also act as an aesthetic feature. But these require more study.

Light effects of skylights depend on the materials that are used as covering of skylights. Skylight materials are divided into basic materials like glass and plastic and types of each respectively. Each material have different effects on light. The use of these materials will depend on the requirements of each project or as per the design. The material should also contribute to sustainability of the building. Growing urbanization has led to the increase in density of the areas leading to close placing of houses.Thus the light cannot penetrate through such small space and then through the windows to the interiors. Openings in roofs are an appropriate option for such conditions. This

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gives a solution of using skylights which would act as opening for daylight and also give natural ventilation.

Thus to find out the feasibility of such concept where integration of skylights and natural ventilation is suggested at the same time through the same source, some experiments are done using the simulation toolVeluxto find out the appropriate amount of daylight and air flow in a building.

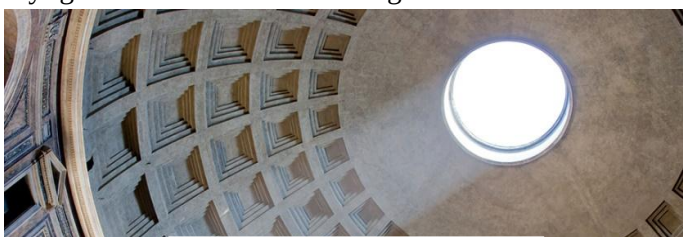

Figure 1 – Oculus (ii)

II.Literature review

A skylight is an opening in the roof or ceiling that provide daylight and natural ventilation to the space. They result in unwanted summertime heat gain and wintertime heat loss, thus manufacturers use various glazing technologies to reduce these impacts including heat-absorbing tints, insulated glazing, and low-emissivity (low-e) coatings(i). Framing material could be wood, metal , PVC ,etc. and fitted with glass or plastic to allow light or ventilation or both into a building. Earliest kind of skylights can be dated back to the 13th century in Rome. Romans have used domes in their buildings, which were completely open from top to allow and also rain into the space. Thus this type of skylights known as Oculus were not favorable to use further. Simultaneously, colored glass was invented nearly in 14th century and was used in small scale. Glass was then used on the top of the domes having wooden frames to stop rain and other atmospheric factors from entering into the interiors. These were known as roof lanterns. Wood as a framing material would allow moisture inside thus replacing that with metal. Later more clearer and larger glass was discovered. This made skylights more larger and clearer and non-colored glass allowed more light into the interiors (ii).

Coming through the middle ages to the modern era, rapid urbanization is observed. Urbanization is the process of population shift from rural to urban areas. It has been observed that 13% people were living in urban areas in 1900 which has increased to 29% in 1950 (iii). India is one of the cities where urbanization plays an integral part. Most of the rural population is migrating to the urban areas due to increasing job and educational facilities. This leads to the random development of the urban areas .Urban settlement of migrants tends to develop near the industrial sector duetheir jobs ,increasing the population density in that area. The increasing density leads to the need of more houses . Its been observed that most of the houses are placed very close to each other deteriorating the laws and giving no breathable space between the houses (iv). Artificial lighting and mechanical ventilation is used all the time as there is no enough room for the natural light and ventilation to pass through the wall openings. This increases the energy consumption of the building leading to non-sustainability. Including daylight and natural ventilation will reduce the use of electrical energy in the building (v).

India being a growing economy has seen rapid industrialization in the recent past and thus this made an adverse effect on the environment. This gives the need for sustainable development to reduce the impact of this industrialization.(vi).Skylights are an European concept where natural light is a scarcity. Using these skylights in Indian context where natural light is abundantly available with more than 300 sunny days is not a good option. But due to changing design trends and living patterns, using this western concept should not be problem is it is placed strategically and designed properly. They might create overheating in the room where there are no openings. So instead of creating openings in the walls to draw out the warm air from the top notch of the room, opening the skylights would be more feasible(xiv).Skylights are not been studied or practiced usually. Soproviding ventilated skylightswill be affordable and also sustainable.

Figure 2- Ventilated skylights(vii)

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III. Methodology

A quantitative method of obtaining desired results was adopted. A model room of 40sq.m in Pune city. As Pune lies in the moderate climatic zone, IMD data for daylight in Punewas used ,whereJune has the highest daylight and December has the lowest daylight. The average wind speed seen in Pune is highest in July and lowest in January(xv).The model room has pitched roof 30 degree inclined at a height of 2.5m.The room is enclosed from all the sides having no windows in the walls/facades for the purpose of simulation. Various sizes of skylights are placed on the roof to check the lux amount entering into the interior through the simulation tool Velux. The sizes of the skylights are referred from a reference literature study(viii). The model is oriented east-west and the skylights are placed on the northern and southern side. The northern side is the best to place openings as it gives even distribution of light without any glare.

The location for this model in Velux was selected by entering the latitude and longitude as 73.51 N and 18.3 E respectively of Pune and the months were selected asJune and December according to IMDwhich have the highest and lowest daylight respectively(ix).

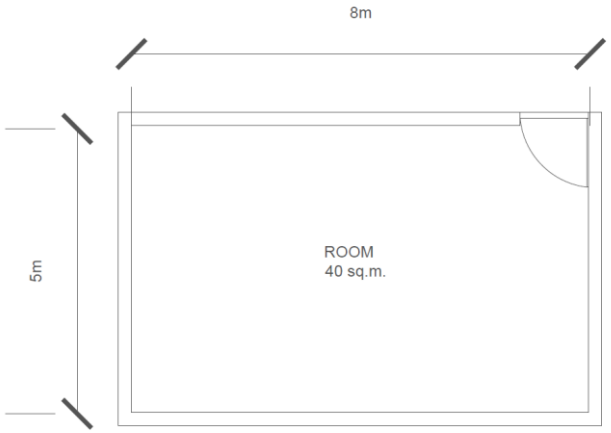

Figure 3 – Plan of the room.

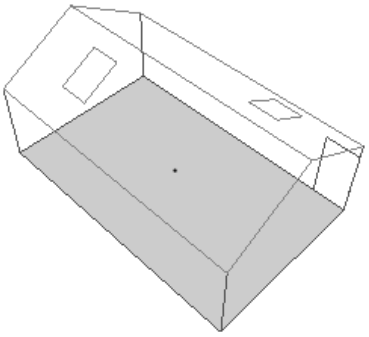

Figure 4 – 3D model of the room.

The following table gives the sizes of skylights which will open upto 50% of the skylight area, were used in the model to check the lux levels in June.

Table 1 – The daylight lux level for June.

Sr.no	Skylight sizes	Lux value
1.	1m x 1m	252
2.	1.2 m x1.2m	501.6
3.	1.2 m x 1.5m	751.2
4.	1.2 m x 1.8m	984
5.	1.5 m x 1.5m	910
6.	1.5 m x 1.8m	1128

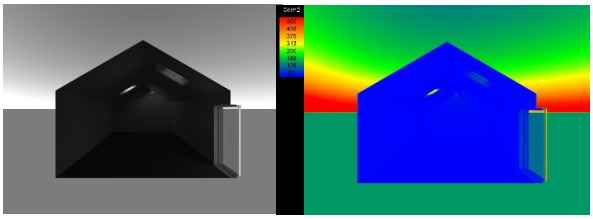

Figure 5 – Velux model having 1m x 1m skylight.

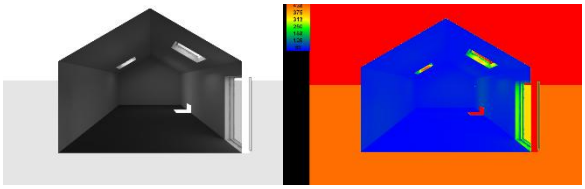

Figure 6 – Velux model having 1.2m x 1.2m skylight.

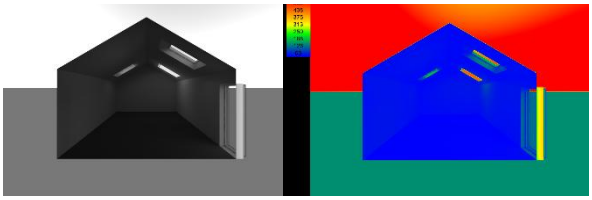

Figure 7– Velux model having 1.5m x 1.5m skylight.

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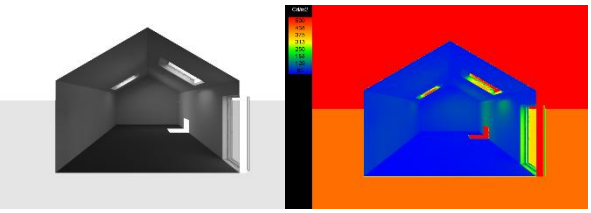

Figure 8 – Velux model having 1.2m x 1.8m skylight.

The values above are recorded in Velux and an appropriate lux level is established for the room of 40 sq.m. Appropriate value for lighting for a room is 500-1000 lux.(xi).Through this table it shows that the 1st and 2nd skylight does not allow enough light into the room.3rd,4th , 5th gives appropriate light into the room and 6th skylight would create glare as they allow too much light into the interior.

Table 2 – The air change per hour values through skylights.

Sr. no	Skylight sizes	Ac/h in a room
1.	1m x 1m	1.45
2.	1.2 m x1.2m	2.12
3.	1.2 m x 1.5m	2.61
4.	1.2 m x 1.8m	3.14
5.	1.5 m x 1.5m	3.27
6.	1.5 m x 1.8m	3.92

The above table shows the air change per hour(ac/h) values in a room through the skylights which would open upto 50% of the opening. Appropriate value of air change for a room in residential area is 3 ac/h-6 ac/h(xii). Thus 4th , 5th , 6th skylights are appropriate for natural ventilation into a room.

For the month of December, which has lower days of daylight , the first two skylights would not provide enough light and ventilation into the room. After comparing both the tables, the 4th and 5th skylight are common and provide appropriate levels of light and ventilation in the room even if the room is enclosed from all the sides.

From the study above, we find that the integration of natural ventilation through skylights is feasible. Looking into the norms of ECBC, the permissible skylight to roof ratio(SRR) is limited to 3-5% (xiii). While following these norms of Energy Conservation Building Code, we find, the appropriate skylight sizes are crossing the limits of 5% skylight area.

IV. Suggestion

Ventilated skylights are an appropriate option for a habitable room in Pune city where the houses are built in congested areas.First three skylight sizes(1m x 1m , 1.2m x 1.2m , 1.2m x 1.5m) from the table 1 give enough lux of natural light, but the air change value of the same skylights in table 2 does not satisfy the recommended air change value of 3-6 ac/h. Thus the feasibility of natural ventilation through skylights is proved.But the norms of ECBC restrict the sizes of skylights to 5% and no appropriate air change is achieved. If the norms permit some increase in the skylight area even by 1 or 2%, good amount of natural ventilation could be achieved through skylights. This would also give the users the whole of the wall area for usage and also solve the privacy issues through the openings in walls. For future use, if someone wills to use the concept it can also help in energy efficiency.

V. Acknowledgement

I would like to extend my gratitude towards my guide Prof. Aprajita Kaushik for her valuable guidance , inspiration and encouragement. Her immense patience and timely help has helped me to reach my goal.

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Child-Friendly Open Spaces: Comparative Analysis of Parks in Pune

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Abstract: The vision of a good city is to design spaces livable for everyone. In India, 39% of the total population are children below 18 years. Planning of a city from the vantage point of a toddler is the best way to start. A child friendly city includes child friendly parks, streets, and other public spaces. This research focuses on child-friendly parks and how does these spaces contribute in physical, mental and social development in early childhood. The focused age group is 3 – 8 years. The methodology followed is live case study along with activity mapping and photographic documentation. The inferences from the research would help in designing child-friendly public parks in future which will support healthier, safer and more exciting urban neighborhoods for young children, for those who care for them, and for everyone.

Key words – Child Friendly City, Public Spaces, Parks, Early Childhood Development, Urban Design, Children

1. INTRODUCTION

1.1 CHILD-FRIENDLY CITY

'If you find children happy, then the city is healthy.' (Ives, 2004) The needs and perspectives of children are largely overlooked in urban development, in spite of children forming a significant percentage of population. A child-friendly city is a city, town or community committed to fulfilling child rights as formulated in the Convention on the Rights of the Child. It is a city or community where the voices, needs and rights of children are an integral part of public policies, plans and decisions. Thus, a child-friendly city is a city that is suitable for all. All countries in the world, regardless of their level of human development, are now involved in implementing the 2030 Agenda for Development. The Child Friendly City Initiative (CFCI) supports local governments in implementing the 2030 Agenda through holistically addressing issues related to the health and well-being of children and families at the local level. (Louise Thivant, 2018)

The concept of child-friendly spaces has been inspired by the idea of child-friendly cities. It refers to developing better and healthier conditions for children within urban areas by focusing on child-friendly green spaces within the built environment. Children need open spaces, in order to connect and interact with their natural environment and

consequently, develop their skills and natural abilities to their full potential. The focus of urban planning should thus be to provide, among others, for green spaces designed particularly for children's needs.

1.2 CHILD-FRIENDLY OPEN SPACES

Public spaces like neighborhood parks and playgrounds are important elements of daily urban life for Infants, Toddlers and Caregivers (ITCs). For the 0-5 age group particularly, playing is a way to have fun, to socialize but also to learn. A big portion of this valuable playing time happens in designated play areas like small tot-lots, parks, squares or green areas. If a city invests in better quality of open spaces for children, it also invests in creating better citizens for tomorrow.

1.3 EARLY CHILDHOOD DEVELOPMENT

Playgrounds provide vital opportunities for children to play. There is substantial research showing the clear link between play and brain development, motor-skills, and social abilities. All learning—motor, cognitive and social—is accelerated by the act of play. Playgrounds that promote different types of activities are important for a child's cognitive, emotional, physical, and social development. Research on brain development shows that the most crucial time for a child's development is in the earlier years. (U.S. Department of Health and Human Sciences, n.d.) Children run, jump and play in a park which aids their motor skills and helps in the physical development. The playground maximizes opportunities to interact with their peers and allows them to express ideas and feelings, and develop their social skills. The act of play by a child stimulates brain development and has a key role in building the foundation and capabilities of the brain.

2. LITERATURE REVIEW

Research done by Cilliers and Goosen on 'Child friendly approaches in a city' stated that the necessity for the urban green spaces with the focus of planning for children within a city are regrettably not recognized due to the extensive

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growth in population, urbanization, adding to exponential housing demands within town and cities. (E. J. Cilliers, 2016) Research by Blinkert and Weaver suggested that conventional playgrounds with limited, fixed facilities and equipment, lack scope for imaginative or creative play. Natural play areas on the other hand are more adaptable and have more scope for creativity. (Baldo Blinkert, 2015) A study by Finnish researchers showed that even a ten minutes visit to an urban park significantly improved stress indicators. (Liisa Tyrväinen, 2013) Parks and open spaces should have a diverse landscape and varied vegetation, natural groundcover, shading and natural play materials. An abundance of literature and authors confirm that safety and security issues are the major problems faced by the children. The concept of child-friendly spaces should aim to enhance the freedom of movement and accessibility to all public spaces safely. Safety refers to physical design elements such as fencing, lighting and visibility. Perceived safety, on the other hand, refers to children feeling safe and comfortable within the space. Though all the studies have tried to find issues faced by children in a city, there is a lack of specific design guidelines to follow while designing a particular child friendly space.

3. METHODOLOGY

A qualitative research method has been followed to study the child friendly parks. The study was through live case studies of seven neighborhood parks in Pune out of which three parks namely Bhimale Udhyan- Bibewadi, Shivarkar Garden- Wanowrie and Anusaya Sabda Lonkar Garden- Kondhwa were chosen for the detailed study. The process of case study included photographic documentation, activity mapping and comparative analysis of design parameters like furniture, color, texture on the basis of safety, accessibility, anthropometry, inclusiveness, and playfulness. The parks were visited on weekends during evening when there was maximum footfall. The parks were studied holistically to understand different zones inside a park namely dedicated play areas, partially child friendly areas, restricted areas and built structures. Activity mapping of users inside the park were documented. The identified users were children of age 3-5 years, 5-8 years, caregivers and other users.

4. DATA COLLECTION AND ANALYSIS

Table 1 shows a comparative analysis of the three parks studied on various parameters. All the three parks consisted of four zones namely dedicated play area, partially child friendly area where there was potential of being more child friendly, restricted areas included spaces which were not allowed to be used, and built structure included pavilions, toilet blocks. Through this zone mapping, it was analyzed that how the area of these zones affected the children and their activities. Dedicated play areas were located at a corner of a park which restricted the kids to experience the entire park. Activity mapping of these parks were documented to understand the concentration zones for different users. Children of age 3-5 years were mainly in the dedicated play area along with their caregivers. It was observed that children of age 5-8 years liked to play among their friends but within the vision range of their caregivers. Hence the location of the furniture determined the play zones. Surface materials used for the play area and the other spaces were also identified to understand how the texture of these materials mattered inside the park.

Figure 1,2 and 3 are the images of play area of all the three parks studied. The use of different surface materials and textures is evident in these images. An urban tactical intervention by TARU Leading Edge, was implemented at Lonkar garden, which included painting of seats and ground surfaces with numbers, characters, color games, and retrofitting of existing pergola infrastructure as sensory boxes, using hanging xylophones, rope art and wall art. This intervention aims to develop young children's cognitive, emotional and social skills through introduction of visual, sound and sensory play.

Figure 1: Play area of Bhimale Udhyan
Source: Author

Figure 2: Play area of Shivarkar Garden
Source: Author

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Figure 3: Play area of Lonkar Garden
Source: Author

5. DISCUSSION

From the data collection and data analysis of the case studies, we can deduce that a park should entirely be child-friendly and thus should be designed accordingly. The design of a park can have a direct impact on a caregiver's perception of its safety and their willingness to use the space. If parents or caregivers know that their children are safe within the margins of a play area, they will relax more and be less stressed. Safety in parks needs to be considered in its overall layout, clear vision lines, clear signages and lighting system. Urban furniture in parks, if well-chosen and placed, can become playful elements for children and toddlers. For kids, colorful benches can become exciting elements to climb, crawl, and have different playful experience. Increased contact with nature has benefits that impact the child's overall development. Similarly for caregivers, access to a green space will have a direct bearing on their mental health.

6. CONCLUSION

This research helped in analyzing parks and their effects on the child development. The findings of this research can be used as the design guidelines to create a safe, healthy and exciting park. This small step can be a great initiative towards a child-friendly city and eventually creating a child-friendly world.

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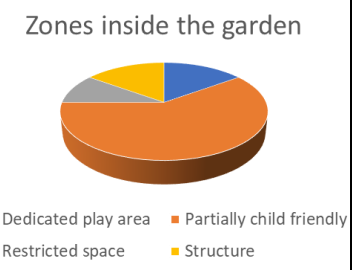
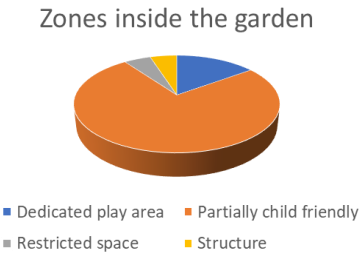
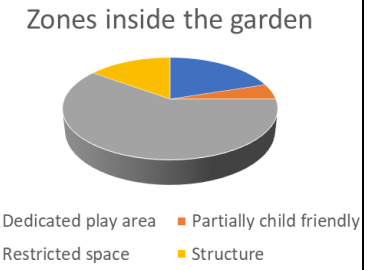
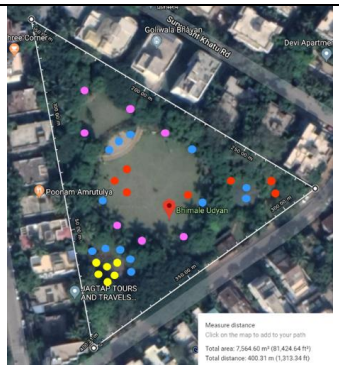
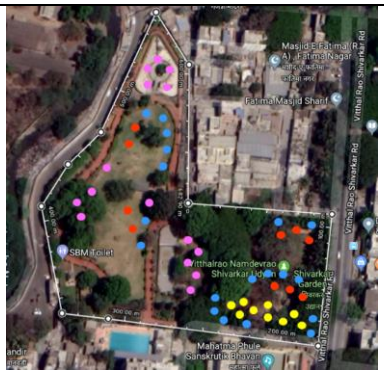
Table 1: Comparative Analysis of Live Case Studies

	Case Study-1 Bhimale Udhyan	**Case Study-2** Shivarkar Garden	**Case Study-3** Anusaya Sabda Lonkar Garden
Description	Bhimale Udhyan, located in Bibewadi in a residential neighborhood, was studied holistically to understand different zones inside the park.	Shivarkar Garden, located in Wanowrie in a residential neighborhood, was studied holistically to understand different zones inside the park.	Anusaya Sabda Lonkar Garden, located in Kondhwa in a residential neighborhood, was studied holistically to understand different zones inside the park.
Zones inside the park	 	 	 
Activity Mapping Kids: 3-5 years Kids: 5-10 years Caregivers Others			
	Design Parameters:		
Furniture	-Total of 10 play equipments were provided in the dedicated play area -Benches were provided in the periphery of the play area and the central ground	-4 big play equipments were provided in the dedicated play area -Boundary plinth of this play area was raised to act as seating for the caregivers -Benches were unevenly located in the entire park	-2 big play equipments were provided in the play area -The play area was lowered than the usual ground surface and the peripheral area was used as seating by the caregivers -Seating was provided in two different parts of the park
Surface Materials, Texture	-Surface materials used in play area: Pebble Gravels -Other areas were covered by soft grass -Use of colorful paver blocks	-Surface material used in play area: Sand -Natural ground cover was maintained on the other parts	-Surface material used in play area: Granular Gravels -A lawn was maintained in the central area -The pathways were painted

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Impact of High-Rise and High-Density Buildings on Sustainable Living W.R.T Mass Transit Systems: The Case of Mumbai, Maharashtra State, India

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Abstract : Mumbai, India's largest citykeeps drawing people from all over the country; creating spatial crisis created by the ongoing urbanization. This effect of urbanizationis addressed through high rise and high-density buildings. This paper aims to study the impact of transit-oriented development along the major corridor of high-rise and high-density buildingsby studying the areas with similar scenario using parameters like travel patterns, routes and modes of conveyance; to study the change in land use pattern in the transit corridor. This paper critically analyzes the role of connectivity systems in contributing to the sustainability of a city.

Keywords**: Sustainable living, High-rise and high-density buildings, Transit-oriented development, Mixed-use development**

1. INTRODUCTION

1.1 What is sustainable living?

According to UN standards sustainable living can be described as an ability of coping and recovering from stresses and shocks, and meanwhile flaring up the capabilities of the assets and creating similar opportunities for the next generation.Itis a lifestyle attempting to reduce carbon footprint and energy consumption by minimizing the use of earth's resources like land, water, trees, etc.
Sustainable living on a city level alsomeans maximizing the utilization and efficiency of the public transport.

1.2Impact of mass transit systems on sustainability

The major domains of the sustainable development of a city are urban forms, transport and infrastructure. These are inter-dependent on each other; the corridor of transit system impacts on the urban form and the land use patterns, better infrastructure leads to better and efficient urban forms and deintensification of the problems of transportation systems.
Mass-transit systems encourage mass interchanges, ingress and egress of the people therefore creates opportunity to accommodate larger volumes while avoiding intensification.

1.3Impact of high-rise and high-density buildings on sustainability

When a city grows in an unplanned manner it leads to decentralization;slowly creating urban sprawls which further creates distinction between the people on the basis of their income as the high-income groups would prefer their private vehicles and thus the public transport will become the transport for the poor.
A high-rise and high-density building is a new urban form; having mixed uses to cater the current needs of the people: housing, employment, health care, education, recreation and services; increasing pedestrian mobility. This leads to the centralization of labour and promotes mixed land use.

1.4Mumbai: Area of study

Mumbai is the most important financial and trade center of the country from the time of the British rule and even before.
In 1688, East India Company started building docks, the trading posts and a fort; this attracted industries and trading communities like the *Parsis*, *Gujratis*, *Marwaris* (from Rajasthan) and started setting up their business practices in the late 19th century. These immigrants shaped the city and their traditional livelihood gave character to the place. Work opportunities were created which attracted people from all over the country.
The mass transit systems were first adopted here. In 1849, the Great Indian Peninsular (GIP) Railway Company was incorporated under the British rule along with the East Indian Railway Company. The first railway tracks were inaugurated on April 16, 1853 between Thane and Bombay (then, Mumbai now). In 1855 the Bombay Baroda and Central Indian Railway Company was founded and they undertook the project to build a railway line from Bombay to Surat. Later, they established the first suburban line, between Virar and a station in *Bombay Backbay*, in 1867. The Harbour Line (of Mumbai railway network) of the GPI. Ltd. started in February 1925 simultaneously with the electrification of the suburban railways.

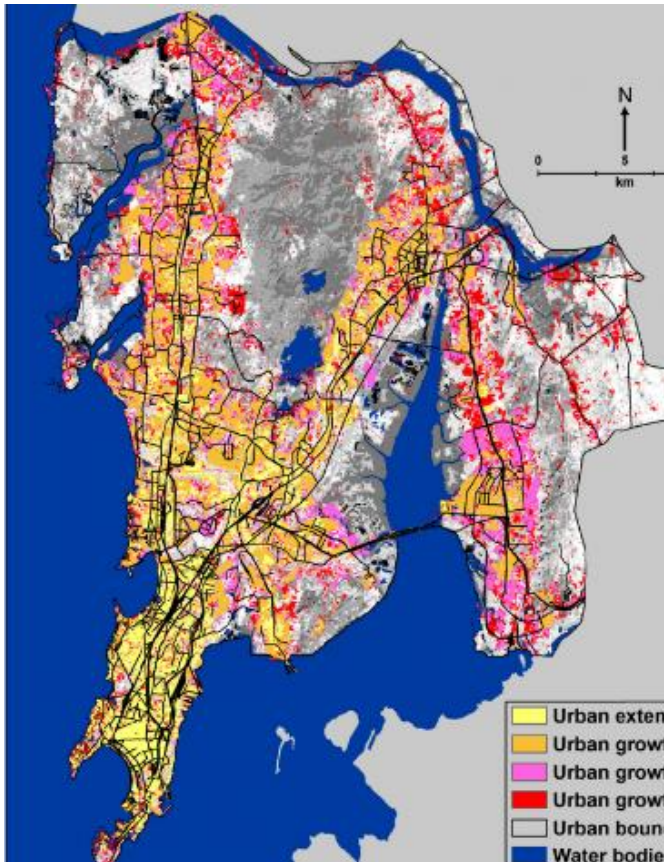

Fig. 1 : Growth of the city from 1973 to 2010 along the main roads

(Moghadam & Helbich, 2013)

2. LITERATURE REVIEW

1.1Understanding the impact of transportation in the case of Curitiba, Brazil.

The city observed drastic increase in the population in the 1960s wherein the population grew from 120000 to 361000; to cope with it became the major concern. The city responded by widening the roads for dedicated public bus lanes and the city got the world's first bus rapid transit system (BRTS).

While the transit lanes were planned simultaneously the mixed-use corridor with high densities were planned for the decentralization of the city core. And the areas with the centralization of the activities were directly linked with one of the modes of rapid transit systems. It was observed that the low-density areas were responsible for increasing the usage of private vehicles. So, the urban planning city was an integrated approach of the land with the transit systems.

2.2Understanding the impact of transportation in the case of Copenhagen, Denmark.

It is the most populated and the capital city of Denmark and the most bicycle-friendly city in the world.

The city has a substantial road network which led to colossal traffic, to deal with it, the city has undergone several strategies to promote sustainable modes of transportation.

The government adopted the *"Finger Plan"* in 2007, which is a national planning directive in order to avoid the creation of urban sprawls and the intensification of the city core.

It was called so because it aimed to regulate the mixed-use development of land along the major transit corridors. These transit corridors were the fingers and the city core: the palm of the hand.

2.3Soria Mata's theory of linear city

Arturo Soria Y Mata introduced the idea of the linear city in the and challenged the theory of the city developing around the nucleus He believed his concept of the linear city would be more apt and efficient in the modern context. He believed that it would enable controlled growth of the city with organized development of infrastructure and transit systems. It also ensures mixed land use with decentralization of the assets and simultaneously de-intensifying the city.

Both, Copenhagen and Curitiba are a product of this theory.

3. ANALYSIS

3.1The impact of transit-oriented development on built-mass.

Transit-oriented development is a type of urban development which promotes mixed-use of land with high density in order to create opportunities for people in walkable distance.Around mass-transit stations are mixed-use areas with smaller building footprints and taller structures catering different needs of the people; making the city pedestrian friendly.

3.2The impact of rapid transit systems as an asset of sustainability.

Rapid transit systems are a core component of sustainability of a city. With the intensification of buildings there will be concentration of activities, thus leading to less demand and use for transport systems.

3.3Analyzing the role of connectivity in Mumbai's sustainability.

In India, Mumbai is the first city to get a mass transit system. Being the economic capital and the largest city, Mumbai has the manpower and economy to bear the regular influx of immigrants while maintaining its existing transportation networks and experimenting with new systems and additions to the existing.

4. FACTORS CONTRIBUTING TO THE CURRENT SITUATION

4.1The industrialization of the city

It 1853 the effect of industrialization spread in the city, it started with the construction of railway line in the Bombay presidency; India became the main supplier of cotton to the world; simultaneously promoting railway that led Bombay to become an industrial center.

4.2Network of transportation system

The government has taken steps to implement the existing scenario of traffic prone mega-city. The Mumbai Urban Transport Project (MUTP): Phase I, Phase II and Phase III undertaken by the Mumbai Metropolitan Region Development Authority (MMRDA) is aided by the World Bank to improve the road and train network.

4.3Effective use of transportation systems

The city has 4 major rail-corridors and 5 government bodies operating the bus services operating at the sub-city level for the convenience of the people, and there are routes connecting these sub-divisions; micro to macro level approach in order to maximize the efficiency of the transit systems.

4.4Influence of technology

The government body has acknowledged the infrastructure deficit in the past and is attempting to implement the issues by adopting the latest smart systems. Mumbai being a metropolitan city and the economic capital has easy access to the latest developments and their use has shown a significant increase in the efficiency of the transit systems.

4.5Scope of experimentation in Mumbai

Mumbai haseasyaccess to the latest advancements in technology and a fully functional sets of various transit systems; addition of new systems would be beneficial, but in the worst casescenario, if it fails, the city pre-existing systems willsupport and cater to the current needs.

4.6Floor Space Index (FSI) along the transit corridors: Present vs Development plan 2034

The city has witnessed the urban growth along the major transit corridors. Because of geographical constraint and inefficient supply (of area), the city grew vertically with high density; with the increase in the proximity to the transit corridors and station, the density increased. But due to the regular influx of the people, with time, the density became uniform throughout the city.

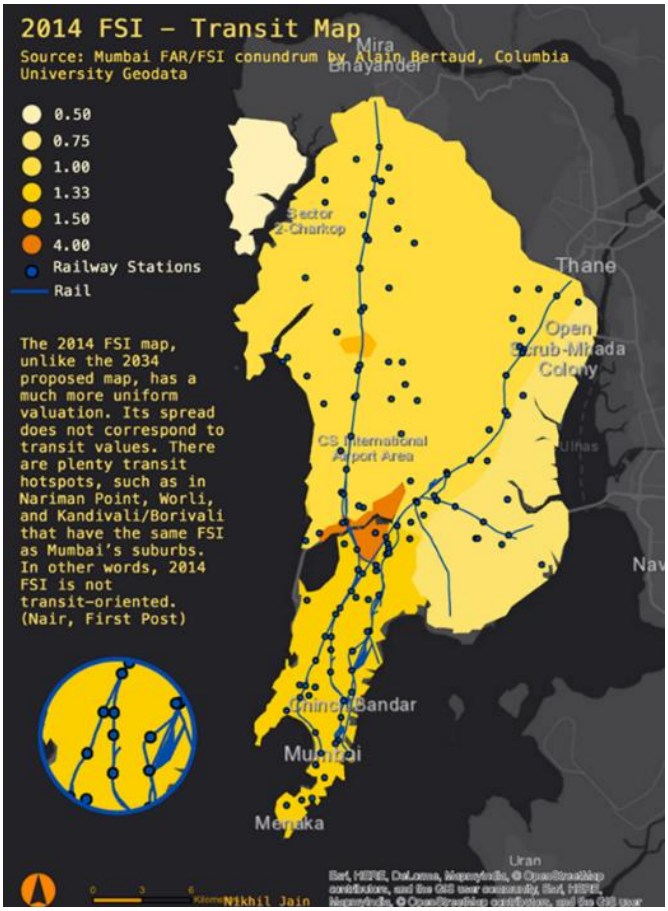

Fig 2(a): 2014 FSI- Transit Map

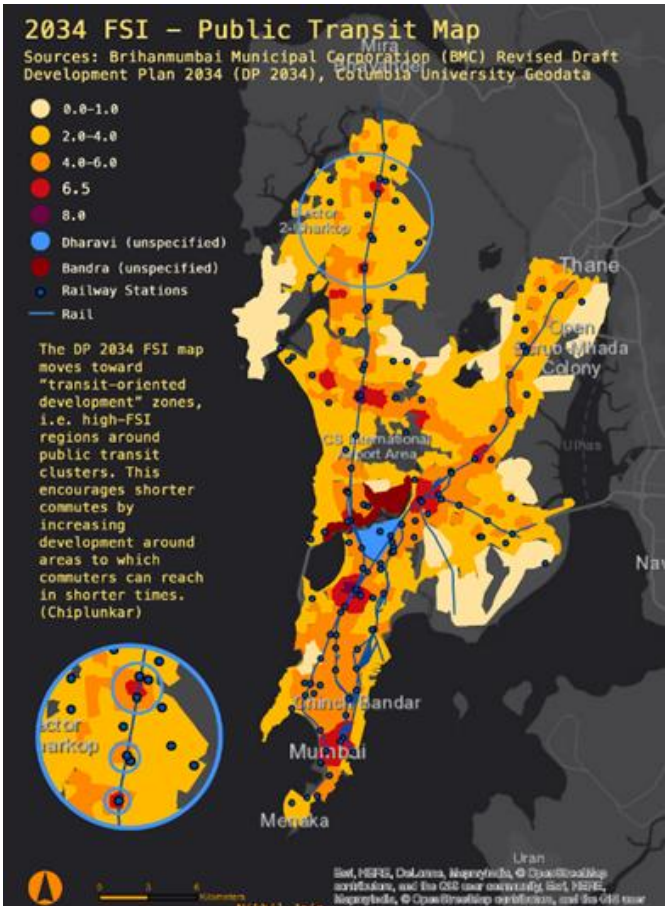

Fig 2(b): Proposed 2034 FSI- Transit Map

According to the new development plan, the government has substantially increased the floor space index (FSI) along the major transit corridors.

4.7Changing Land Use's impact on sustainable living

Mixed use land development and transit system development are two interdependent parameters of the urban development contributing to sustainable living.

Mixed-used development leads to concentration of different kinds of space, thus promoting the pedestrian mobility and use of public transport.

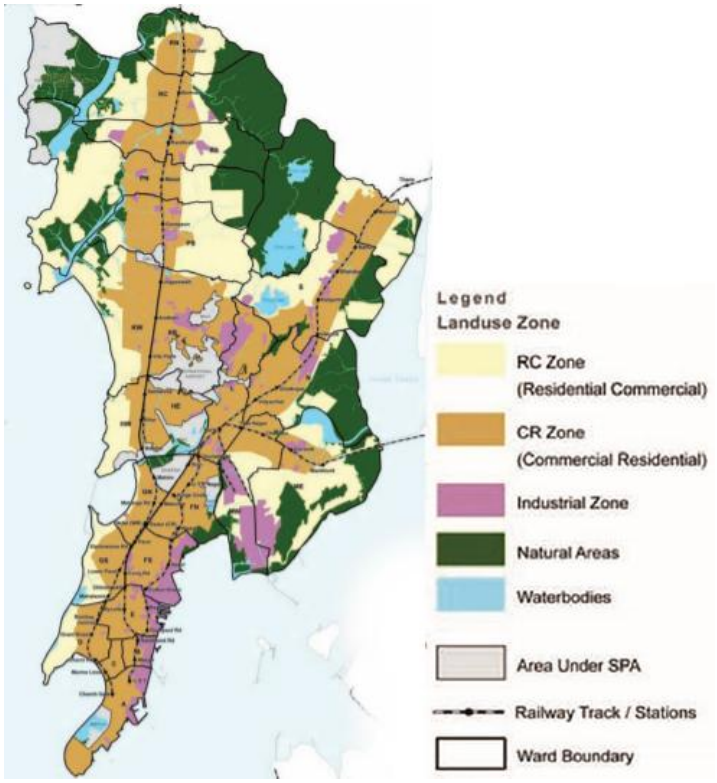

Fig 3: Land Use Map

5. DISCUSSION

Transit oriented development is generally linear, engaging various kinds of activities on a single corridor. Linear cities are always benefitted with transit-oriented development. Mumbai being a linear cityhas benefitted immensely because of its development along the mass transit routes.

It has been identified that along with Mumbai's geography, its rich history is responsible for the current image and urban character and functioning of the city. The city flourished because of the mass transit systems and has sustained time successfully because of it.The urban development was caused because of the development of transit systems.

6. CONCLUSION

All the transformations that have happened were induced by idea of development of transit systems which in-turn led to the mixed usage of land by concentration of various activities in a place;thus density increased and the city grew vertically.

All these transformations and development indirectly led to sustainable living.

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Transformation of Organical Development of Urban Public Place to Public Plazas

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Abstract: ***In the current socio-economic life there are multiple public spaces designed and there are many that are eventually created over the period of time. These are the places used by public for recreation in everyday life. The aim of the topic is to understand how an organical (unplanned) development of public space is transformed into public plaza. The objectives of the research include study of organically developed space, public space, typology public places, public plazas and function of public place as public plaza. The Case studies are based on two different spaces in two different districts in Maharashtra state. Considering the diverse cultures, regions and religions operate at different levels regarding the boundaries of public vis-à-vis private, the nature of spaces is constantly changing. there's a need to create interconnected ecosystem with the city fabric to allow the organic (not through a formal planning process) to constructively engage and mutually coexist with the inorganic(planned) and to see the cities as the sum of its multitude of spaces and people's interactions in them as a reflection of their culture with due course of time and not see cities as buildings and streets.***

Key words – Organical development, Public Spaces, Public Plazas, Transformation, Planned Spaces.

1.INTRODUCTION

In the current socio-economic life there are multiple public spaces designed and there are many that are eventually created over the period of time. These are the places used by public for recreation in everyday life specially to socialize hang out, public events or community celebrations. Although public spaces can be indoor but urban designs are mostly interested in outdoor spaces (between the buildings spaces, squares, markets, parks) are the most common types of places which act in terms public plaza. They are often located at major cross roads, at the end of two busy streets or adjacent to a special natural feature (John Martoni 2010).

In moving through and around the public space we gain opportunities to engage with its private functions and explore how it could conceptually inform the interaction between space of public and private use. There's need to see the cities as the sum of its multitude of spaces and people's interactions in them as a reflection of their culture with due course of time implemented in the usability of public spaces.

2.RESEARCH QUESTION:

How an organical development in public spaces is converted to public plaza?

3.SYNOPSIS:

AIM: To understand how an organical development of public space is transformed into public plaza.

OBJECTIVE:

- To study organically developed space.
- To study public space.
  - Typology of public places.
  - Study public plazas.
  - Study functions of public places as public plazas.

SCOPE:

The Places which had a significant meaning eventually start serving as a public place, that enhances the vibrancy of a city life. City life from the point of view of metro cities to the district level cities.

LIMITATION:

Study is limited to the places or space which evolved into public plazas over the course of time in the districts of Maharashtra in India.

4. RELEVANCE OF THE TOPICS:

Indian cities and public spaces within them are fast evolving and being driven by global economy, western influence and rapid urbanization. Good spaces serve as a stage on which the daily drama of a city's public lives is enacted by providing a unique window into the socio cultural fabric of the city. Considering the diverse cultures, regions and religions operate at different levels regarding the boundaries of public vis-à-vis private, the nature of spaces is constantly changing. there's a need to create interconnected ecosystem with the city fabric to allow the organic (not through a formal planning process) to constructively engage and mutually coexist with the inorganic(planned) and to see the cities as the sum of its multitude of spaces and people's interactions in them as a reflection of their culture with due course of time and not see cities as buildings and streets. (Dr. Devdutt Pattanaik, celebrating public space in India)

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The growth of cities characterized as either new development or re-development and densification of existing city areas extent to informal settlement, supported by infrastructural development in spurts. Underlying the apparent chaos there is a strange order in way the public places in our cities work, and there is unique character and liveliness associated with each of these spaces that become an integral identity of the city.

5. LITERATURE REVIEW:

Organically developed space:

From the ancient times, towns and cities are classified into different types according to their growth such as 'naturally' or 'organically' and 'artificial' or 'planned'. There exists a continuum from organic to planned growth. Organically growing cities develop much more slowly than those which are planned. Cities which grow naturally are formed from through a small scale growth then those which lead to planned growth. Organic change involves both growth and decline, while planned change is more asymmetric, frequently embodying growth nut rarely dealing with decline. More complete picture of the urban development is based on backcloth of natural or organic growth both in space and time. Thus there is a requirement of built environment with consideration to organic change of space. The organically growing public spaces play a major role to the urban development, these spaces need to identified and recognized.

Public spaces:

Public space is a social space that is generally open and accessible to people. It may be a city level converging spot or waterfront spaces or other area within the public realm that helps promote social interaction and a sense of community. Possible examples of public place includes city plaza ,town squares ,market places , high streets and malls ,city level parks and public greens, water edge boulevards and spaces, open spaces within public buildings or spaces within private buildings .a space where social interactions and economic exchanges take place and give birth to string sense of community and commerce-where friends meet , strangers interact ,where homeless or dejected ponder over what to do ,kids play, also where political demonstrations ,religious processions and cultural celebrations take place. Vibrant public places are both democratic and equitable in nature. These belong to homeless as much as they belong to the millionaire.

Many of our public spaces are crowded, chaotic, dirty and unsafe-yet they are alive and throbbing with vitality and dynamics. These places celebrate their democratic and multifaceted nature and offer something of functional utility and value to everyone. To understand their richness and beauty we need to identify the characteristics of these public places and how they evolved over the period according to the requirement of the public. It is equally important to note whether specific planning efforts and formal design contributed to create a sustained and enhanced character of public space or if the space formed historically, or in organic (not through a formal planning process) manner and grew in its importance as the city grew around it. This created spaces turns as public plaza a community amenity that serves a variety of user including building tenants and visitors.

- Devdutt Pattanaik "the flowered gaze'' in Hindustan times june2011
- http://www.pps.org (project for public places)
- LUMEN 2014 City Architecture as Cultural Ingredient

Public spaces are found to be of four kinds – examined from a built form perception.

- Spaces which are intentionally carved out in its current form as part of formal designs.
  Eg. the Connaught place inner circle and its central park in New Delhi.
- Historic spaces parts of old historic towns or monuments, which originally had a specific design function and scale, but after hundreds of years later, its current schema within the city.
  Eg. temple square at Jagannath Puri.
- Spaces which are geographically built and available, and experience has been accentuated by means of some intelligent and sensitive design interventions by city planners.
  Eg. Marine Drive, Mumbai.
- Spaces which through their incidental location in the overall city scheme have over the years became a focus point as the city has grown around them.
  Eg. South extension market, Delhi.

Functionally, these spaces can be broadly classified into following categories:

1. Public building and monument plaza.
2. City squares and cultural spaces.
3. City level urban parks.
4. Bazaar streets and market places
5. Waterfront spaces
6. Religious spaces
7. Ancient heritage monuments spaces.

- Celebrating public spaces in India by Archana Gupta and Anshuman Gupta forwarded by Dr. Devdutt Pattanaik.

The main focus of public spaces throughout remains to re-define our gaze, understand and celebrate the liveliness, timelessness and the beauty of these great Indian urban public places.

6. METHDOLOGY:

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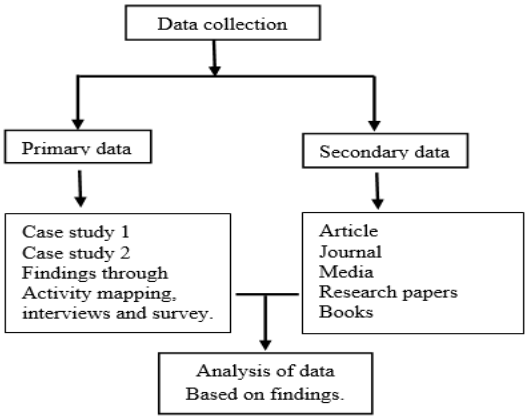
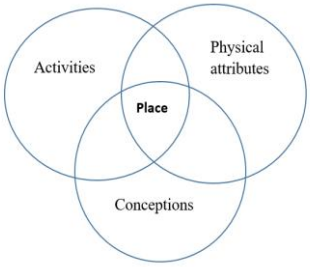


Primary data: Consist of the case studies of the selected two organically developed public spaces. Research method will be followed by the activity mapping of these places along with the interviews and survey.

Activity mapping: It's the method of observing people's movements that relate to the physical characteristics of built environment components and its attribute. It is observing the day to day activity of the people in the space. This mapping demonstrates and describes how activities are allotted and what type of activities take place in the space.



Basic elements of place
By Cater (1977)
Activity mapping method will lead to know the unique identity of the place.
By considering the Montgomery (1998) there consists of two main concepts 'diversity and vitality' which will define the range of activities within that place.

Diversity: This concept refers to primary uses and activities of the place.
Vitality: This concept includes the number of people within the place during day and night time and is analyzed by the number of cultural events taking place along with the street activities.

This method will help identify the proposed concept of organical development into inorganic development and its potential relationship between people activity and physical setting of the place.

- Activity mapping of the places:

This mapping demonstrates and describes how activities are allotted and what type of activities take place in the space. Activity mapping method will lead know the unique identity of the place.

- Survey of the place:

This survey is to ensure that each respondent is able to answer the questions at a level playing field to biased opinions that could influence the outcome of the research. This involves asking people for information through the questionaries' about the space they have lived through. By the general questions how the space severed over the time and changed its functions.

- Interviews:

This method is appropriate when there is need to collect in depth information on people's opinion, thoughts, experience and feelings. This interview can be conducted face to face or over the telephone with the local people professors etc.
Here people spoke about the place being developed or changed according to them over the period of time.

The research can be conducted in the district level cities of Maharashtra such as Satara and Karad.

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SATARA: The surrounding area the Rajwade in Satara.
KARAD: The surrounding areas of Priti sangam -ghat in Karad.

7.DATA COLLECTION:

Case study 1 (Ancient monumental building):
RAJWADA

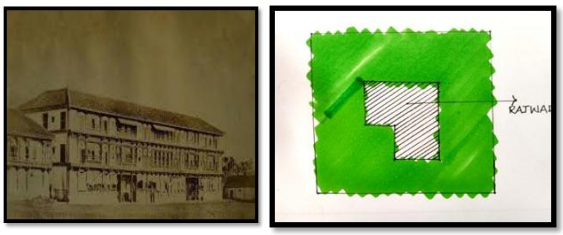
Figure. Rajwada

Rajwada located in the Satara district of Maharashtra. An historical place built as the residence, for the descendent of Maratha Empire. It is situated in the core area of Satara city. It is one of the ancient monumental historic building in Satara.

Rajwada built as the residence for the descendants of Maratha Empire in 1844 was surrounded by the green land. There has been development of the space surrounding the rajwada over the time. There is primary school built by the descendants of Maratha Empire in 1937. There is a Aryangal hospital built in 1943 as the health facility for the people in Satara and surrounding area. Rajwada mandia is the vegetable market building allotted to the
increasing encroachment surrounding Rajwada. The Panchpal haud is the Durgamata Mandir built in 2017 due to the importance and worshipers of the goddess around that place from an ancient time. These are the fewer places surrounding the Rajwada which mark the landmarks and the buildings that were constructed over the time as per the requirements.

8.FINDINGS AND CONCLUSION:

Figure. Rajwada Mandai-2004, Rajwada Choupati-2018 area

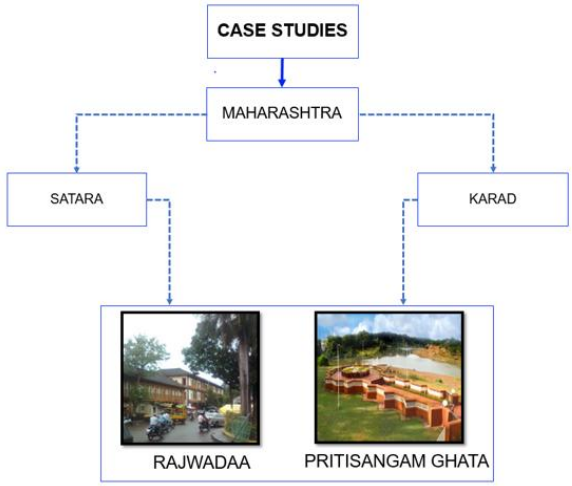


1950:

Rajwada built as the residence for the descendants of Maratha Empire in 1844 was surrounded by the green land. During 1950 there were still very few built structures around the Rajwada it was surrounded by the green land. The area in front of the wada was used for the rest area of animals like horses and elephants.

1960:

Figure. Weekly Market



By 1960 there was an increase in the settlement around the wada there was primary school built and a health facility introduced. With the increasing needs of the people there started weekly market, where people from the nearby villages would come and sale the goods.

1980:

Figure. Part of Rajwada-Primary School

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By 1980 the descendants of Maratha Empire had moved to the new Rajwada building. The part of wada started functioning as the primary school. There was an increase in the people migrating to Satara. There was also increase in the vendors in the weekly market (on Saturday). Hence the daily market began which would be situated in the lane between the wada and the school.

2000:

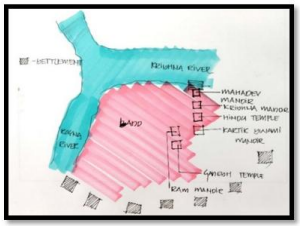
By 2000 Rajwada functioned into two activities in two divided parts of wada one as the Pratap Singh Raje Bhosale primary school, and the other part as the justice court. The issue of encroachment around the wada had not yet stopped there was a rise in it. The area surrounding the wada had grown live due to the public activities held on daily bases. There were stalls of eatables being set along with the market.

Figure. Encroachment stalls, DP 2001 Rajwada area

2019:

By 2014 Rajwada mandai building was allotted to the

people holding vendor license. Since there was great disturbance in the activities held in the wada. This though reduced the number of encroachment but it still did exist. Though the market moved to mandai building the food stalls replaced them creating the area called Rajwada Choupati. There are yet many issues regarding the impact on economy of people being displaced, current usability of the space in front of wada, vibrancy of the space etc.



CONCLUSION:

Over the period of 50 there has been a change in the activities of the Rajwada along with its surrounding area. The function of the wada had an impact on the activities held outside it. From a weekly market to the choupati there has been an evolvement of the space surrounding the Rajwada. Though the activities differed the vibrancy of the space took its own form throughout the time. The people engaged in the activities also differed from the migrated farmers to the license holding vendors. The vibrancy of the space evolved creates its own identity in the city. This organical development of the public place serves as the public plaza.

Case study 2 (Geographically built- water front space): PRITISANGM GHAT

Pritisangam ghat is a place where Krishna river and Koyna river meet each other. It is situated in Karad. Both rivers originate from Mahabaleshwar and meet each other at Karad from front. This sangam is very rare in world where two rivers come from front and take a turn and become one river.

8.FINDINGS AND CONCLUSION:

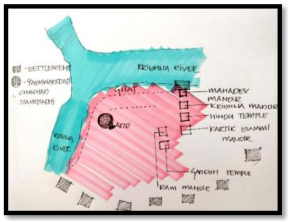
Figure. Pritisangam Ghat, Temples by the river

Pritisangam ghat is a place where Krishna river and Koyna river meet each other. It is rare geographically formed sangam. There are several legends connected with the formation of rivers and the establishment of the temples. eg. Rivers are considered sacred and believed that a holy dip in these rivers will erase all the sins. Hence there are various temples located at the sangam Mahadev temple, Ganesh temple, Kartik Swami temple etc.

Due to the existence of the water body there has been a town and settlement grow along it in Karad.

Figure. Growing settlement around Ghat

Since throughout the history of human civilization river valley is an ideal location for human settlement due to importance of water in human life. The Ghats are more intricate spaces within the city, and their dialogue with the city is experimental.



After the death of Yashwntrao chanvan (the first Chief Minister of Maharashtra) In 1984

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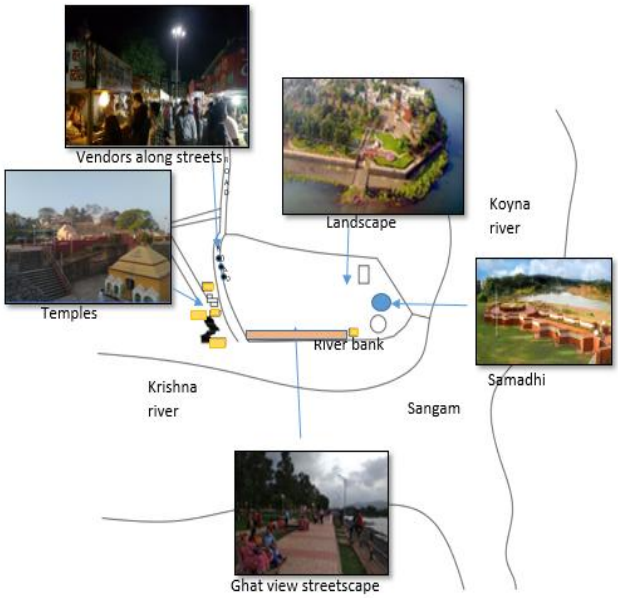
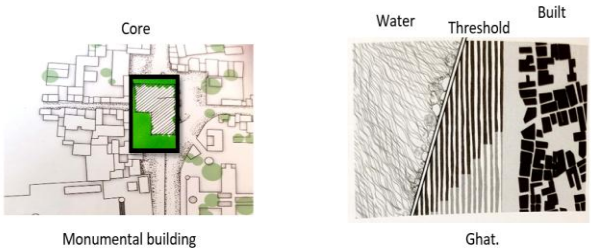


his samadhi (resting place) was constructed along the



Pritisangam Ghat.

Figure Ghat view and street, walkways along ghat

Along with the religious believes like sangam temple and the scenic view of sangam, the Samadhi of Yashwantroa Chavan also become major reason for people visiting the ghat area.

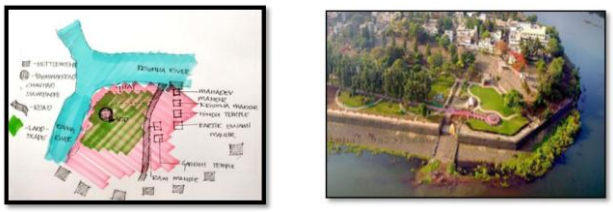


Figure. Area surrounding Pritisangam Ghat

Figure. Landscape developed around ghat

Since ghat is the edge that is activated by the locals for whom this is a major breathing space of the city and also has become one of the tourist place in Karad that has drawn by the combination of natural plus man – made scenario. The number of people visiting ghat has increased the area along the Samadhi and the temples have been redeveloped with streetscape, landscape, garden, kids play area and walkways and scenic points.

Figure. Pathways along garden, Vendors around street

Increase in visitors there has been increase in the public activities and the streets leading to ghat and areas along the landscape developed is crowded with the encroachment vendors and has started serving this public place as the public plaza creating one vibrant atmosphere in the city.

CONCLUSION:

started evolving. Vibrant public waterfront space became the signature of the city. The same space with the sangam of rivers today serves as a significant public plaza with diverse mix of public activities that adds to the unique factor of city. From the religious believes to the Samadhi construction there was an increase in the importance of the space. There is increase in the public engagement surrounding these place.The place that was geographically created over a period of time

8. DATA ANALYSIS:

The reasons for the conversion of organical development of places as public plaza:

The original purpose of the space.

- The change in its functionality: as seen in change in the functioning of Rajwada.
- The change in surrounding of the space: starts creating an identity seen in the Pritisangam ghat.

Public spaces being the most vibrant and live identity of the city sometimes remain unorganized and unrecognized due to the organically development of such spaces. These are prominent spaces that is witness to the majority of community and city level events like festivals, lectures, national days, religious activities etc. These spaces have the potential with time, to eventually integrate itself deeper into the fabric of the city. Public spaces in historic cities are recognized and associated with a corresponding historic monument. In the

Evolving fabric of traditional cities, these monuments and surrounding areas are interwoven within the fabric of the city. Water attracts people, provides a focal point in the

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city for the day-to day fundamentals of life as well as a backdrop for celebration and rituals, recreation, fishing, tourism etc. Hence we find many public spaces built around rivers, lakes etc.

The spaces such created are then activated by the tourists who visit it as well as the directly linked livelihood and allied cultural activities associated with the spaces. The scale may be larger enough with time to develop and sustain a significant urban area serving as a developed public plaza.

ACKNOWLEDGEMENT

Primarily I would like to thank God I would like to express my deep sense of gratitude from the bottom of my heart to my guide and co-guide Ar. Revati Daware and Ar. Seemanthini Chaphalkar for his valuable guidance, inspiration and encouragement. Indulgence in this work helped me to reach an irreproachable destination.

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The Urban Memory Association in Public Open Spaces:

Case of Mahatma Phule Mandai, Pune

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Abstract: ***Urban spaces define the historical and cultural character of the city. Indian streets are viable public spaces which retain the functional character yet providing a psychological meaning to people's lives. The memory that people make with a space leaves a lasting impression in their minds, advancing from the past to the present. The streets around the Mahatma Phule Mandai in Pune highlights the city's social and political development. The image of a place related to the associated memories of the people with the place has not been studied yet. The research methodology of this paper involves reviewing the historical development of the Mandai, cognitive mapping and interviewing the users of Mandai.***

Keywords: ***Urban space, cultural character, viable public space, memory, image, associated memories***

I. INTRODUCTION

1.1. Urban Space

Urban open spaces are a critical site for cultural, political and economic life from the civilizations to the present day. (Stanley)People interacting in such urban spaces is an important dimension of the public space. (Zahrah, 15-17 June 2011)The image reflects the psychological inheritance of the people relative to the place. The quality of life of people in urban areas is the outcome of the interaction of people with the urban environment. Being a cultural product of its setting, such spaces project a complex social and political meaning to the people. Indian public spaces provide a physical setting for socio-economic activities. The streets in religious precincts showcase a strong sense of religious spatiality, reflecting social functions. (Sehgal, 4 May 2017) The narrow streets are perceived as humane, warm and personal; adding to the values of the space.

Do such psychosocial processes in such public spaces have continuity in time and space, as the memory of life in a big city?

People tend to experience the world that is connected physically and mentally with the past events. Memories act as a threshold of the past events. (Ahmadi Oloonabadi, 2011)Even when an event happens and time elapses, it is the space of the event that remains in our mind. This feeling of familiarity of a space creates the sense of the place. (Mowla, 2004) Memory is the diffusion and transformation of meaning across time and space, both to the rituals of everyday life and to the special moments of remembrance. (C.J., 2004)Memory associated with a space highlights the psychological significance of the place. Such places become the focal points of cultural spirit, increasing social interaction. The space association can add to the memory, meaning and perception of the place, but at the same time the loss of identity can also weaken the depth of the meaning and attachment to the place. (Sumaiyah Othman, 19-22 March 2013)

1.2. Introduction to Pune

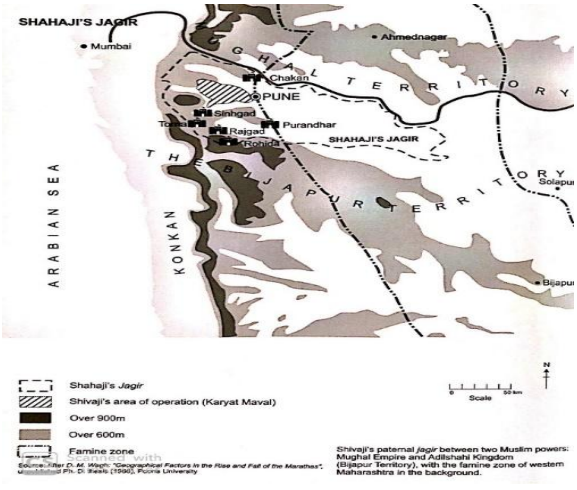

Figure – 1.1 Map of Pune showing the provinces

Source: Book: Pune Queen of Deccan

Pune, the second largest city of Maharashtra, is located on the Deccan plateau, along the Mutha river. Pune was the seat of the Peshwas in the 18th century, which was a strong political center on the Indian subcontinent. The city is also known as '*Puṇyanagara'* meaning "city of virtue". Pune reflects the blend of traditions with modernity. The old

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core area of Pune consists of 18 peths and is symbolic due to the presence of the Maratha culture; epitomizing arts and crafts, music and dance. The peths represent the cultural past in harmony with the chaotic present.

1.3. Mahatma Phule Mandai

The Gothic-style building of Mahatma Phule Mandai, located in the old core of Pune, is the biggest decentralized market of Pune. The market building taking 4 years, was completed in 1886, with the structure carved in local grey stone and wood. The structure is dominated by an 80 feet central octagonal tower, with eight entry wings signifying eight directions. Gothic arches flank the entrances of these eight wings.

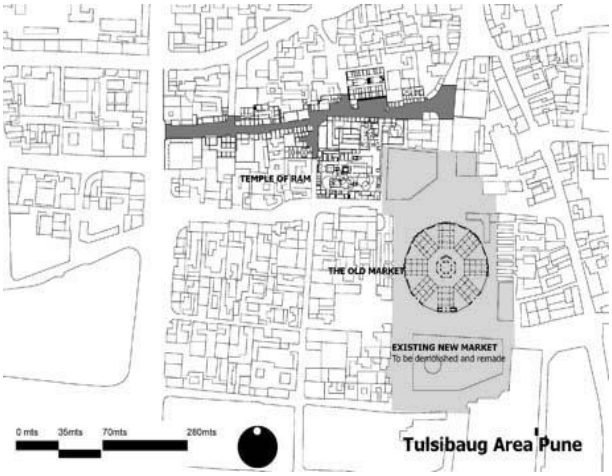

Figure – 1.2 Plan of Tulshibaug, Pune

Source: Internet-Shirish Joshi

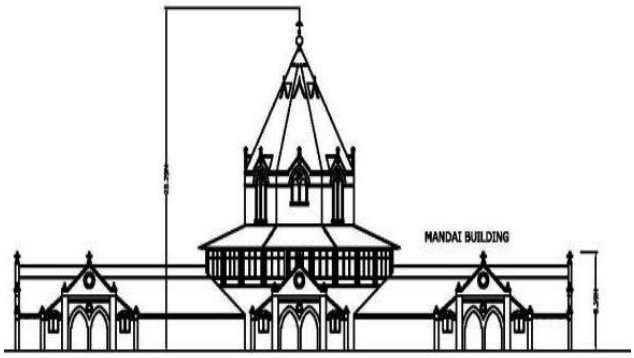

Figure – 1.3. Elevation of Mahatma Phule Mandai

Source: Kimaya

Originally called Reay Market, the Mandai was built by the Poona Municipality also serving as their Municipal office. The British era in India, especially in Maharashtra was characterized by the display of power by the Britishers against the Peshwas. The Reay Market stood as a symbol of might, erected right in front of the Tulshibaug Mandir. The height of the structure was intentionally kept taller than the shikhara of the Tulshibaug Mandir, to show the domination of British over the Peshwas. The Post-Independence period was marked by an ironical turn of events. The Mandai was renamed after Mahatma Jyotirao Phule, the very man who opposed its construction. Over the years, the Mandai has lost its symbolism, following the urban growth of the city. Once the tallest structure in Pune, the Mandai became an agglomeration of social and cultural events. With around 526 stalls of fruits and vegetables, the area is a vibrant market place, showcasing activities like Ganesh Chaturthi, Gokul Ashtami, Ram Navami. (HOLEY)

This place has now lost its beauty and age-old symbolism due to the unplanned growth around, and placement of intrusive elements.

II. METHODOLOGY

The methodology followed in this paper is collecting historical data regarding the growth and development of the Mahatma Phule Mandai; analyzing the space on the parameters stated in the Kevin Lynch theory and also understanding other aspects reflecting the sense of the place. A study of the qualitative aspects of the space was done. A series of interviews was taken of the users in and around Mandai; the buyers, the sellers and the visitors. An open-ended questionnaire was prepared to assert the symbolism and meaning of the structure in the people.

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Figure – 1.4. Evolution of Mandai- Mahatma Phule Market (Reay Market) circa 1900, 1920, 1980

Source: Book: Pune Queen of Deccan

Figure – 1.4. - Mahatma Phule Market- Present day

III. RESULTS

3.1. Kevin Lynch Theory

Kevin Lynch in his theory of imageability discusses the quality of cities according to the legibility factors of the elements perceived by the observers. People create mental images of a city as a result of their memory and meaning. The theory emphasizes on the component of 'identity' and 'structure' of the urban elements as two important factors in affecting environmental image. Lynch highlights the five major urban elements that enhance the imageability; which are paths, edges, nodes, districts and landmarks. Lynch states vitality as the degree to which the form of places supports the functions, biological requirements and capabilities of human beings. Vitality also refers to the degree with which an urban space is socially successful. (Oktay, 7-9 December 2011) He also defines spaces according to the extent to which a place feels alive or lively.

3.2. Application of Kevin Lynch theory in Mahatma Phule Mandai

Kevin Lynch established a connection between psychology and environment by asserting such parameters. (Kevin Lynch mapping method: Physical & Spatial Characteristic Of Environment)

The mental map created by people of a city are based on the following parameters as stated by Kevin Lynch. The analyses of the Mahatma Phule Mandai is done on these five parameters.

3.2.1 Path: Path is the most legible element in the city image, signifying the linear form in which the observer walks. The path leading to the Mandai is marked by narrow, congested lanes in the old core of Pune. Earlier, the path towards Mandai was traced from the monumental fortification of Shaniwarwada.

3.2.2 Edge: The Tulshibaug Ram mandir was an important structure created by the Peshwas during the British rule to remind people of the glory of the Maratha empire and boost their morale. The Mandai came up right in front of the temple, with its height bigger than the shikhara of the temple.

3.2.3 Landmark: The Mandai itself stands tall as a landmark, right from the era it was established. It was the site for remarkable cultural and social events. The land once marked a space for protests, cultural gatherings and festivals.

3.2.4 Node: The node acts as a prominent market space in Pune, where fruits and vegetables are sold at a cheaper price than the rest of the city. The node is characterized by stalls of the vendors.

3.2.5 District: The Tulshibaug complex is a prominent market area in the city and the peths have a distinguished urban pattern from the rest of the city. (Lynch, 1960)

3.3. The qualitative aspects can be studies under the following heads which define the sense of the place.

3.3.1 Identity: Identity means a distinction from other objects or place. The Gothic building of the Mahatma Phule Mandai holds a strong identity right from the time it was built, making it unique for the place it was built in. The events also mark the identity of the place, adding to the spatial attributes and memory of the place.

3.3.2 Structure: Structure means a relationship to larger pattern of other elements; the object is not seen isolated from the surroundings but as a part of all the environmental components.

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3.3.3 Meaning: Meaning means a practical and emotional value for the observer. The meaning of the space is relative to its culture. People relate to the activity which in turn associates to the mental image of the inhabitants. The Mandai is a space for major cultural, social, economic activities of the city.

3.3.4 Association: The association that one has with the Mandai is symbolic. The vendors at Mandai have a strong association with the space. There have been generations of vendors sitting at the same place from years together.

3.3.5 Congruence: It is the relationship of the form to its function. The degree of congruence is less in the case of the Mahatma Phule Mandai. The structure was designed as an office space for the Municipality; now the Mandai serves as a market space.

3.3.6 Transparency: There is a degree of visibility of Mandai. The events in and around Mandai have immediacy to the passers-by.

3.3.7 Legibility: Lynch considers legibility as the physical and spatial characteristic of the environment. The visual sensation of colour, motion, smell, touch and sound are cues of the orientation in Mandai. The legibility of Mandai enhances the identity, structure and meaning of the surroundings.

3.3.8 Accessibility: The accessibility is defined as the ease of the ability of reaching a place. The accessibility is through narrow, bustling lanes of the old core of the city, with markets and pedestrian crowd.

3.3.9 Usability: Today the use of the structure has shifted from the intended use. It was built as an office space of the Poona Municipality.

3.3.10 Visibility: The location of the Mandai is prominent, with high visibility. The visibility in the 18th century was defined from the Shaniwarwada.

3.3.11 Visual Attraction: It is concerned with the physical characteristics of an object to strengthen it as a landmark. The characteristics that shape this factor are:

Façade: The façade signifies the Gothic era of architecture, with a building made in grey stone and wood.

Shape: The Mandai is a prominent structure in plan; octagonal central tower with eight flanges radiating out in eight directions.

Colour: The grey building in the midst of the vernacular constructions of Pune is remarkable and hence memorable. (Kevin Lynch mapping method: Physical & Spatial Characteristic Of Environment)

IV. CONCLUSION

The world has evolved continuously and will not stop. Cities are fast changing. Factors like increasing population, sprawling development, failing infrastructure affect the growth patterns of the cities if not looked after. The modern Indian cities have lost their degree of homogeneity and also their expression of the culture. Such urban areas have been transformed into inhuman spaces which reduce the quality of life of the public.

On analyzing the mental image of the Mahatma Phule Mandai, we assert the influence and relation the structure has on the people using the space. The Mandai holds a strong historical significance in terms of the events as well as the association that the people have with the structure. The users of Mandai reminisce the space. One major finding is that the surrounding structures dominate and diminish the presence of Mandai in the present day.

Such prominent structures of the past shall be preserved and there should be stringent laws regarding the growth in the surrounding areas.

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Transformation of Transitional Spaces in Traditional Maharashtrian Residential Built Form.

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Abstract : The transitional spaces are the spaces which connect two or more different spaces, these spaces also act as buffer zones for indoor and outdoor spaces. Looking at Indian architecture, there are features like pavilions, courtyards, terraces, vestibules and thresholds which accentuate transition. In Maharashtra, the transitional spaces are observed in residential built environment performing similar roles traditionally. These spaces play an important role in the various festivals, social and cultural activities. The research focuses on the physical aspect of the space. The research examines the various transitional spaces used in Maharashtrian architecture by investigating the transformation of transitional spaces according to different timelines. The paper concludes with understand the transformation of transitional spaces according to the time and how the traditional values are adopting the change in the transitional spaces.

Keywords: Transition space, Maharashtrian residential built form, Maratha Architecture, buffer zone, traditional aspects, socio cultural association.

Introduction.

What are transitional spaces?

The transitional spaces are the spaces between indoor and outdoor spaces, these spaces act as a buffer zone for going in and out. It is also defined as a link or a connecting space between two enclosed spaces. These spaces are mainly provided in structures like educational buildings like schools and colleges, research centre, commercial buildings, and even residential buildings. Transitional spaces are mainly created to give user an experience of a buffer space or a zone to connect indoor space and outdoor space. It can be also link between public space and private space. Transitional spaces usually consists of entrance foyers, corridors, buffer zones, lobbies and other transitory areas used inside a building.

In Indian architecture, the transitional spaces plays a very significant role, especially in residential buildings. The transition spaces marked the boundaries of the living space. These spaces played a role in dividing and connecting the inner and outer space. The gate, the security door, the threshold. These spaces were decorated and ornamented to highlight the transitional space.
In traditional Maharashtrian architecture, the typology and form have been transforming with the time. They vary in usage and connection. In earlier times the villages were scattered and were having lot of space to construct their home, hence the transitional spaces during that time were large as compared to transitional space present. In the transitional various activities are happening since many ages like welcoming ceremony of bride after the wedding, performing pooja in these spaces for festivals like Ganesh Chaturthi, Diwali, drawing Rangoli daily, etc. These cultural and traditional activities are connected to these spaces. As the transitional spaces transformed the cultural and traditional activities also transformed with them.

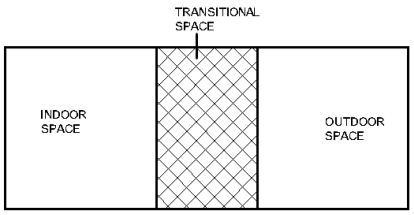

Figure 1: Transitional space

Research Background

Architectural spaces that can envelope like a physical presence. Transition is in between state. In architecture it is defined as a link or a connecting space between two enclosed spaces and also in the circulation spaces, in the form of corridors, stairwells and atriums, it cannot be avoided in design of most of the building. The percentage of these spaces may vary according to the function. Their functionality also varies according to the appropriate requirements of the user.

These in between spaces offer an opportunity to interfere and create a space which re-engages the person, in that space or passing through that space, through repetitive interruptions or pauses. The spaces could create a subtle interconnections. Which can be exploited and temporal experiences could be defined through architectural interpretation of transitional spaces.

The use made of the spaces outside the home the home is more obvious in southern societies. In Mediterranean countries, balconies and courtyards are for women, while the men occupy the public square markets.

However, according to J.Miller, countries of the north do not do not ignore this use of the threshold, and we are familiar with the symbolic use of the threshold of the Amsterdam

house with its three vanished ceramic steps. It recalls a truth that these extra spaces are really much more useful to poor than to rich and that the street has always been the poor man's sitting room. (Nicole elb harle, roles and meanings of transitional spaces)

Transition space plays an important role in residential spaces. These spaces are used maximum during festive events. In Maharshtra transitional spaces have both traditional and social importance.

These spaces are used for various purposes like, drawing rangoli, celebrating festivals,etc. These activities are performed by people since many years.

As these spaces have traditional importance as well as social importance. Social importance is when any guest or a respected persons visits a house they are welcomed at the entrance or in the transitional space.

These socio cultural activities have transformed along with the transformation of the transitional spaces in residential built form.

Research Methodology.

Transitional spaces plays an important role in residential spaces. These spaces are used for various purposes like activities during festivals, etc. In Maharashtra residential traditional transitional spaces have both traditional and social importance. This research is done by studying various traditional structures of Maharashtra which have transitional spaces according to the different timeline and how the transitional spaces are transforming. And along with these spaces how the traditional and cultural activities are transforming. This research only focuses on the physical aspects of the space and the socio cultural activities related to it. The research methodology is by doing the case study of various structures according to the timeline.
In this research I have took three different structures according to different time line and having different volume of transitional space.

- Vishrambaugh wada, Pune.(1807)
- Jagtap's Residence, Nashik.(1970)
- Arunodaya Society, Pune.

By studying these spaces, the various cultural and traditional activities happening in these spaces are noted. And the socio cultural aspects are studied.

Scope and Limitations

This research is based on the physical and socio cultural aspects of the transitional spaces. And it is only restricted to the traditional maharashtrian residential spaces.

Vishrambaug Wada, Pune.

This wada was constructed in year 1807. The place was owned by bajirao peshwa the 2nd. Following activities used to happen in the transitional space of the wada.

Activities:

During various festivals the transitional space is decorated and ornamented in various ways like: tying garlands made of the various natural elements like mango leaves, marigold flowers, and jasmine flowers. The space was decorated mainly during the festivals like Diwali, Ganesh chaturthi, dussehra, gudi padwa, holi, navratrti and many more. According to the each festival the transitional space is used in different pattern and different activities takes place. Some examples of usage of these spaces are: lighting oil lamps during Diwali, drawing rangoli during various festivals.

Socio cultural activities:

In olden time or during the peshwa era, when the peshwas or their commanders used to return from war or from abroad after many days to the wada they used to be greeted in these transitional spaces, the ladies used to greet men with the aarti thali. If any elders or respected person comes to visit the place he is also greeted in the same way in the transitional space. In the same way after marriage, when the bride enters the wada she is greeted in the transitional space and various other cultural activities happen in that space.

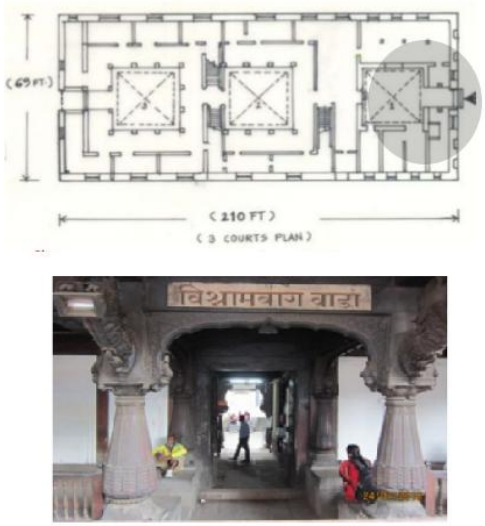

Figure 2: Plan and photographic study of transitional space at entrance of vishrambaug wada, pune.

When the wada was constructed there were no security doors or the security guards so the soldiers were appointed as the guards and they were appointed at the entrance in the transitional spaces.
If any goods seller or a stranger wanted to enter the wada they were asked the purpose of visiting the wada from the inner end of the transition space, the conversation between owner and the stranger used to happen from the both ends of the transitional spaces, in short the transitional space used to act as a security space in those times.
Similarly when a person used to pass away in a family different rituals takes place in the transitional space before taking the deceased to the cremation ground.

Jagtap's Residence, Nashik

This is the residence of Jagtap family which was constructed in the year 1970, almost 163 years after the vishrambaug wada

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was constructed. Between these times many things happened that affected the traditional mahrashtrian architecture like, British rule in India, modernism, etc. According to the time the size of transitional spaces changed according to economy classes of the people, in most of the cases the transitional spaces got reducing in the size. The transitional in Jagtap's residence is less than the transitional space in vishrambaug wada.
The activities happening in transitional spaces are similar but some of the activities got transformed and some are still the same. Some of these activities changed but the purpose still remained the same. Along with that the material used for ornamenting the transitional space also transformed along with the time, e.g. Along with garlands people started using electronic lighting, various light, etc.
Following activities happen in the transitional space of the bunglow.

Activities:

Most of the activities happening are similar to the previous example. Some activities are cleaning the space daily with water daily then drawing rangoli, this was done every single day in this space. During festivals the space is decorated, this space is less in area as compared to the wada. During ganeshotsav the idol is worshipped in the space before bringing it inside.

Socio Cultural Activities:
When any family member comes home from abroad or a guests visits the home from they are greeted in the transitional space. If any salesman or postman knocks on the door they wait in the transitional space till the owner unlocks the door and meet them. On the occasions like birthday parties or any function the transitional space is decorated with garlands flowers, etc. by doing this the people around also notice the activity going inside the house.

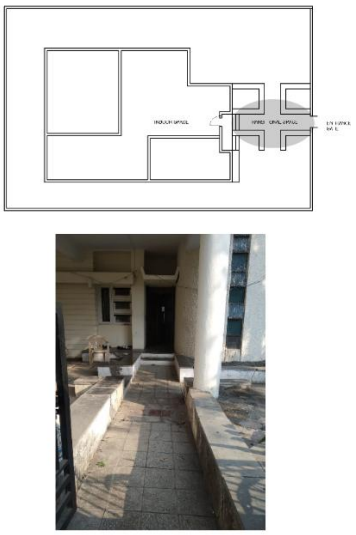

Figure 3:Plan and photographic transitional space at entrance of Jagtap's Residence, Nashik.

Arunodaya Society, Pune

Arunodaya society is a building with multiple number of flats. This structure is designed by reknown architect Girish Doshi. The building has common transitional space for all the flats. When there is any function or festival this transitional space is used. The people celebrate all kinds of festivals together.
Other activities happening in the space is as similar as mentioned earlier. Apart from the common transitional space the flats have their own small transitional space and security door that also acts as transitional space.

Figure 4 : Plan and photographic transitional space at entrance of Arunodaya Society, Pune.

Results

After studying the transitional spaces of all the three structures which were constructed in different periods. The transformation of these spaces is very interesting.
The size of transitional space got reducing according to the time. Some factors affected the transitional spaces. That are poverty, increase in population, economy factor, etc.
The transitional spaces changed but the cultural and traditional activities related didn't change although purpose of some activities changed.

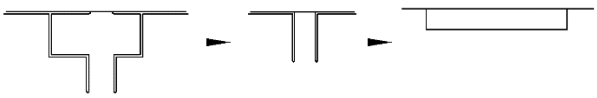

Figure 5: Transformation of the transitional spaces.

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Table no.1

In 18th century there was lot of space to construct residential structures, so we can see large transitional spaces.	In 19th century structures the transitional space in the structures got small a little bit as compares to the earlier structures.	The structures from 20th century onwards have less area for the transitional spaces, and we can get to see the more of a common space acting as a transitional space.
The traditional and cultural activities are followed in great amount in the transitional spaces.	The traditional and cultural activities are followed but some of the activities has changed.	The space is less and still some of important cultural and traditional activities happen in the transitional space.
The space was decorated and ornamented with the flowers and garlands.	The space was decorated and ornamented with flowers along with electronic light lamps and lightings.	The space is ornamented with various types of the new materials available in the market.

Conclusion

In Maharashtraian residential structures the transitional spaces has transformed gradually, the space has become lesser in size as compared to the earlier. This didn't affect any traditional and cultural activities. The material used for the decoration transitional spaces also changed or rather upgraded as the transition spaces transformed. In future these spaces will get thin and still the activities and importance may continue.

Acknowledgement

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Understanding Parameters of Approaching The Wetlands as a Sustainable Ecology

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Abstract : Water is a crucial element of life. Humans have always designed the settlement close to water. Though water demand is rapidly increasing, the usage, ecological values are changing dramatically. India is blessed with wetland ecosystems of unique habitats but, are under tremendous pressure due to land degradation, water pollution, encroachment, and other human - nature conflicts, lead to declining hydrological, economic and ecological performance. Wetland study reveals a balanced, meticulously interwoven humans and ecology maze of transactions. Ujani Wetland at Bhigwan generates economics supporting various ecological, traditional, religious, recreational, transportation, and community-based activities. This paper would help us understand the parameters of approaching wetlands as sustainable ecology.

Keywords: Ujani, Wetland conservation, community, sustainable ecology,

Introduction

Traditionally, water was seen as the responsibility of people. The community collectively used to the responsibility of not only using water wisely but also of maintaining the water bodies. Today, as water pipelines have been provided to each tenement, it has led to the neglect of the water bodies and catchments areas.

People are used to receiving water at the turn of a tap and are no longer concerned about maintaining water bodies.

On the other hand, there is still hope as worried citizens across the country have mutually come to fight to stop this degradation of urban water bodies. Rivers and their associated wetlands and lakes form a chief factor in larger landscapes having economic nature as the provider of sustenance and resource of raw materials, communication, transport, choice of settlement site, business generator, ecological, biodiversity zone. The ethnographic matter is to be drawn from communities based on Bhima River near the concerned area of study- Kumbhargaon, Bhigwan.

Figure 1Types of wetlands as per RAMSAR definitions (Ghosh, 2005)

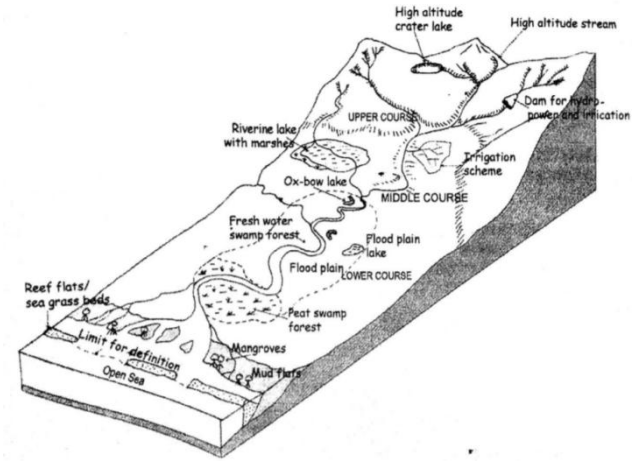

Figure 2: Bhigwan wetlands famous for winter visitors, flamingos

"Waterfronts have scenery, optimum climate, and fertile soil as agriculture and source as needs.

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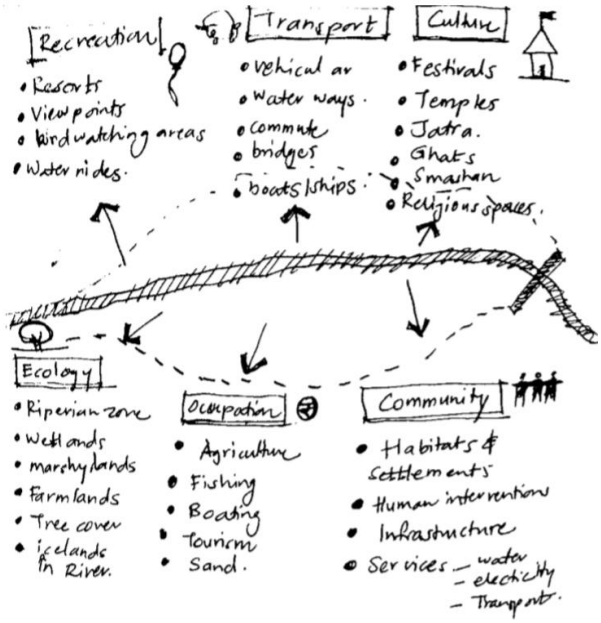
Running and still, waters affect the environment in both urban and suburban."(MITSCH & GOSSELINK, 1986.)Aim expresses that the systems made according to the natural factors vital to achieve "Wetlands are parts of the earth's surface between these terrestrial and aquatic systems. Thus shallow lakes ponds, marshes, bogs, swamps, dead river beds, tanks, borrow pits, are all wetlands irrespective of their extent, duration of waterlogging, climatic regions in which they exist, their water quality and degree of human intervention."(Ghosh, 2005)



Flowchart 1 Aspects of wetland study. Courtesy: Author

"One unique characteristic of wetlands is the presence of water and water-saturated soil. This may again either be a permanent or seasonal feature. During the period of waterlogging, wetlands should support hydrophytes"(HOLLAND, 1987)Wetlands are transitional zone between the dry terrestrial and wet aquatic systems, having characteristics of both the systems, as well as some of its own, which are unique. The diversity of character, size, type, and mode of occurrence of wetlands has given rise to different indices of describing them.

Wetlands have been observed as an outcome of an evolving traditional practice, which is interpreted here by using a subjective tool – ecology. Living creatively with nature is how the mindset of these local people has been defined and it can be verified in many other ecosystems where people with similar mindsets have succeeded in establishing sustainable means and peace of exploiting natural resources.

something in terms of function and aesthetic. At the same time, it indicates that the human follows nature knowingly and unknowingly in the developments.

Figure 4 Bhigwan satellite image. Source Google maps.

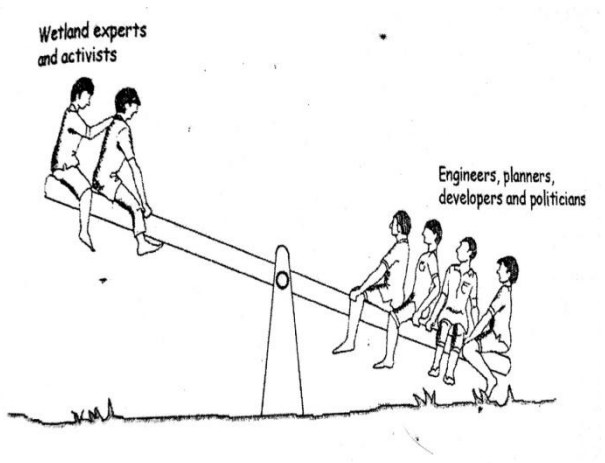
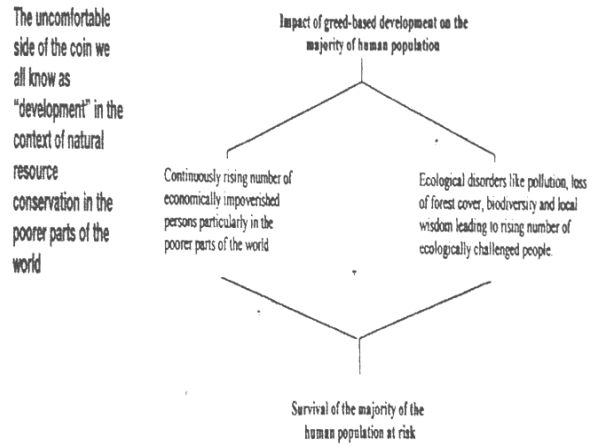


Figure 3 Wetland conservation needs its own constituency a strong support base. (Ghosh, 2005)

Urban settlements, with their ancient history, are existing formations that develop and transform constantly. Although there are several economical, transportation and safety problems for their establishment purposes and for the locations where cities were founded, geographical conditions also significantly affect this cause. Water resources transform humankind's settlements and the ecological chain. The relationships, similarities, and differences between human activities and ecological events need to be studied to understand the topic in depth.

Material & methodology



Flowchart 2: Development and conservation as sides of same coin. Source (Ghosh, 2005)

Today, Care for nature, has become concerned agenda for every government. Ecology and economics have never come so close to each other. There is very little research to satisfy this investigator, there exist enough intellectual collaboration in pedagogy proposals combining these two disciplines. Ecological interpretation challenges to bridge the gap between the traditional/ local wisdom are concerning humankind's connections with nature, and the typical planning and design process.

Wetland functions and benefits

The wetlands are frequently assessed from an anthropocentric approach. white evaluating wetlands, opportunities provided by the wetlands to are only measured. The effectiveness can be observed from the flora and fauna it maintains, the contribution for maintaining global air and water cycles, ecosystem values. The populations thrive on wetlands range from human, waterfowl, aquatic animals, trees, to a host of other micro-organisms. Plants provide food, protection, wood, medicinal elements, and a host of other non-edible uses. Animals and birds provide food, oil, fur, skin, feathers, and other items.

Ramsar Convention defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, including areas of marine waters, the depth of which at low tide does not exceed six meters'.

"Wetlands are helpful in nutrient revival and recycling, discharging excess nitrogen, deactivation of phosphates, detoxification, chemicals, heavy metals absorbing using plants, treating wastewater, controlling floods, recharging aquifers and groundwater, wells, and reducing surface run-off and subsequent erosion." (G. E. Hollis, 1988)

Wetlands: misconceptions and misuses

The association between wetland area and inappropriate value is complex Traditional economics holds the universal notion that the less there is of some product, the more precious it is. This is the universal law of scarcity & applies to wetlands. In areas, wherever most of the natural wetlands have been drained, the wish for the conservation of the remaining few wetlands is frequently very strong.

The value of wetlands: the significance of scale and setting

Wetland in a setting with moderate but not excessive urban built development and it will have the strongest ecological value because an adequate human population is present to benefit from those values, but the population is not so large as to overwhelm the wetland functions. The ecological values of wetlands are based on the biological population residing next to it or within the wetlands (William J. Mitsch, 2000)

Research Methods

Bhigwan is 120 km from Pune city towards Solapur. While this research was in progress, 3 visits were made to understand the site, context and overall condition holistically. Visits were planned in different seasons, time frames, considering the flow of visitors, birds, availability of water in the wetlands and other climatic parameters. Visitors have been interviewed with non-structured interviews understanding their ideas and aspirations about ecological conservations and development programs. This site is being documented by the government for declaring Bird wildlife sanctuary. The wetland is being reviewed by ecologists' environmentalists, engineers, bird watchers, planners, and wetland experts, for declaring important RAMSAR sites in Maharashtra.

Results

Water demands are increasing rapidly, but the water used and societal values placed on the water are changing dramatically. Water is the resource forsurvival, the sustenance for a living; the resource needed for Agriculture, manufacturing, fishing; and it provides the habitat for much of our wildlife. Water in current society is more than a simple physical

entity, it's symbolic values, and non-instrumental uses are growing significantly.

Decision-makers, authorities, policymakers may also find this research work of some use for putting it ahead of them an unspoken and hence unheard treaty for its sensible use. They should directly adapt to the framework of traditional, age-old proved, well-established wisdom in the field of wastewater management and wetland treatment in particular for sensible sustainable growth. So-called 'Development models' are undergoing fundamental changes.

Wetland performs and hence values have the meaning and potential to last for a very long time. So-called 'Modern agriculture' or industrial/ commercial/ manufacturing/ production activity are usually not sustainable and resource-depleting (soil loss; use of fossil fuels) so the life span of these human-based options is short-lived. Also in large public works project periods extends over 50–60 years. The importance of this issue is that, when wetlands are getting lost during development, then the loss of activities, functions, relationship with the context and values with the community are rarely possible.

Comparing temporary (just) financial gain from a non-wetland commercial use of a piece of landscape, with long-term wetland values may not appropriate. Not so thoughtful social decisions of assigning unnecessary value to wetlands, in addition to the danger of comparing ecosystems, is that it will be possible to find a more profitable utilization of the land if temporary economic studies are made forever.

Here, wetland cost, estimates cannot compete very well with the financial returns of sugarcane and rice in the Baramati region hence, drainage will be economically favored than wetland conservation if the traditional cost-benefit analysis is carried out. Values are influenced by religious, cultural prejudice and financial system. In Bhigwan, there are good reasons why we need & aspire to protect nature; developed countries, having already taken care of the fundamental needs of their population, are principally and actively involved in enriching ecosystems- including wetlands, for their commercial, environmental, aesthetic as well as more functional attributes, not that all of this contributes to direct financial benefit. Here, various settlements live in and around wetlands and use them for daily survival – for the production of food and thread. Yet, generally, they try to keep the usual wetland purpose intact, meaning unchanged, boundaries unbroken and values are preserved. The beliefs that we assign to wetlands are not different from the learning and culture from which we arrive. Here, In Bhigwan the fundamental needs of food and shelter are not taken granted and yet they have a unique view of the economics of wetlands.

Conclusion

One cannot survive without the other; they are 'dependent arising this relationship is an exponential, growing, and spiral course of action. "If this exists, that exists; if this ceases to exist, that also ceases to exist." Hence, "If wetlands and ecological habitats are to be conserved, the dependently arising communities need to be conserved."

Acknowledgement

I would like to thank and express my gratitude towards various my guide, experts, architects, environmentalists, activists, bird watchers, and villagers who have helped me in exploring this research topic about wetlands of Ujani, kumbharwadi, Bhigwan, Indapur, Pune, Maharashtra, India.

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To Study Carbon Footprint in Coliving Space

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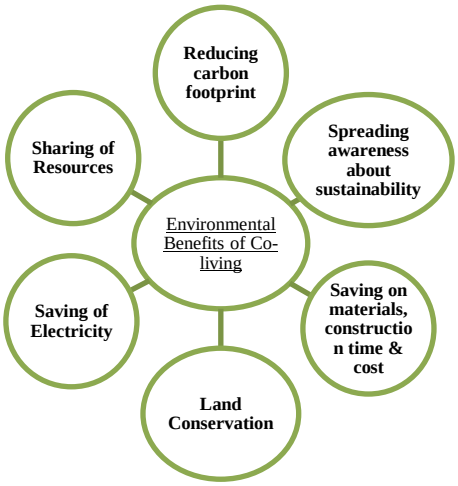
ABSTRACT: Coliving spaces share essential resources such as gas, food resources, appliances, and, spaces etc. By sharing such resources, co-living spaces reduce the energy consumption for appliances. Individuals occupying the coliving spaces help achieve a sustainable approach for reducing carbon footprint. This research aims to study and identify how the sustainable benefits of coliving spaces helps toreduce the carbon footprint.The methodology adopted for research is on the basis of case studies and observations. The amount of reduction in carbon footprint can be observed through a comparative analysis. The study is focusing on a user of 18-35 year age group covering the major millennium populated areas in Pune.

Keywords: Co-living, Millennium, Sustainable, Environment, Carbon Footprint, Communal Living

INTRODUCTION

As per a recent research, India's millennial population is expected to grow from 28% of total population in 2016 to an estimated 42% of the total population by 2025[i]. Having co living environments, with a millennial consumer in mind, will henceforth become a necessity. Co-living spaces are shared living spaces in which residents have individual rooms and share common spaces such as kitchens and living rooms. These living spaces have become quite popular with young professionals and digital nomads as convenient housing arrangements for those that are new to the city or pursuing higher education in non-native cities. Co-living spaces run on the principle of collaboration. Such collaboration is a necessity for sustainability as creating a sustainable environment is not just the responsibility of governments or environmental activists. Since each one of us leverages our planet's resources, working together to create a greener and more sustainable environment becomes everyone's responsibility too.The central idea behind coliving is living with purpose by focusing on building an ecosystem of support, connection, and collaboration. Within this system of community support, all kinds of resources are shared, swapped and borrowed. This encourages community members to create more sustainable everyday routines. This also helps to reduce waste and consumption. Domestic appliances and tools can be used communally,sustainable practices and pro-environmental behaviors, such as better recycling, composting, using less hot water and heat and carpooling are greatly encouraged Furthermore, there are shared communal cooking spaces, where community members can cook, bake and eat together, ordering ingredients in bulk, which both saves money and cuts down on food wastage, as well as reducing energy use. Leftovers are refrigerated or saved for lunches the next day. Coliving thus helps you to have a smaller footprint, contributing to the building of more resilient, sustainable, and environmentally friendly cities and societies.All the co-living spaces work on the principle of four C's. '4C' in their business simply represent cost, comfort, convenience, and community



Hence, Coliving spaces has certain sustainable parameters which makes that more user friendly as well as in benefit for the environment as it saves energy time, and reduction in the carbon footprint "A carbon footprint is the total greenhouse gas (GHG) emissions caused directly and indirectly by an individual, organization, event or product."It is calculated by summing the emissions resulting from every stage of a product or service's lifetime (material production, manufacturing, use phase, and end-of-life disposal). There is much research conducted on Coliving spaces, defining its need & the requirement for the millennium population and acceptance by the users. Whereas no consideration of sustainable relation of coliving and environment is listed, so this research is carried out identifying the existing coliving spaces in pune and concluding how much amount of carbon footprint can be reduced by calculating through a calculator developed by an organization (x) as well as individual footprint of the user when compared to a non coliving model.

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METHODOLOGY

Co-living spaces are modern housing solutions that enable residents with similar intentions, interests, and values to share a residential space like a hostel or a dorm. Such co-living spaces can promote a sense of community within the individuals who share the space. These shared spaces can contribute to a much larger cause too - the sustainability of resources.Consumption of non-renewable energy sources leads to high greenhouse gas emissions, resulting in increased carbon footprint. This phenomenon leads to global warming and climate change, which in turn is responsible, to a large extent, for the extinction of animal species. Hence, we have held a moral responsibility to reduce the impact of climate change using sustainable solutions. Generally, co-living spaces share essential resources such as gas and electricity.

DATA COLLECTION	EXPLORATION & RESEARCH	FINAL OUTCOME
➢ Defining the term & need ➢ Identifying Research gap	➢ Case study ➢ Observations& Findings ➢ Interviews	➢ Analysis ➢ Conclusion

By sharing such resources, co-living spaces reduce the energy consumption for appliances, like thermostats and air conditioners. Individuals occupying the co-living spaces help implement a sustainable approach for energy consumption to ensure a reduced carbon footprint. Co-living spaces can help in developing communities of motivated individuals who are well informed on sustainability. These communities can further create networks with other individuals who are passionate about 'green' initiatives. Together, these individuals can focus on using renewable energy sources and reducing air and water pollution. Such communities of proactive individuals can set an example and educate people from their experience of co-working and co-living. Also Sources of Emissions in the coliving spaces considered as parameters are mentioned:

1. Food
2. Electricity
3. Household Emissions
4. Personal Transportation

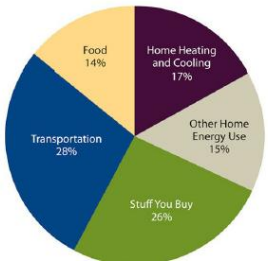

Fig.1 Sources of Emission

CASE STUDIES

In India, the co-living concept is gaining widespread acceptance and has brought to the fore some new models in the private rental sector. Though the concept is novel, it's here to stay, as India's millennial population currently accounts for 440 million(vi). The growing interest for co-living spaces in cities such as Bengaluru, the National Capital Region (NCR) and Pune has been instrumental in many investors sitting up and taking notice of this emerging sector to diversify their portfolio and risk. The renting philosophy for co-living spaces is derived from millennial behavior where such renters share less utilised areas such as living spaces, kitchen, balconies, etc. in order to make an economical rental decision and be part of a working community. To cater to this sort of renting philosophy, many buildings in prime locations such as city centers, near employment hubs like IT parks, special economic zones or universities are being redesigned, repositioned and rebranded keeping millennials in mind.

From saving energy to reducing waste packaging, sharing living space has the potential to reduce our environmental impact. Living more communally can have great social and personal benefits. Co living projects can make eco-building cheaper, as materials can be bought in bulk, and the cost of land can be shared. Here are the few cases of coliving in pune describing the shared parameters

Sr.No.	Name	Parameters
1	FLO COLIVING	Energy saving , sharing resources, spreading communal living
2	YOUROWNROOM	Sharing resources & provide coworking in coliving
3	URBAN NOMADS	Emphasizing on cultural interactions with living
4	HELLO WORLD	Sharing ideology with communal living
5	BEE URBAN COLIVING	Comfort, Safety & Nurturance in living

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Fig.2 Coliving Private Space

Fig.3 Coliving Dining Space

Fig.4Coliving Living Space

Fig.5 Coliving Private Sharing Space

RESULTS AND FINDINGS

- FLO COLIVING, Kharadi
  (COLLABORATE | COLIVE | COSHARE)

FLO, a co-living venture by Panchshil Realty for the people of today and creators of tomorrow was founded to create a solution to a seemingly insurmountable problem: the hassles involved with renting a home. This aims to enhance and simplify the rental process and home experience while creating an environment where ideas, passions and people thrive.Proximity to all major IT hubs and important landmarks in Pune, making our residents' commute significantly shorter and simpler while reducing our carbon footprint

Total greenhouse gas emissions	29.948 t CO2eq
Individual Carbon Footprint of each member	4.99 t CO2eq

- YOUROWNROOM, Amanora Town Park, Hadapsar- Kharadi Bypass, Pune

YourOwnROOM is a Residential Proptech rental and property management business. We provide strategically located good quality Co-living and Family managed homes to millennials tenants that are safe and comfortable.

Total greenhouse gas emissions	19.501 t CO2eq
Individual Carbon Footprint of each member	3.19 t CO2eq

- URBAN NOMADS , Koregaon Park, Pune,
  COLIVING, COWORKING, COLLABORATION & MORE

We offer flexibility, the ease of renting fully-furnished spaces, smoother, technology-enabled renting experiences and the chance to live alongside others of similar age, experience and mindsets

Total greenhouse gas emissions	30.055t CO2eq
Individual Carbon Footprint of each member	5.01 t CO2eq

- HELLO WORLD , Hinjewadi , Pune

This has created a world to turn your experience of co-living and student living into a pleasant one. Hello World is keen on creating comfortable spaces that embody the freedom paradigm of lifestyle and work for our tenants. They have created a world to turn your experience of co-living and student living into a pleasant one Hello World is keen on creating comfortable spaces that embody the freedom paradigm of lifestyle and work for our tenants.

Total greenhouse gas emissions	31.059t CO2eq
Individual Carbon Footprint of each member	5.02 t CO2eq

- BEE URBAN COLIVING, Viman Nagar, Pune
  (COMFORT, SAFETY, NURTURANCE)

Bee Urban is a fast-growing Youth Co-Living concept committed to providing world-class housing experience to students and young professionals. The Bee Urban experience is based on basic values of comfort, safety and nurturance and our state of the art hostels provide for a secured, warm and pleasant living experience that delivers an enriching environment, encouraging friendships and self-development.

Total greenhouse gas emissions	28.546t CO2eq
Individual Carbon Footprint of each member	4.35 t CO2eq

Also in comparison to these coliving models, one non coliving model is identified to compare the results with respect to carbon footprint.

- SINGLE PERSON ACCOMODATING ONE FLAT (Non Coliving model)

In this model single tenant is using all the facilities which are shared in coliving model such as kitchen, dining, living, working space, except private spaces such as bedroom and

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washroom. Thus carbon footprint of this model is mentioned:

Total greenhouse gas emissions	21.035 t CO2eq
Individual Carbon Footprint of each member	4.35 t CO2eq

COMPARATIVE ANALYSIS:

On comparing coliving & non-coliving models, the reduction of carbon footprint is found and with this the individual carbon footprint is observed. This can be very well stated that if consider for a non coliving model, carbon footprint of a single person is consuming 4.25 CO2 eq and 5 persons staying in coliving model consuming carbon footprint as 19.50 t CO2 eq. therefore considering 5 non coliving models the total carbon emission will be

= 5* 4.25 t CO2 eq = 21.25 t CO2eq

So on comparing the cases, the results are identified as it is emitting more carbon and the carbon footprint is found less in a coliving model.

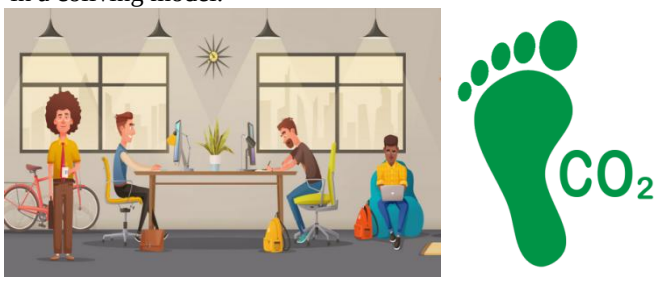

Fig.6 Coliving Model resulting in lower carbon footprint

CONCLUSION

The research is concluding with the facts and figures showing that the reduction observed in carbon footprint as in comparison of coliving to coliving and coliving to a non coliving space. Coliving model helps saving in electricity, sharing of resources and spaces, saving time and money in construction which overall results in reducing carbon footprint.

ACNOWLEDGEMENT

I would like to express my deep sense of gratitude to my guide Prof. Ashish Sakat for his valuable guidance, inspiration and encouragement. Also I would like to thank my college to provide me with such opportunities and continuous support in this research work which helped me to achieve this destination.

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GST and Indian Construction Industry

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Abstract : With the implementation of GST, there are mixed responses, arguments and opinions among the manufactures, traders, builders, construction managers and chartered accountants about the drastic change in the working environment of the construction industry. This paper aims to understand GST for Indian construction industry. The objectives include; knowing the basics of GST, tax slabs for various construction materials and understanding the key aspects of GST for the construction industry. It also discusses the deficiencies of the earlier taxation system, and concludes with benefits and drawbacks of GST. This study does not include any transaction details.

Key words: GST, Construction industry, Tax slabs, Deficiencies, Key aspects, Transaction

I. INTRODUCTION

1.1 Introduction-

Introduced on 1st July 2017, GST is one of the biggest changes in indirect taxation of India. By replacing almost all indirect taxes such as VAT, sales tax, service tax, excise duty, etc. GST has eliminated various difficulties of the earlier tax regime. By adopting the dual model of GST, the tax revenue of each transaction is shared by the centre as well as the state government. The impact made by GST has transformed the entire tax system in India. This has paved way for the unification of the entire country under "one nation, one tax and one market".

With the implementation of "One nation one Tax", there has been a drastic change in the working environment of the construction industry which has led to changing rates of laborers, construction materials, machinery pertaining to construction, technologies used construction, which has ultimately affected the cost of construction as well as the cost of buying and selling properties.

1.2 VAT and Service Tax regime-

Old Taxation system had three elements- Excise, CST, VAT and Service Tax.

- **Excise-** Excise duty was charged by the manufacturer on the manufacture of excisable goods.
- **CST-** On inter-state sale of goods, the dealer used to charge CST on value comprising of (basic value + excise duty charged by manufacturer + profit by dealer).
- **VAT-** On subsequent intra state sale of goods, the VAT dealer used to charge VAT on value comprising of (basic value + excise duty charged by manufacturer + CST + profit by dealer). Hence there was Cascading of taxes (Tax paid on tax)
- **Service Tax-** Service Tax was payable at 15% [Service Tax (14%) + Swachh Bharat Cess (0.5%) + Krishi Kalyan Cess (0.5%)] on services provided by various service providers.

This old system had several deficiencies like

- Multiple taxes.
- Multiple returns (forms)
- Restricted credits (Credits available only for VAT)
- Confusion between origin based and destination based tax.
- Cascading of taxes (Tax on tax)
- Non-Integration of VAT and Service Tax.
- Maintenance of data and records.
- Different tax laws in different states.

1.3 GST Regime-

GST tries to iron out all the wrinkles of the VAT and Service Tax regime. Introduction of GST has subsumed various central and state taxes. It will be levied on manufacture, sale and consumption of goods and services.

GST is categorized as

- CGST (Central Goods and Service Tax)
- SGST (State Goods and Service Tax)
- IGST (Integrated Goods and Service Tax)
- UTGST (Union Territory Goods and Service Tax)

Under GST, five tax slabs are proposed- 0%, 5%, 12%, 18%, 28%. GST will lead to creation of a

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unified market, which would facilitate seamless movement of goods across states and reduce the transaction cost of businesses. Under GST, manufacturers will get credits for all taxes paid earlier in the goods/ service chain, thus incentivizing firms to source from other registered dealers.

Table 1: Central and state taxes subsumed into GST

Central taxes subsumed	State taxes subsumed
Central Excise Duty	Sales Tax/ VAT
Service Tax	Luxury Tax
Excise duty under Medicinal and Toilet Preparation Act	Tax on lottery, betting and gambling
CVD & Special CVD (Additional duty of customs under section 3 of customs tariff Act, 1975)	Entry Tax (All Forms) and Purchase Tax
Central Sales Tax	Entertainment Tax
Surcharges and cesses which relate to supply of goods and services	State surcharges and cesses which relate to supply of goods and services
	Taxes on advertisement

II. MATERIAL AND METHODOLOGY

2.1 Literature Review-

Sabari Nath T V discusses about GST in their research paper titled "Implementation of Goods & Service Tax (GST) in India Emerging Opportunities & Challenges." He gives an overview of the earlier tax system. The author explains the core concept of GST and also compares non-GST regime to the GST regime and concludes that GST will help to eliminate the cascading of taxes at multiple level and will help to build a transparent corruption free tax administration.

Girish Garg sheds light on history of taxation system in India in the research paper titled "Basic Concepts and Features of Good and Service Tax in India." Mr. Garg explains objectives of GST. He summarizes various salient features and benefits of GST. He also describes impact of GST on various industries including the Housing and Construction Industry and concludes that GST will strengthen nation's economy and development.

A book published by The Institute of Company Secretaries of India (ICSI) titled "GST- A Simplified approach and Practical Guide for GST Accounts Assistants" gives the background of GST, how and why it was implemented. It provides clear explanation of the various sections of GST Act with simple examples. It also consists of various formats (Registration forms, Payment forms, practitioner forms, etc)

Dr. N VisalakshI and Dr. K. Kanaka Raju explain various concepts of GST in the research paper titled "An Overview of GST". The authors shed light on impact of GST on a consumer through a comparative study and conclude that implementation of GST has eradicated multiple taxes, problems and issues in the economy.

2.2 Methodology-

The methodology adopted for this research includes informal discussions with a chartered accountant. These informal discussions are vetted through questionnaire survey with tax practitioners and several other chartered accountants. A market survey was conducted to compare tax rates for various construction materials.

III. RESULTS AND TABLES

3.1 Key Aspects/ Important Features of GST-

a) One Nation, One Tax- GST law extends to the whole of India and it came into force on 1st July 2017.

b) No Cascading of taxes- Since, only value added at each stage is taxed under GST, there is no cascading of taxes (tax on tax) under GST.

c) Input Tax Credit- ITC is the backbone of GST. A registered person will be eligible to claim Input Tax Credit (ITC) for tax paid by them on purchases.

d) Destination based tax- GST is a destination based tax on supply of goods and services. It is a levy at all stages right from manufacture up to final consumption with credit of taxes paid at previous stages available as setoff.

e) Composition scheme- A person whose aggregate turnover is less than Rs. 1.5 Crores in the preceding financial year can opt for a simplified composition scheme. The person opting for composition scheme

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is liable to pay tax at a concessional rate on the turnover in the state without the benefit of ITC.

f) Classification of goods and services- HSN (Harmonised System of Nomenclature) code is used for classifying goods and services under GST.

g) Taxation on import and export- IGST will be levied on import of goods and services as it will be treated as inter-state supply. No tax will be payable on exports of goods and services as export is treated as zero rated supply.

h) Threshold- A taxable person is liable to pay tax when he crosses the turnover threshold of Rs. 40 lakhs (Rs. 20 lakhs for NE and special category states) except in certain specified cases where he is liable to pay tax even if he has not crossed the threshold limit.

i) GST Identification Number (GSTIN)- Unlike the previous indirect tax regime, where multiple registration numbers were present for different laws like Excise, Service Tax and VAT, it is a single registration number under GST- GSTIN.

3.2 Results from Questionnaire survey-

Following are the results from the questionnaire survey, which was targeted at the chartered accountants having at least 5 years experience and clientele of construction industry.

Figure 1: GST is simpler than earlier tax system

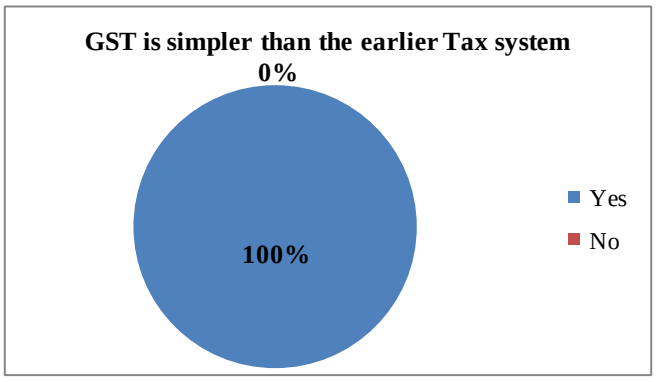


Figure 2: GST is simpler than earlier tax system

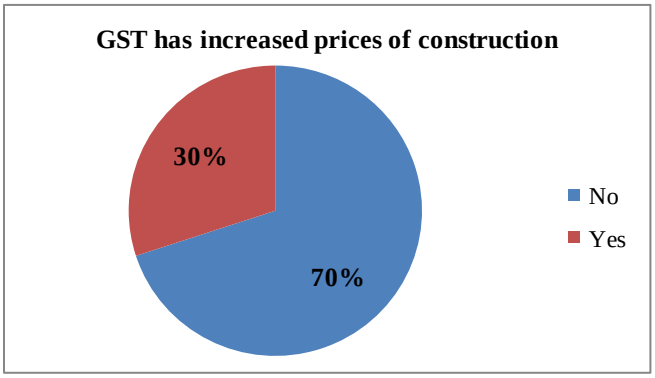


Figure 3: GST: Benefit or barrier

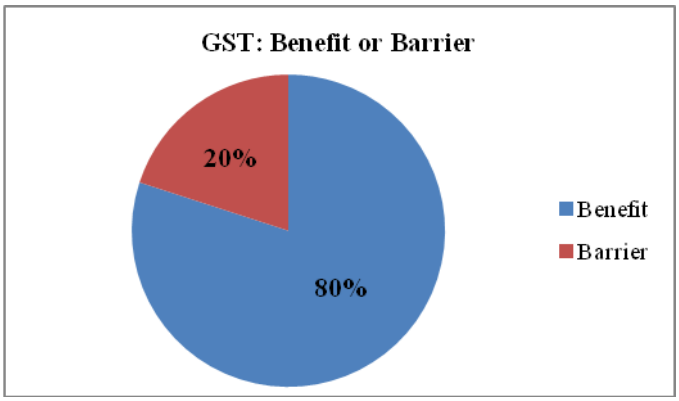
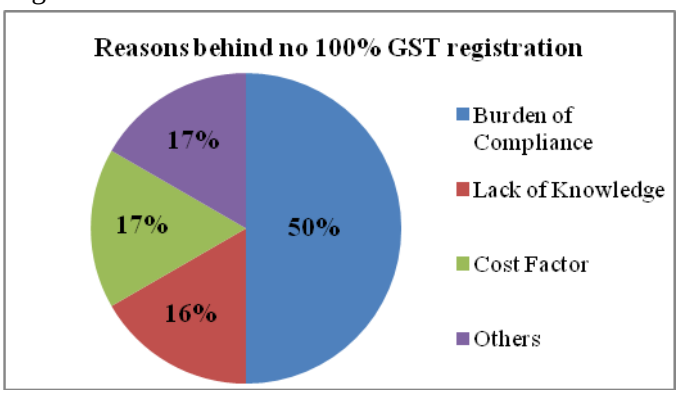


Figure 4: Reasons behind no 100% GST Registration



3.3 Results from Market Survey-

Table 2: Tax rate comparison for construction materials

Sr. No.	Material	Pre GST	Post GST	Difference
1	Cement	32%	28%	-4%
2	TMT Steel	23.5%	18%	-5.5%
3	Coarse Aggregate	6%	5%	-1%
4	River Sand	6%	5%	-1%
5	Bricks (locally manufactured without the	6%	5%	-1%

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	use of power)			
6	Floor & Dado Tiles	32%	18%	-14%
7	Plywood	30%	18%	-12%
8	Laminates	30%	18%	-12%
9	Wires and Cables	31%	18%	-13%
10	Glass	31%	18%	-13%
11	Paints & Varnish	32%	18%	-14%
12	Sanitary Fittings	32%	18%	-14%
13	Wooden Door & Window	30%	18%	-12%
14	Aluminum Window Sections	32%	18%	-14%
15	Marble and Granite	32%	18%	-14%
16	AAC Blocks	21.5%	5%	-16.5%
17	Waterproofing chemicals	32%	18%	-14%

Note- Pre GST rates include Excise Duty, CST, MVAT and other taxes. Green color indicates reduction in the tax rates.

3.4 Benefits

- One Nation, One tax.
- Single and simplified return filing.
- No Cascading effect.
- Duplication of work is avoided.
- Simple online procedure for filing returns.
- Input tax credit easily available.
- Less paperwork.
- Simplified registration process.

3.5 Drawbacks

- Heavy penalty for non-filing of returns on time.
- GST website problems.
- Rectification of mistakes is not possible.
- More frequency of returns.
- Frequent changes in tax rates.
- More compliance cost.

IV. CONCLUSION

From the results of questionnaire and market survey, it can be concluded that, GST is simpler and beneficial to the construction industry. As we are new entrants into this taxation system, the act has several drawbacks, which if rectified can surely be more beneficial to the construction industry.

ACKNOWLEDGEMENT

I am extremely grateful to my guide Mr. Sumesh Sawant for his valuable insight, discussions and support in completing this research. I would like to express my gratitude towards CA Sunil Ingale and Prof. Satyajeet Shah for their valuable time to explain various GST concepts.

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Daylighting in public areas of hospital building.

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ABSTRACT : ***Public areas in hospitals are accessible to people on any time of the day or night, the people who visit hospitals are not that emotionally stable which makes it different from other public areas like museum or malls. Use of artificial lights is provided in large hospitals without considering the comfort of people. While considering this aspect the focus of public areas include waiting areas, entrance and reception areas and main corridors. As people spare most of the time in waiting areas because of the patients. The cases of general hospitals in Pune region will be considered, analysis and comparison of these hospitals public areas would be taken into consideration with identification of problems if any. This research will help in studying different public areas that require or has natural light and its impacts on people that visit patients including family members, relatives, friends,staff etc. Outline of the research will have findings that prove the need for natural light in public areas of hospital building and in what way such hospitals can provide better environment for visitors.***

Keywords- public areas, natural light ,hospitals ,waiting areas , visitors.

INTRODUCTION

An efficient hospital design includes concern for human comfort, indoor environment & productivity. They are usually occupied 24 hours per day, all year round and careful control of their indoor environment is necessary. Natural light is critical aspect in hospitals as not all the hospitals incorporate natural light in buildings, use of artificial lights also serve their purpose.Daylight affects human beings psychologically. Several studies have documented the importance of light in reducing depression, decreasing fatigue, improving alertness, (1). Further, the presence of windows in the waiting areas and access to daylight have been linked with increased satisfaction with the physical environment.

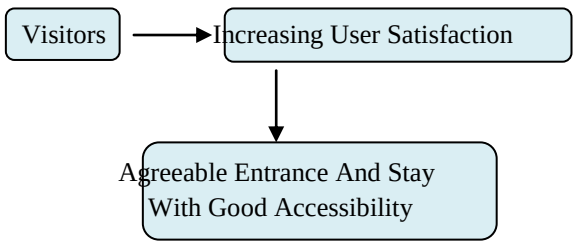
Reasons for maximizing daylight and views in public areas of healthcare building:

1. Helping users to orient themselves and find their way through the space : since healthcare facilities are often very large, with multiple floors, wings, and extensions, it's not always easy for users to determine where they are and find their way around. This can be the case in particular for new visitors, patients with cognitive impairment, or elderly people with reduced mobility or poor vision. Bright spaces and enhanced views to the outdoors, combined with a well-planned choice of colors, contribute to users correct orientation and ability to find points of reference. therefore seeing more and more atriums and patios that create areas of light inside these spaces.

2. Reassuring visitors: hospital environments are traditionally not seen as being very welcoming and can be a source of additional stress for visitors who are already anxious when they arrive. For example, the hallways of hospitals and emergency departments are often very compact and barely receive natural light. However, these spaces are the first areas of contact with patients and visitors! Psychologically, visitors tend to determine the quality of a service or a healthcare professional based on the quality of the waiting room,
including the lighting. Bringing natural light and views into these spaces as well is vital to improving the user's experience

3. Creating comfortable, welcoming, high-quality spaces, similar to those in the hospitality market: ambiances based on the optimization of light and views, this is true not only in the areas used for patients families, but also more generally in lobbies, waiting rooms, consulting rooms, and recovery areas.

4. Contributing to the facility's sustainable development: energy and environmental performance is also a key challenge in hospitals, and maximizing the use of natural light can contribute to reducing the use of electrical lighting and the building's carbon footprint.
Therefore the user is truly being repositioned at the heart of the architectural design for hospitals, whether that user is a visitor, family member, or staff member. In this context, natural light and outdoor views play a vital role.



There is much research on the impact of daylight on patients health recovering faster, but there is no

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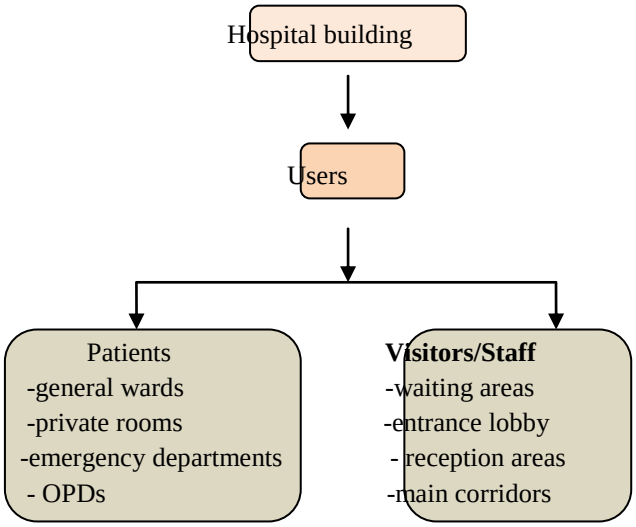
consideration for visitors which spares most of the time in the waiting areas and the public areas without their choice in the hospital because of the patient. As in general, for a single patient two or three family members have to be there in hospital for some or other need. So the public areas of hospitals needs to be focused upon.

Without access to daylight the human body-clock becomes disrupted –it needs recalibration on a daily basis and unless we receive adequate daylight overwhelming medical evidence suggests that humans become stressful and agitated. Any disruption to our circadian rhythm has highly negative consequences in terms of our health, happiness and wellbeing. A well designed daylighting will obviate the need for artificial lighting. The effort to reduce dependency on artificial lighting would directly contribute to the energy consumption of hospital buildings, subsequently assisting sustainability.

METHODOLOGY



In general, daylight has also been found to be a more effective form of environmental lighting than electric lighting in boosting alertness (2). Natural light provides high-intensity blue light (400–500 nm) in the morning. The wavelength smoothly transitions to orange-red light (600–700 nm) at sundown with minimal blue light intensity. Human physiology has evolved by responding to this phenomenon. An effective light wavelength for a circadian response is mainly between 460 and 500 nm (3). When indoor electric environmental lighting is not appropriate for our body's natural state, occupants will be trapped in "biological darkness"

All of the above qualitative and quantitative evidence is derived from the fields of human biology and environmental psychology.(4) Experiments undertaken between 1941 and 1944 demonstrated the extraordinary and remarkable effectiveness of daylight in killing the bacteria streptococci .The blue light in skylight was found to be particularly potent. The trials also examined the bactericidal effects of artificial light, which was found to have little value as a disinfecting agent.

Cases of general hospitals in Pune-

1. Case of Jahangir hospital, the courtyard space has been closed, and glass cubicle medical shop is situated there, the daylight entering the building is not used, which is making maximum use of artificial lights in entrance and reception area. The waiting areas of this hospital are always crowded, even though the waiting area is a huge space on ground floor itself, but it feels conjusted, as the windows provided are not enough to the size of waiting areas which are closed by curtains that doesnot get any outside view and all .artificial lights needs to be switched on even during daytime which doesnot give feeling of waiting for visitors.

Fig 1 (a) – closed courtyard space fig 1(b)- waiting areas

2. In Dinanath old Hospital building, it is designed in a manner having a central skylight dome. The natural light enters into the building but it doesnot reach sufficiently till ground floor. As we enter the building, it feels dark in central foyer and the visitors have feeling of anxiety, waiting areas are along the central foyer even passages on first floor do not get sufficient light in day time where most of the people have to sit and wait, which doesnot give a pleasant feeling sitting there.

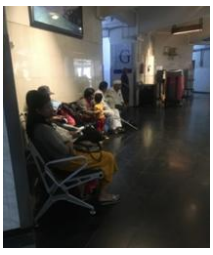


Fig 2(a)- ground floor waiting areas in darkness fig 2(b)- skylight dome

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3. In Dinanath new hospital building, windows of double height entrance and reception area is large and
proportionate, so there is no need of artificial lights in public space, circulation spaces in public areas are big and daylight is enough so that people may find their way inside, also entrance is of glass façade, which gives the feeling of welcome to patients and visitors, indoor canteen area is also provided with large windows for view so people coming in canteen will feel mentally relaxed but all windows are fixed, so canteen's foul smell comes in the public space which is a disturbing factor.

Fig 3(a) entrance, reception, waiting and canteen areas are properly daylighted

4. The design of Ruby Hospital, It has entrance from two sides. On both sides they have used the double height of ceiling in the foyer at the entrance in order to make the patient and visitor feel warm welcome with tinted glass façade used throughout the front façade of double height entrance lobby penetrating adequate daylight and to diminish the fear and frustration causing the worry to the patient and visitors during his visit to the hospital.

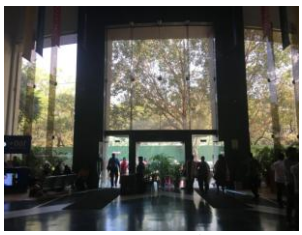
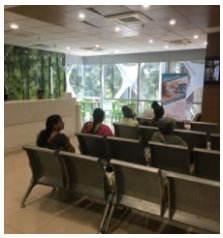


Fig 4(a)- tinted glass façade entrance

fig 4(b)- skylight in waiting area

The waiting areas of public is a courtyard like space having skylight in the center where people sit comfortably around it. The place is always full of people but waiting area feels open and daylighted as use of artificial light is less and there is enough seatings over there so people spend most of the time over there.
Apart from that the spaces inside the hospital also has a daylighted view on the above floors where waiting areas are designed for public, even though space is conditioned but people's comfort is considered.



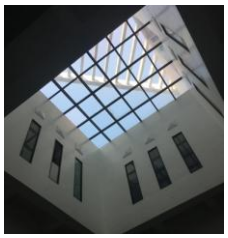


Fig 4(c)- daylight and skylight view for public to mentally relax

5. As for Poona Hospital, the waiting areas for public are provided on mid landing of every floor, which is why the natural light penetrates inside directly, as waiting areas are not inside. The windows in waiting areas are also large and throughtout the wall so it doesn't feel dark .The main passages of hospital are wide enough with circular large windows so passages doesnot need any artificial light and people sit over there also.The entrance and reception area of hospital is single storey but entrance has large openings for daylight so there is no need of artificial lights in daytime.

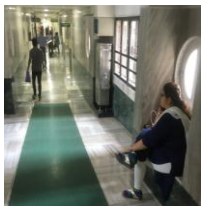


Fig 5(a) passages and with windows

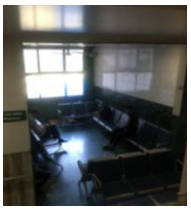


fig 5(b)- waiting areas

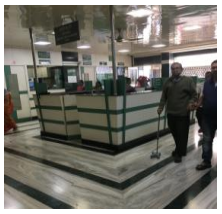


fig 5(c)-entrance reception area

6. In Sassoon hospital, the double height hall for the public space is not having adequate light and hygiene consideration so it doesnot feel to sit in the waiting areas inside, so the people also sit outside the hospital on the footpaths or shed which looks very disturbing when we enter. The reception areas are also not spacious, they are enclosed with small openings without proper lighting levels. Also it is a government hospital, not much care is taken on the ambiance and comfort of the public areas of hospital.

Fig 6(a)- entrance, reception and waiting area with no adequate light

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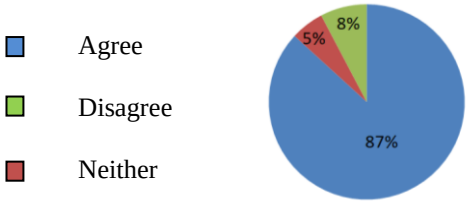
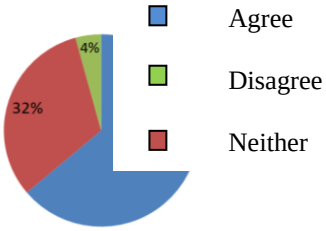
DISCUSSION

In this paper focus is on two groups, visitors and staff. Questionaires were asked in above hospitals visited, the people who were discharged were more answerable. Following verbal introduction to the nature and purpose of the survey and acquiring the background information, the subjects were then asked to rate their satisfaction with the following four questions.

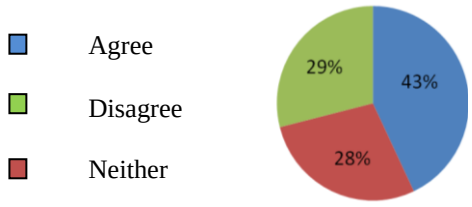
1. Do you think , waiting in daylighted area feels more comfortable and relaxed?



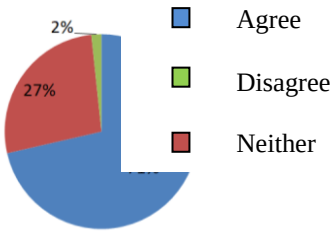
2. As soon as you enter this hospital do you have feeing of uneasy or nervousness apart from patients health



3. Will you be able to sit in artificial lights for long time?



4. Does it feel pleasant to work more in daylight hours? (helping desks, reception counters, security guards in public areas)



The above survey is done with sample size of 60 in seven different Hospitals .

FINDINGS

Hospital Area	Entrance	Reception	Waiting areas	Corridors/atrium
Recommen-ded lux levels	200 lux	300 lux	200 lux	100 lux
Jahangir	212	209.2	104	109
Dinanath old bldg	85.8	115.8	74.0	85
Dinanath new bldg	215	324.3	210.3	110
Ruby	228.3	281	250	-
Poona	199.6	204.5	222.3	150
Sassoon	118	100	89.2	90..46

The critical cases identified among these hospitals are Sassoon and Jahangir Hospitals. As in Sassoon hospital case public areas are not at all considered with respect to daylight or hygiene, it feels dark inside even in daytime. On the other hand in Jahangir hospital although artificial lights are used in the waiting areas it doesnot feel to sit in waiting areas as space allotted is compact with less windows without double height. The best compliance was with Ruby hospital and Dinanath new hospital building.

CONCLUSION

Major conclusions drawn from this study is there are identified gaps in the existing lighting standards in the Hospitals and the recommended lighting levels and standards in the public areas of Hospital. As per the analysis, where there are spacious daylighted areas or large windows for view people prefer sitting there for long time compared to dark or artificial lights areas. This has been stated in the study with the effect of daylight on psychology of people. The salient features of various guidelines and standards on lighting in the public areas of hospitals should be considered by Hospital Administrators and Medical Architects before planning a new healthcare setup. These lighting standards should be circulated in the environment for compliance thus this will have better environment for visitors or public.

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I would like to express my deep sense of gratitude from the bottom of my heart to my guide Dr. Parag Narkhede

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Sir for his valuable guidance, inspiration and encouragement. His keen and indefatigable indulgence in this work helped me to reach an irreproachable progress.

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Analyzing Energy Consumption Pattern and Compensating With Rooftop Solar PV for Chaitraban (Indra Nagar) Slum, Pune

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Bharati Vidyapeeth Deemed to be University College of Architecture, Katraj, M-Arch, II year, Sem IV
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Abstract: India's Energy sector is one of the most critical component of an infrastructure that affects India's economic growth. In the present energy scenario, Smart grid technology plays a very productive role towards alternate sources of energy as compare to coal (which is already dominating the production of energy). This paper analyses energy consumption patterns & electricity costs of Pune Chaitraban slums & suggests recommendation for energy substitution with rooftop solar PV for reducing their electricity cost. The paper also recommends rooftop solar PV as a portable source of income for slum dwellers when linked to the grid supply for excess solar PV generation.

Key words – BAPV, Energy consumption, Conventional energy source, Energy cost, Rooftop solar PV.

INTRODUCTION

Established in 1975, the Chaitraban slum is located near the Pune upper indra nagar, Bibwewadi. It is a large residential slum with about 800 households. The slum covers an area of 1.6 hectares. Located in the outskirts of Pune city the slum has a gradual slope of 2m across the site. Increasing electricity costs is one of the major problems faced by the slum dwellers. In the year 2019, the charges for electricity consumption escalated from 3.00rs per unit to 3.05rs per unit. Slum dwellers and socially poorer segment are facing problems with the increasing cost of energy. As an alternative solution for increasing energy cost, suggestions and guidelines can be recommended to the residential sector to use solar energy, primarily due to easy installation, higher productivity, lower operating, maintenance costs, and incentives offered by India's government through various subsidies. BAPV (Building Applied Photovoltaics), an advancing renewable technology thus plays a vital role in leaning on conventional energy sources as well as being very effective at the moment for rapid climate change. To Slum dwellers, BAPV appears to be the best alternative option with the help of government subsidies.

METHODOLOGY

The Methodology is divided into two parts primary analysis and secondary analysis.

Primary analysis: -

- Climate analysis

Secondary analysis: -

- Field survey, Survey questionnaire, Taking random sampling
- Market survey for Solar PV (1kW Off-grid and 1 kW ON-grid
- Identify Government policies.

Furthermore, shadow analysis using Ecotect software have been done. Based on shadow analysis results there is a suggestion for preferable roof area for solar PV panels and their energy generation.

Data Collection

1. Field Data

Climate analysis: - Pune falls under moderate climate ranging from 20 to 28 ° C mean temperatures. Typical summer months are from mid-March to mid-June, with maximum temperature of 42 ° C. Average solar radiation in Pune is 1266.52 W/sqmt. Pune's warmest month is May. In May, there are strong dusty winds, with still high humidity. The monsoon lasts from June to October, with mild precipitation ranging from 22 to 28 ° C. Most of the city's annual 722 mm (28.43 in) precipitation falls between June and September, and July is the year's wettest month.

2. Site survey

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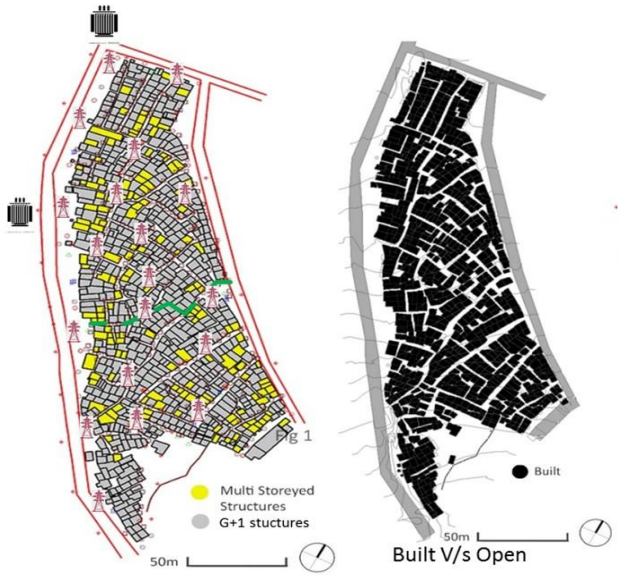

Figure 1 Site plan

Legend: -

Boundary of transformer distribution

Transformer – 11kV each (Nos. = 2) (400People/1 Transformer). Total 800people

Electrical poles (Nos. = 19)

Ward no. = 38
Total no. of houses = 800
Number of Pucca Houses= 680 (85%)
Number of Kuccha houses = 120 (15%)
Total approximate population of slum = 3500
Total area of the slum = 16000 sq. mt (1.6 Hectres)

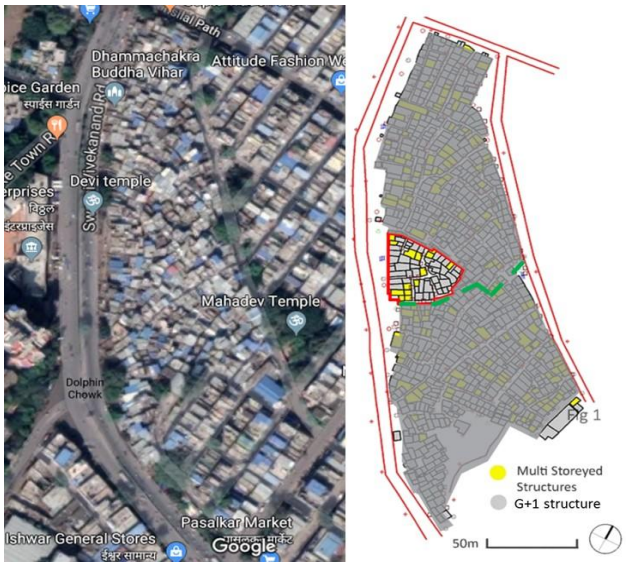

Figure 2 Demarcated sample size

3. Random sampling

Zone:-

- 37 Houses
- G, G+1 & G+2 structures.
- all 3 types i.e Kuccha(Tin roof and Tin walls), Semi-Pucca(Brick walls and Tin roof) and Puccha (Rcc roof and RCC Wall).

Taking random sampling and selecting 37 houses of various types (kuccha, semi Pucca, Pucca) and marking it as a zone for further survey. In this zone all types of houses are there i.e. G, G+1,G+2 and contains commercial(shops) also.

Figure 3 typology of houses

CONDUCTING SURVEY AND LOAD CALCULATIONS: -

All 37 samples are taken for survey and connected load calculation. 90% of the houses have 3-4 members in a family, having 3-4 electrical equipment's per house. All samples are grid connected. 90% of the houses have Floor area/house is around 25 sqmt. Connected Load calculations for each individual unit is carried out in the survey. The quality and life of equipment have also been examined.

	No. of storey	Type of equipment	Time of use	Pattern	Quantity	Total capacity in watts	Working hours	Energy consumption in kWh
House no. 2	G+1	TV	Day	Daily	1	50	7	0.35

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		Fridge	Day & night	Daily	1	250	8	2
		Tubelight	Evening & night	Daily	2	22	8	0.176
		Bulb	Evening & night	Daily	2	9	8	0.072
		Fan	Night	Daily	2	75	5	0.375
								2.973

Table 1 Connected load consumption

- Boundary of transformer distribution
- Transformer – 11kV each (Nos. = 2) (400People/1 Transformer). Total 800people
- Electrical poles (Nos. = 19)

MARKET SURVEY DATA COLLECTION FOR SOLAR PV

Loom solar 1 kw Grid connected AC Module (75,000 + installation charges) with 25 years' warranty.

Loom solar introduces 1 kW solar panel called Solar AC Module. A 1 kW solar system generates 5 units every day from morning 9 am to 5 pm which is sufficient to run 1 Refrigerator, Television, Fans and lights during the day from small 1-2 bhk home. It does not work when there is power failure. To convert solar energy to AC current (AC module is mounted in the back of the solar panel).

GOVERNMENT SCHEMES

- JNNSM (Jawahar Lal Nehru National Solar Mission) :-The Phase-II of Grid Connected Rooftop Solar Programme for achieving cumulative capacity of 40,000 MW from Rooftop Solar (RTS) Projects by the year 2022.

Page 2

- MEDA (Maharashtra Energy Development Agency). :- MEDA Maharashtra rooftop solar policy complies with the subsidy available from the central government. Accordingly, the subsidy can be availed on installation of rooftop grid connected solar plants as either of the following- (MEDA, 2019)

  - 30% of the project cost (or)
  - 30% of the benchmark cost, whichever is lower.

RESULTS

DATA ANALYSIS AND INFERENCES

Using 'Ecotect' software, yearly shadow analysis of the selected sample is done for 4 representative months i.e. for January, April, August and November.

As per the Solar radiation data, the horizontal radiation is 1266.52 watts/meter²/day. During Monsoons i.e Except July and august the radiations falling on the horizontal surface are 263 W/m²/day. During summers i.e from March to June the radiations are harsh i.e. 496 W/m²/day minimum to 735 W/m²/day maximum respectively.

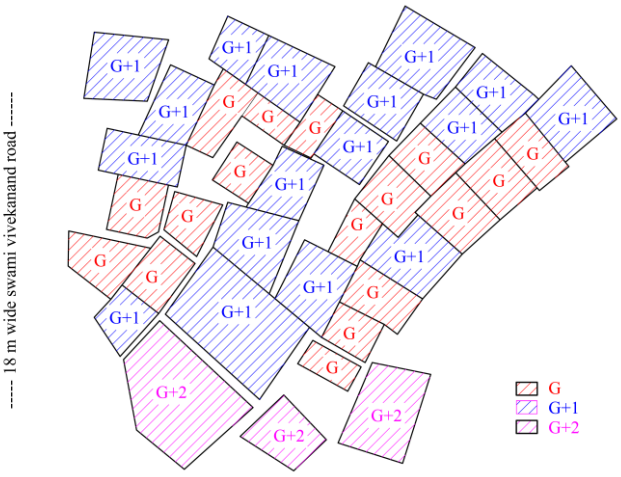

Figure 4 types of houses (G,G+1,G+2)

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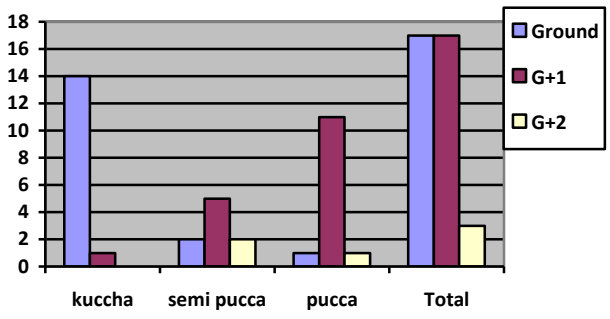

Chart 1 - Number of houses from selected zone

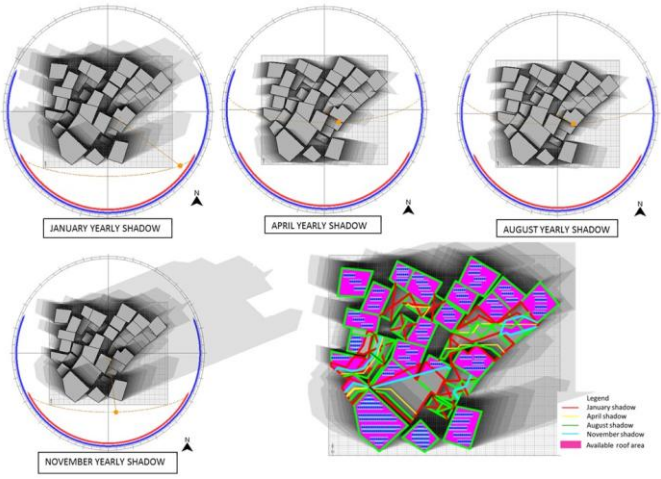

Figure 5 Yearly Shadow analysis using Ecotect Software for the month of January, April, August, November. Also showing Available roof area in magenta color with number of possible rooftop panels.

INFERENCE

The available yearly sun lit rooftop area (No shadow area) w.r.t the installation of solar PV. Available rooftop area = 202.52 Sqmt for 37 households.

- Depending upon the load a roof can take, Solar panels are placed accordingly.
- Total number of solar panel are = 528 panels, generating electricity of 528 x 0.35Kw = 184.8 Kw/day.
- Taking average Load Consumption per day of individual slum is = 4 Kw
- Number of houses getting solar electricity = 184.8Kw/day divided by 4Kw Load consumption = 36.96 houses (approx. 37 houses)
- Hence 37 houses are getting catered with 528 panels.

PV PANNEL SIZING

1 Kw Pannel generates = 1800 kwh per year & 1kwh = 1unit 1 Kw will generate in a day: -

1800/12 months = 150 kwh(approx..) per month.

150/30 days = 5 kwh(approx.) per day.

GUIDELINES

Installation

1 solar panel weight is 10-20 kg, which can be mounted on a sloping roof as well. The model includes a mild streel frame on which to install the solar panels. Because most of the slum has a tin roof with a mild steel frame, the installation of solar PV is optimistic.

Financial requirements:

Bank loan are also available for purchase of 1kW Rooftop Solar PV. And after payback period of 7 years it will be free energy for the slum dwellers.

Page 3

As per MNRE "All banks are advised to encourage the home loan/ home improvement loan seekers to install rooftop solar PVs and include the cost of such equipment in their home loan proposals just like non solar lighting, wiring and other such fittings"

Subsidy:

To initiate the project, 30% subsidy of benchmark cost will be very helpful to the slum dwellers.

RECOMMENDATIONS AND CONCLUSIONS

RECOMMENDATIONS: -

1 kW of panels on the roof need an area of 6 square meters. On grid (without battery) costs 80 thousand and off grid cost goes to 1 Lakh (with battery) for PV, including installation charges. Since both central government and state government subsidies exist, the Solar PV can be installed financially for slum dwellers. Since the On-Grid PV system connects to the main power supply grid, selecting the ON-Grid connected option for slum residents will be good enough, as it will provide opportunities to produce

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more energy and supply the network. Compared to the 25-year warranty from the solar PV firm manufacturer, the 12-year payback period seems to be financially favorable also to slum dwellers.

Houses	Pv panel per head cost	Total cost for 37 houses	Govt. Subsidy	Final cost of PV panel	Electric bill cost per consumer in Rs/month (approx.)	Permonth Electricity bill of whole slum	Payback (in months)	Payback in Year
37	80000	2960000	30%	888000	700	25900	34.2	2.8

Table 2 Payback for Whole (sample size) Slum (calculated Together)

From the table above, the Payback period calculated for the sample size (37 houses) is 2.86 years.

CONCLUSIONS

Energy consumption per day for Slum dwelling units with refrigerators is 5.6kWh and without refrigerators is 2.9kWh/day (i.e. almost 50% reduction). The study recommends that slum Payback period is 2.86 years hence reduction in electricity bill costs plus through net metering there is a potential source of income also.

ACKNOWLEDGEMENT

It is pleasure to thank many people who made this dissertation possible. I would like to express my gratitude to My guide, Ar. Aditi Lanke, for keeping me in the perspective and ensuring that the analysis and methodologies were logical.

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Quantifying Amount of Water Wasted From Showerheads, From Households in Pune, Having Central Solar Heating Systems

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ABSTRACT: World over, water as a resource, is sparse and expensive. Considering the growing population and rising number of residential buildings coming up, it is necessary to understand the need and urgency to pay attention to water conservation in the services provided in buildings by reducing both, wastage and consumption. Conserving water will help in making the overall building sustainable. The objective of this study is to test methods to quantify the amount of water wasted from showers while waiting for hot water in situations where water is heated using central solar heating systems, in order to compute actual quantities.

Key words: Solar heaters, water, showerheads, losses, Pune

1. INTRODUCTION

As per a study conducted across seven cities in India it is noted that bathing consumes the maximum amount of water, at 28 % of the total domestic consumption, roughly 55 litres per person per day [1]. Shower water wasted by individuals, has a cascading effect that amounts to huge loss of potable treated and heated water being lost while waiting for hot water to get to an optimum temperature, hot enough to bathe and this paper intends to find methods to compute these losses. As per Ministry of New and Renewable Energy (MNRE) reports, it aspires to cover 20 million sq metresof Solar Water Heating Systems (SWHS) tillthe 13th plan by the year 2022 [2]. As solar water heating comes under the purview of green building norms, builders today are particularly providing this facility to consumers and are expected to adhere with MNRE guidelines while providing so[3]. Yet the facility is unable to fulfil expectations of the consumers, both time and resource wastage is a problem. Due to its dependency on climatic conditionsand functional inconsistencies it is noted that the wait for hot water from solar heaters is the fairly long. For management professionals, the primary goal is to manage costs and resources and as architects' sustainability cannot anymore be an afterthought but needs to be woven in system design itself. The building Industry in India will eventually have to comply with the Sustainable Development Goals formulated by the United Nations Development Programme (UNDP) that mandates that development must balance socio-economic and environmental sustainability. The crisis that we currently face in terms of water scarcity not only directly affects urban consumers but has now become a potential deterrent in the development process itself as new building projects face the threat of being potentially stalled due to lack of resource. On June 28th 2019 The times of India, one of the premier newspapers carried the news announcing that the State of Karnataka, India was considering a 5 year ban on new construction activities due to water crisis [4]. Chennai city is one of the worst hit cities in India as far as the water crisis is concerned. The Chennai Metro Water Supply and Sewage Board, (CMWSSB), on worst days of the crisis could provide only 525 million litres of water to the city that has a requirement of 830 million litres a day[5].

Pune is considered as a city that demonstrates a gross overuse of water as pointed by Madhav Chitale, an expert on water issues and recipient of the Stockholm Water Prize, 1993. According to him, users in Pune consume almost double amount of water than the prescribed 100-135 litres per person per day consumption norms applicable for urban areas [6]. Currently the Pune Municipal Corporation cannot meet the current demand of the consumers and hence consumers have to purchase deficit amount.

2. NEED FOR RESEARCH

According to the Ministry of Water Resources, potable water is the second largest projected water demand in India, after the irrigation sector which shows the highest demand [7]. As per statistical data and surveys conducted by The Energy and Resources Institute, India(TERI), a **large demand for water and increased volume of wastewatergenerated thereby** both put a significant strain on costs of distribution and treatment both on regional level, as well as micro level, which is the individual user level [8]. Most of the municipalities like Pune Municipal Corporation cannot provide enough potable water to meet the requirement of the population due to variety of reasons like leakages and unaccounted water losses [9]. There is an urgent need to identify the reasons and sources of these leakages as well as the unaccounted water losses. In order to conserve this precious resource conducting audits and identifying problems will help to rectify grey areas. Losses from showerheads need to be quantified and hence there has to be an effective method to compute these losses.

3. LITERATURE REVIEW

"National Building Code of India (NBC)" [10] Part 11 covers approaches to sustainability and **section 3.7** talks about Integrated water management emphasising that efforts are needed to reduce the per capita water consumption in buildings. It emphasises that least anthropogenic water discharge should be a strategy implemented to achieve sustainable water management in buildings. Hence this literature elucidates that reduction of wastage will be possible by reduction of consumption which is directly linked to reduction of losses.

"Ministry of New and Renewable Energy (MNRE) report on Progressive achievements and plans" [3], this report presents the vision the ministry has in terms of implementing Solar Water Heating systems (SWHS) across India. The government aspires to cover upto 20 million sqmts of SWHS by the thirteenth plan by year

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2022[3]. Hence the objective of this paper, to focus on wastage from showerheads, stems from ministry'sintentions to scale up the system.This reference helps to form grounds thatsteps to preclude potential wastages need to be taken.

"Water Consumption Patterns in Domestic Households in Major Cities" [1] by Abdul Shaban, R.N Sharma throws light upon the plight of supply deprived Indian cities reeling under the scarcity of water. Seven Indian cities have been studied to examine consumption patterns in the domestic usage of water .The cities chosen are population and culture wise similar to Pune hence the findings are relatable to the context. The paper gives an insight into how showering is an activity that consumes maximum amount of water across all domestic uses and is as high as 28.2%. This is an important premise upon which this research is based so as highlight the importance of conservation of water in this activity by accounting for the losses first by quantifying them and then finding and employing mitigation methods.

4. MATERIAL AND METHODOLOGY

The objective of this study was to find methods to **quantify the amount of water wasted from showers.**Two methods have been devised to quantify the wastage. First method records data by using a 'metered method' and second by 'observation method'. Thesecomputations calculate losses that occur daily. When a shower is turned on there is a lot of time spent waiting until a steady stream of hot water starts to flow from the shower, which is a temperature comfortable for usage. The **water that the shower dispels before this point is the wastage that needs to be quantified**and this paper intends to structure methods for the computation.The methods tested were:

1. Metered method:

- A showerhead was fitted with a flow meter and the reading before starting the shower and after stopping was noted. Water was allowed to run till an optimum temperature was felt to touch which was adequately hot enough for taking a bath.
- A video recorded number of rotations of turbine to show how many cycles were completed and odometer indicated overall rotations. The needle moved from one point to the other in a cyclic manner and readings were noted at the start and the end of the cycle and noted as photographic data.
- By mathematical computation water wastageswere calculated in litres by incorporating the readings noted during the recording of data.
- Temperature was measured using a regular thermometer that gave the value in Fahrenheit degrees.
- It was possible to derive data to a fair degree of accuracy as no losses were incurred in collection of water

Figure 1: Installation of meter on the shower and meter (Source: Author)

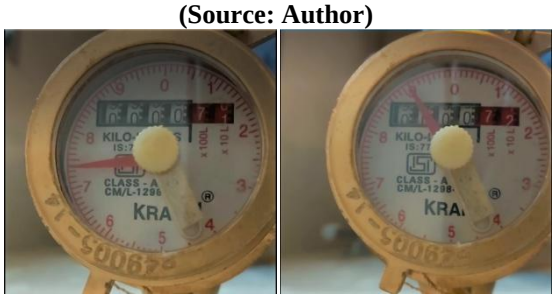

Figure 2: Meter readings showing start and end values (Source: Author)

The figure above indicates that the needle has completed one rotation and gone ahead. Calculation done is:

10 – 7.4 = 2.6 +9.1 = 11.7 litres

Hence 11.7 litres is the amount of wastage.

2. Observation method:

- A calibrated bucket was placed at a position where it would receive the shower water.
- The shower was started and adjustments were made to the hot and cold faucet till observer started receiving water that iswas comfortable to use.
- Once a steady flow of water,suited to the temperature requirement of the observer started flowing, the shower was turned off.
- Some water was collected at this point in a mug to record final temperature
- A picture of the bucket of wasted water and the thermometer was taken to document data.
- The wastage was measured in the calibrated bucket and amount was recorded in litres.
- Final temperature was also recorded in Fahrenheit degrees.

Figure 3: Recording of wastage by observation method (Source: Author)

The wastage of water recorded manually in the above figure was 11.8 litres. The results of both methods corroborate.

5. RESULTS AND INFERENCES

The quantum of water wasted, defers with respect to several variables like height of the building, temperature outside, the persons rank in the series of baths taken in the building,the floor on which the water is being consumed and the kind of heating system used to heat the water and the distance from heat source. This makes the quantification of shower wastage extremely challenging in terms of extracting authentic data.

While the metered method leaves a lower margin of error it is cumbersome to install, involves meter cost and installation cost and recording of readings is a difficult

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task as it is installed at the receiving end of the shower and hence at a height of over 7 feet.

The observation method is easy to conduct but as the data would be self supported the integrity and honesty of observer is very important. It can be noted that some losses occur due to improper positioning of the bucket and hence skills of the observer are also needed.

The observation method needs precise skills of observer so as to minimise the losses occurring if water is not collected completely in the bucket.

Observation method could be implemented for large scale data collection. It can be used in a mass survey, while metered method can be employed for a focus group or selected participants. The socio-economic, educational and cultural backgrounds of the participants are also key aspects to be considered in observation method while conducting a survey, as consumption pattern parity can be maintained while recording the readings.

6. CONCLUSION

Both the methods tested to extract quantitative data in this study proved to giveaccurate data and can be employed in computation of wastage.

7. IMPACT ASSESSMENT AND RECOMMENDATIONS

This wasted water is collected and used for other uses by consumers but it is still considered wastage as it is essentially a flaw in system design. If the plumbing design mitigates these losses in design itself the onus of conserving water is not solely placed on the consumer who, is in most cases,is not sensitised to the magnitude of the problem. Consumer attitude and behaviour is a larger and more complex issue to handle than finding economical, workable solutions in the plumbing design itself.Awareness campaigns that take statistics to people will help them grasp the gravity of the situation by looking at numbers.

Correctional plumbing design needs to be done to save these losses in buildings. A resource as precious as water, that is fast depleting cannot be forgone in favour ofimplementing a renewable energy system that need corrective measures to augment its efficacy. Considering MNRE's goal of covering 20 million square meters by 2022 corrective measure for this problem has to be addressed urgently to mitigate potential losses.The development in the coming years needs happen in such a manner that the gap between policy, design and implementation of the system are addressed with effective solutions

8. ACKNOWLEDGEMENT

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A Study of Agile Vs Traditional Project Management

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Abstract: The Indian construction industry is known to be inefficient and highly reluctant to accept change. Even with changing market and increasing competition, there are no obvious signs of comparable changes in methods of management and approach. Advancement in Project management tools and techniques, on the other hand, seems to offer what is needed to raise industry standards. The gap between an old view on managing projects and new way of actually conducting them creates uncertainty and anxiousness within the business and its employees. So,use of an Agile methodology helps to address such weaknesses associated with traditional methodologies. Study aims to compare APM method with TPMinconstruction projects with the help of a questionnaire survey based on agile values.

KEYWORDS:
Traditional Project Management, Agile Project Management, ConstructionProjects, Change Management, Flexibility.

ABBREVIATION
TPM – Traditional Project Management
APM – Agile Project Management

I.INTRODUCTION

To avoid or overcome with failure in construction projects is difficult task, most of the countries within the world are experiencing problem in managing failure in construction projects, Where nearly two-third of the development projects in the world are suffered by significant problems as a rise within the cost, delay within the specified duration for execution, and discontinuing of the projects. In this conservative industry, still the old method like the traditional waterfall method is used for managing the projects, This method follows linear processes and practices in which detailed, upfront planning is done at once by project managers and team members. That is an analysis of the project is done very early in the process, meaning stakeholders and customers must identify their desired outcome in an early stage. However, it can be hard to determine all the requirements and outcomes without seeing the project in progress especially early in the design phase. Once a phase is completed, there is no way to go back and change the outcome without repeating the entire process from the beginning. It is both time-consuming and costly to allow room for change within this process, making it difficult for teams to maintain strict timelines if not everything goes as planned. In this project, clients are hardly involved in decision making.Project communications with the client are extremely limited being either at the beginning or at the end of the development. [1]

Good communication is crucial to delivering a successful construction project. When communication among stakeholders breaks down or is mishandled, it can lead to delays, accidents, costly rework, and unhappy clients. Keeping everyone up to date on changes to the work or schedule goes a long way in preventing major problems. The flow of communication affects the flow of a construction project. Problems and delays occur when people stop communicating or responding to inquiries. Projects run smoother and get completed on time and within budget when everyone is communicating and collaborating effectively. [2]

Therefore it becomes necessary to look into new methods of managing projects which overcomes these problems and ensure its success.

Finding the optimal way of managing, control and coordinate projects is a constant challenge. Adjusting working methods, clarifying roles, simplifying project reporting or visualising the project-status through new user-friendly management tools are examples of how this challenge can be met. Project management
today often concerns the entire organisation whether it is a small private company or a larger public business.[3]

Project teams are using agile approaches in a variety of industries beyond software development. Organisations realize that expansions has created a need for a common language ,open mindset, and willingness to be flexible in how projects are delivered to the market. InAddition, there are broad range of tools and techniques ,and frameworks ,teams have choices for approaches and practices that fit their project and the organizational culture in order to achieve the desired outcome.[4]

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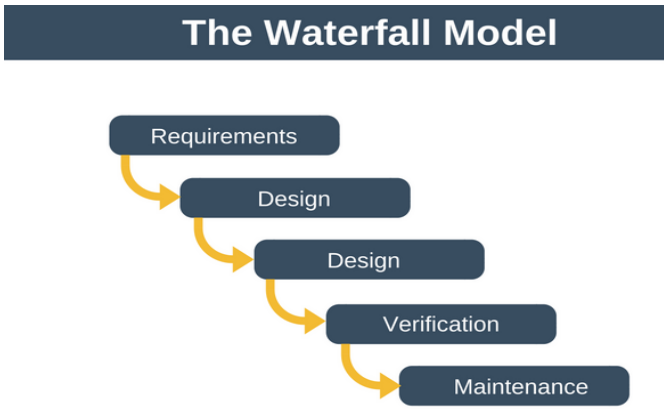
Although the agile movement was the "brain child" of the software development and IT world, it has grown and evolved over the past several years. There is no question that today agile project management can be, and has been, applied successfully to a broad range of projects. Users and stakeholders have benefited from the agile project management approach one in which the end user and the project team are partnered in a collaborative effort focused on the project vision and the end result. [5]

What is Traditional project management?

Traditional project management involves very disciplined and deliberate planning and control methods. With this approach, distinct project life cycle phases are easily recognisable. Tasks are completed one after another in an orderly sequence, requiring a significant part of the project to be planned up front. For example, in a construction project, the team needs to determine requirements, design and plan for the entire building, and not just incremental components, in order to understand the full scope of the effort.[6]Traditional project management assumes that events affecting the project are predictable and that tools and activities are well understood. In addition, with traditional project management, once a phase is complete, it is assumed that it will not be revisited. The strengths of this approach are that it lays out the steps for development and stresses the importance of requirements. The limitations are that projects rarely follow the sequential flow, and clients usually find it difficult to completely state all requirements early in the project. This model is often viewed as a waterfall.[7]Flow chart -1.



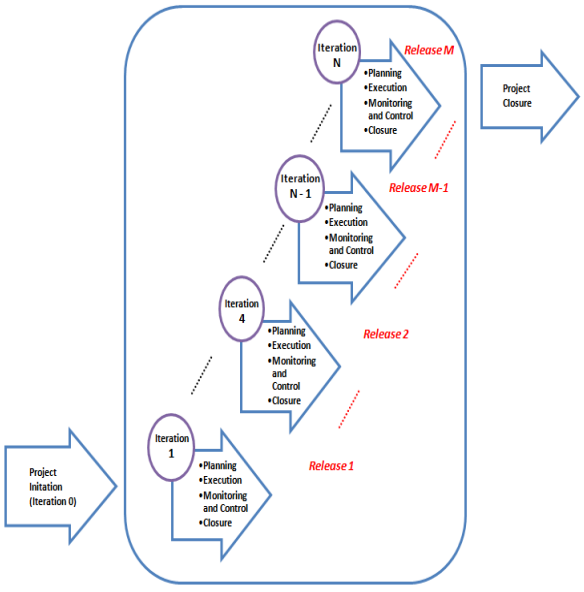
Flow chart -1 Water fall model

(source-www.expertprogrammanagement.com)

According to a Gartner report "The End of the Waterfall as We Know It" by Matthew Hotle and Nathan Wilson): *"Quite simply, Waterfall methods, when used in the traditional, project-based manner, are inconsistent and risky. Since there are other choices available that have the potential to be more consistent and less risky, it's time to begin the transition to these methods."*

What Is Agile Project Management?

Agile project management is an iterative development methodology that values human communication and feedback, adapting to change, and producing working results.[8]Agile is iterative, meaning that it is done in pieces (sprints), with each sprint building and improving off the lessons from the previous sprint.(Flow chart-2)This is where that term Scrum comes into play. Scrum methodology is a workflow framework made up of sprints and reviews used to promote Agile project management. Unlike Scrum, which can be distilled to a step-by-step process, Agile is an approach and a mindset. Agile methods are based on the central to see the actors' innate ability to learn from experience, to find creative solutions, and to spontaneously seek to derive mutual benefit from each other. "The agile methods are therefore directed to create situations where players are able to communicate very informally and can govern themselves"-Tomas Jansson, PhD & Professor of Project Management at Karlstad University



Flow chart-2Agile Project Management process.[9]

Agile methods are used when these conditions are present: project value is clear; the customer actively participates throughout the project; the customer, designers, and developers are co-located; incremental feature-driven development is possible; and visual documentation (cards on the wall vs. formal documentation) is acceptable.The Agile approach consists of many rapid iterative planning and development cycles, allowing a project team to constantly evaluate the evolving product and obtain immediate feedback from users or stakeholders. The team learns and improves the product, as well as their working

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methods, from each successive cycle. After a streamlined planning, requirements definition and solution design phase is completed to get the project underway, iterations of more detailed planning, requirements, design, build and test take place in waves. This approach allows for immediate modifications of the product as requirements come into view. APM requires a dedicated full-time project team that includes a customer or end user, where team members work from the same location.[7]

The Agile Manifesto is a proclamation that articulates four key values and 12 principles.

1. Individuals and interactions over processes and tools:
2.Working software over comprehensive documentation:
3.Customer collaboration over contract negotiation; and
4.Responding to change over following a plan.

In agile refers values on left more.

The twelve clarifying principles flowed from these values are as follows:

1.Our highest priority is to satisfy the customer through early and continuous delivery of valuable software.
2.Welocme changing requirements, even in late development. Agile processes harness change for the customer's competitive advantage.
3.Deliver working software frequently, from a couple of weeks to a couple of months, with a preference to the shorter timescale.
4.Business peopleand developers must work together daily throughout the project.
5.Build projects around motivated individuals. Give them the environment and support they need and trust them to get the job done.
6.The most efficient and effective method of conveying information to and within a development team is face-to-face conversation.
7.Working software is the primary measure of progress.
8.Agile processes promote sustainable development. The sponsors,developers,and users should be able to maintain a constant pace indefinitely.
9.Continuous attention to technical excellence and good design enhances agility.
10.Simplicity-the art of maximizing the amount of work not done-is essential.
11.The best architectures,requirements,and designs emerge from self-organizing teams.
12.At regular intervals, the team reflects on how to become more effective, then tunes and adjust its behaviour accordingly.

Although originating in the software industry,these principles have since spread to many other industries. This embodiment of mindset, values and principles defines what constitutes an agile approach. The various agile approaches in use today share common roots with the agile mindset,valve,and principles. The relationship is shown in Figure 3below.

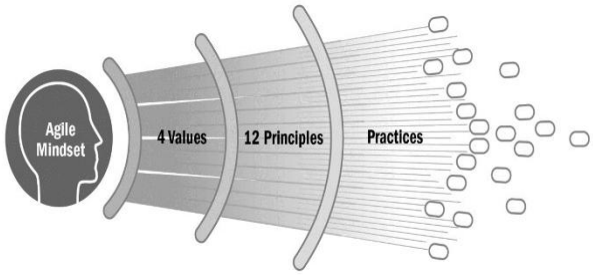

Figure 3The Relationship between the Agile Manifesto values,principles,andcommon practices.(source-PMI Agile Practice Guide)

As shown in the above Figure 3 the model articulates agile as a mindset defined by the agile manifesto values, guided by the agile manifesto principles, and enabled by various prctices.it is worth noting that while the term "agile' becomes popularized after the Manifesto approaches and techniques being used by project teams today existed before the agile manifesto by many years and in some cases, decades.[4]

II METHODOLOGY

The quantitative approach was chosen to gain understanding Depending on the theoretical study of the agile project management, this research examines the applicability of the agile project management on 4 values, which itself compares with traditional management in the construction industry.

For this purpose, the closed questionnaire technique for a group of professional from construction industry was conducted.The questionnaire survey form was for targeted group of people only,Professional who are working in construction project and having knowledge about project management were the main target group. Mainly the technical persons (like project managers, contractor, Team members, architects, client, etc.) were considered for better responses. Since this methodology is not much familiar and well known in Indian construction Industry, Questions were designed based on 4 values of agile project managementidentified through theoretical study. Then, the questionnaire was sent to Research guide and some of the professional experts for evaluation the questions of the questionnaire, the final form of the questionnaire included the General Information about the Respondent and Applying of Agile projects management values in construction projects.

III DATA COLLECTION

The questionnaire was sent to 30 respondents. From which, 23 people read the questionnaire, but only 20 people have actually completed the questionnaire form. Therefore, the total number of respondents is 20, resulting

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in a good response rate of 66.66 % Out of those 20 successful respondents, their roles in projects were, 7 wereProject managers, 7Architects,3 Contractor, 2Clients, and 1structural engineer who had more than 20 years of experience in working with the main parties involved in the construction project.

The respondents were also asked for their experience in construction filed, work sector, organisation details, cost of the project on which they are working.etc. ReferTable 1

Table 1: General information of the study sample

General information		Project Manager	Contractor	Architect	Client	Other Consultants
Total no of experts		**7**	**3**	**7**	**2**	**1**
Professional expereinece	More than 20 years	1	1	2	0	1
	16 to 20 years	1	1	0	0	0
	11 to 15 years	4	1	4	2	0
	6 to 10 years	1	0	1	0	0
Work sector /company	Public	1	1	1	0	0
	Private	6	2	6	2	1
No. of empolyees in an organisation	1 to 9	1	1	4	0	1
	10 to 50	1	0	0	0	0
	51 to 200	1	1	0	1	0
	More than 200	4	1	3	1	0
Project cost	10 lacs to 50 lacs	1	0	2	0	0
	51 lacs to 1 cr	0	0	0	0	0
	1 cr to 2.5 cr	1	1	1	0	1
	More than 2.5 cr	5	2	4	2	0

Table 1General Information of the Study sample.

IVANALYSIS ON FOUR VALUE BASED FACTORS:

Analysis is done through detailed information collected through the questionnaire responses. The objective of this section is to check the possibility of implementing the Agile project management values in the construction projectsby a set of questions related to each value. Respondents had the freedom to choose their opinions about this survey. Specifically, this question focused on their perception about these factors and respondents had to choose one option for each factor. The scale ranged from 1 to 5 wherein, 1 indicates 'Strongly disagree' and 5 indicates 'Strongly agree. The outcome of the survey would highlight perspectives of individuals regarding the kind of environment the project team would like to work within. Along with that, it would also hint on the satisfactory levels of the respondents regarding the agile project management or want to improvise/ suggest changes in the existing management approach. According to the result of this survey, the responses were positive which might lead these people to adopt agile approach and negative ones are for still following the existing waterfall project management approach.

Below are the results of responses for 1st value of APM:

1.Individuals And Interactions Over Processes And Tools.

Valuing people more highly than processes or tools is easy to understand because it is the people who respond to business needs and drive the development process. If the process or the tools drive development, the team is less responsive to change and less likely to meet customer needs. Communication is an example of the difference between valuing individuals versus process. In the case of individuals, communication is fluid and happens when a need arises. In the case of process, communication is scheduled and requires specific content.[1]

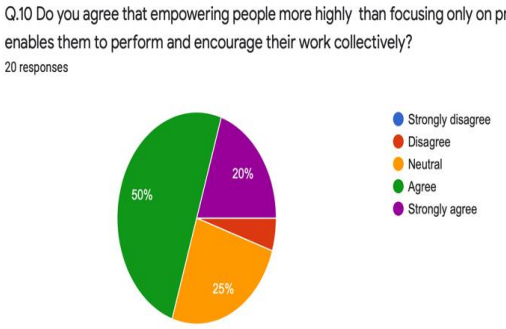

Figure 4Individuals and interactions over Processes and Tools.

The first value of Agile project management values can be applied in the construction projects at a high level as 50 % respondents have agreed and 20 % have strongly agreed ,it means 70 % respondents think that communication within team is very important while working on any project. AsCommunications makes people to think and observe more.25% given neutral (don't know)as their response, only one respondent is not agreeing with this it means that they might be following TPM. In traditional project management approach communication within team in terms of construction is less because they are bound by project managers to work accordingly. Also importance to processes is given more than the outcome.

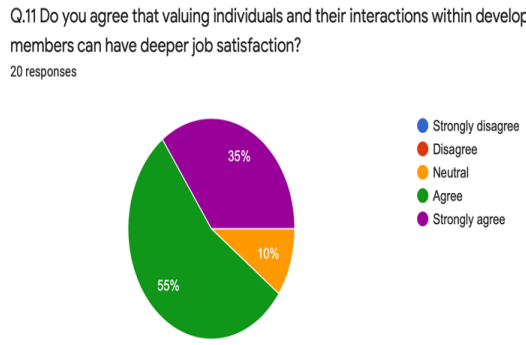

Figure 5 Valuing Individuals

55% respondent agree and 35% respondent strongly agree that the job satisfaction is also more due to valuing individuals and their interactions within the team. No matter how well-researched your process and high-tech your tools are, it's the team you work with and the way you work together that determines success. Your team and their ability to communicate effectively and efficiently is

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more valuable than the processes they follow or the tools you use.

The results of responses for 2nd value of APM

2.Working Software Over Comprehensive Documentation

Enormous amounts of time were spent on documenting the project requirements for development and ultimate delivery. Technical specifications, technical requirements, technical prospectus, interface design documents, test plans, documentation plans, and approvals required for each. The list was extensive and was a cause for the long delays in development. Agile does not eliminate documentation, but it streamlines it in a form that gives the developer what is needed to do the work without getting bogged down in minutiae. Agile documents requirements as user stories, which are sufficient for a software developer to begin the task of building a new function.[1]Useful project outcome over comprehensive documentation" and this makes it easier to understand what it would mean in construction industries. The meaning of this part of the manifesto is to throughout the project deliver smaller useful results, instead of setting up a goal to deliver the result of the entire project at one point somewhere in the far future. The process is divided into short cycles and at the beginning of each cycle there is an opportunity to both review the past cycle but also thoroughly plan the upcoming cycle. At the end of each cycle a useful part of result is presented. How early in a project these parts actually become useful depends on the type of project. By actually closing each cycle and review what has been produced, there are throughout the project possibilities to decide whether the project has been completed or if it needs to be cancelled before completion because of various factors. It becomes a tool of monitoring the progress of the project that naturally includes opportunities for decision-making.[3]

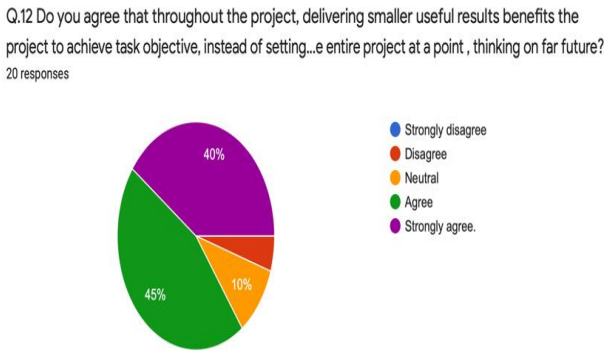

Figure 6 working software over comprehensive documentation.

As per survey resultsFigure 6shows 45% and 40% respondent agree and strongly agree ,together 85% of respondent agree for adapting agile management second value.

The results of responses for 3rd value of APM:

3.Customer Collaboration Over Contract Negotiation

Throughout the history of project management it has been a well-known fact that a good relationship between the client and the supplier is of the essence for a successful project. The thing is that before the Agile management approach methods one did not really know how to achieve a good relationship. Since the process is divided into smaller parts, in Agile, with review and presentation between each of them the client has (and should take) the opportunity to see, discuss and decide whether the present plan should continue or if something should be changed. These presentations are held with, at the most, a month's interval, which makes it possible for theclient to be involved throughout the project and make changes, if necessary, before the issues get too large.At the end of each cycle of an Agileproject, the client is involved to bring forward opinions and thoughts about the project.

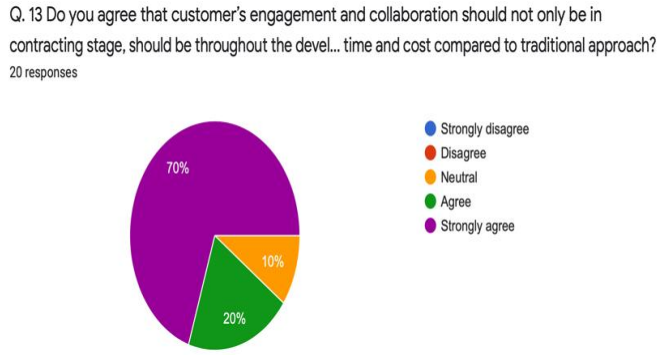

Figure 7Customer collaboration over contract negotiation

As per Figure 790% respondent strongly agree this means that the client collaboration is core to bring the project towards success. The customer gets involved throughout the completely Agile project process by reviewing, discussing and deciding at the end of each cycle.

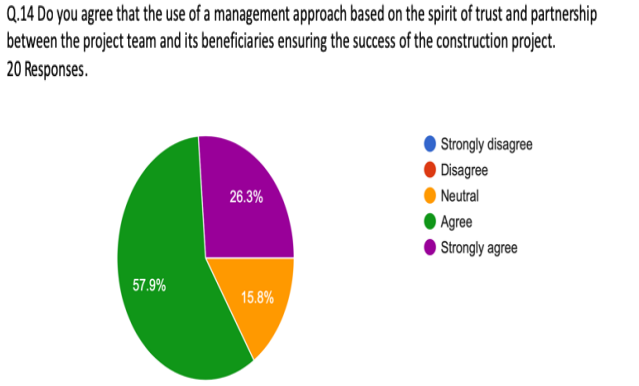

Figure 8Trust and partnership between project team and client.

As per survey results 57.9% and 26.3% respondent agree and strongly agree ,together 84.2% of respondent agree for adapting agile management approach based on the spirit and partnership between the project team and its

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beneficiaries ensuring the success of the construction project.

4: Responding To Change Over Following A Plan

The Agile Manifesto states that changes are welcomed in agile projects. The reason for this is that Agile projects do not believe in "predicting the future" by planning for every detail in advance. The plans should instead be dynamic and Agile teams should realize that projects are prone to change.

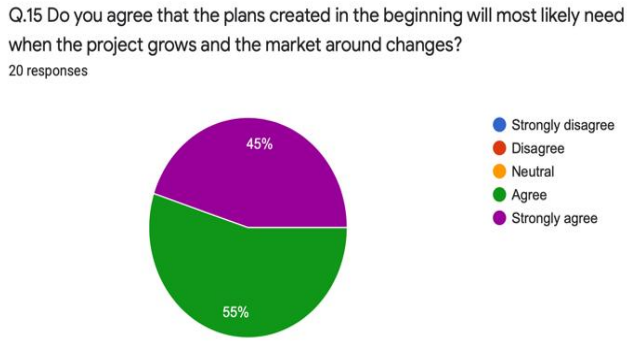

Figure 9Responding to change over Following a plan.

As per survey results 55% and 45% respondent agree and strongly agree respectively, so it means 100 % of respondent positively agree to it that the plans which were created at the beginning will most likely need to be adjusted when projects grows and the market around changes.

V.CONCLUSION:

The major advantage of implementing agile project management in construction projects is to increase communication within development team.Agile approaches are effective and allow the project management process to be a vivid and continuously updated depending on how much information has been disclosed as well as how many different scenarios have been run. Agile project management provides project managers with methods, tools and approaches to aid both the project manager and project client to engage in a more efficient manner, allowing for more open communication, feedback sessions and the notion of pursuing a shared goal towards successful project management. Implementing agile project management will also result in client's satisfaction in the end of the project. As the chosen research topic is mainly focused on agile values, further research can be done on 12 agile principles and its implementation in construction industry.

VI.RECOMMENDATIONS:

Construction companies should provide, conduct the seminars and training courses to raise awareness among the decision-makers and all the team members of the project to adopt these values in the construction projects.

VII.ACKNOWLEDGEMENT:

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Morphological Analysis of 'Shilpashastra' and a Comparison with Contemporary Urban Morphologies : A Case of Madurai

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Abstract: ***Planned historic settlements based on agama texts [Shilpashastra] in India are a unique morphology, physical embodiment of the agama philosophy & practice-ritual systems in these cultural landscapes. These settlements, characteristic to the SE Asian region have remained absent from the global city-planning dialog. The agama texts prescribed city-structure guidelines for urban form. However, there is a large deviation between the prescribed and on ground model. This paper intends to carry out a morphological analysis of Shilpashastra and understand it in relevance to the contemporary city. The process shall help identify the deviations from texts as well as evolutionary developments.***

Keywords: Shilpashastra, cultural landscapes, agama-based city model, planned Indian cities, morphological analysis, Madurai.

Introduction: Planning and conservation practice in India, today, is still a reflection of Western philosophies & ideologies[i]. The knowledge systems embedded within our philosophy are disregarded on the grounds of superstition.

The 'Agama philosophy' has been the basis for the conception of Pre-Mughal historic culturallandscapes in India, especially temple towns. Some of the oldest towns have been functioning for more than 2000 years. Shilpashastra provides guidelines for the architecture and planning of the towns, a system whose history might go deeper than we know.

The engineering of such unique morphological systems, composed by successive layering of geometrical patterns over metaphysical diagrams dictated by social norms and shaped by mathematical proportions, based on the agama texts or the Shilpa-Shastra, exist even today in some of the temple-towns in India.

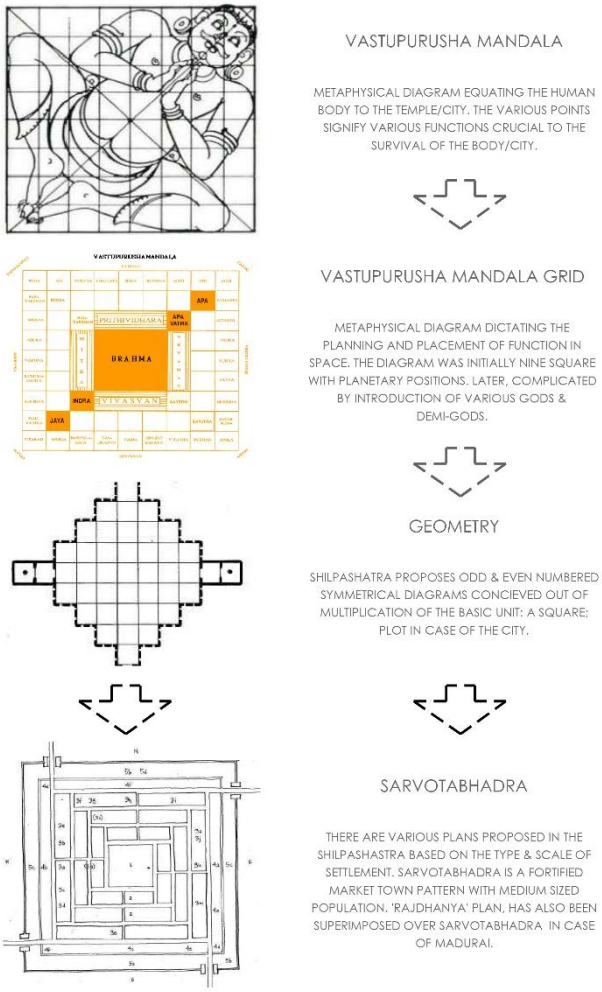

Fig 1: Layering of various diagrams constituting the city-plan
Source: Author

These living cities bear physical witness to the evolutionary processes that the city's urban form has undergone through time, successive cultures, changing politico-administrative structures and ever dynamic 'people's agency'. The lens of 'cultural and religious value' to the system and its central role in these landscapes is pivotal to their survival and continuity. Such a culture of pilgrim towns form a network of connected landscapes at a macro-level and an integrated interdependent local system at a micro-level.

Hence, these norms operated to create interconnected systems of morphology and syntax intertwined at various

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levels. City-building science and cities have been in existence since ages. In the global context, the 'agama-city model' isn't acknowledged as a working model under the alibi of its metaphysical base. This paper intends to explore the city-planning aspect of the Shilpashastra beyond the metaphysical aspect and understand its implication and meaning in the contemporary times.

With recent awakening for the 'need for a different outlook' in the SE Asian context, many more such unique 'agama-based' morphologies are being discovered in the region [loosely referred to as the historic 'Greater India'].

Fig 2: Various cities across SE Asian context conjectured to have an agama-base
Base map Source: Google

There are large deviations in the cities prescribed under the Shilpashastra versus the actual city in existence. This is one of the major reasons that these city models lay buried for centuries undiscovered. Another major issue with studying city models is that archaeological remains of old cities and intact city forms of historic cities can be identified and studied with greater ease than the living continuous cities with evolutionary and executional deviation in the case of the agama-cities in the Indian context.

These models were also governed by socio-cultural and politico-administrative stands and economic statuses at a city hierarchy level. The contemporary forms display strands of such hierarchical systems in their composition. The impact and adaptative-modification of this composition due to time-factor and successive cultures in the timeline[1]. The transformation can also be looked upon as a transition from a utilitarian city-model with centralised administrative control [Madurai] to a decentralised model [Jaipur] and finally a capitalist aesthetic city-model in contemporary times that branch out from these agama-historic cores.

Fig 3: [top to bottom] Jaipur, Srirangam and Madurai; various grids and patterns of the planned historic cores; Base map source: Google

Literature Review: The various arguments of the origin of the schemes and plans prescribed under Shilpashastra have essentially stemmed because of these very deviations. Kramrisch [ii] started the argument of the metaphysical base to the diagrams[2], thereby associating the '**Vastupurushamandala**' to the plans. From this argument stemmed the connotation of **Mandala city plan** addressing the agama-based cities. Adam Hardy [iii] decoded the temple plan and form and drew patterns of extrapolation and projection of plan into 3D form. Bafna [iv] argues that the annotation of Mandala city plan is not fully justifiable in itself and although the Vastupurusha diagram might be considered as an underlying aspect to it, Yantra, the geometrical diagram is the predominant base. BB Dutt [v] is an important contributor to the translation of Shilpashastra and reproducing it nearly close to city-planning guidelines.

Mayamatam helps us understand that the city-form in itself is a product of not only the overlap of Vastupurushamandala [metaphysical] and the pada-vinyasa schemes [geometry], but essentially also mathematical proportions [volumetric proportion of the city's built-form and its hierarchy].

Methodology: Morphological analysis of the agama-texts [Shilpa-shastra] and comparison with contemporary urban-form, forms the core of the research of this thesis.

A basket of methods- both qualitative and quantitative have been used to assimilate the study. Morphological analysis has been used as a method to decode the evolution in the urban form of the planned city of Madurai and understand the agents of change. Along with this, phenomenology and historico-geographic methods have been used as supplementary methods.

[1] Centralised administrative power in Madurai and Srirangam to decentralisation in Jaipur

[2] The interpretation was primarily for the plan-diagrams for the temples

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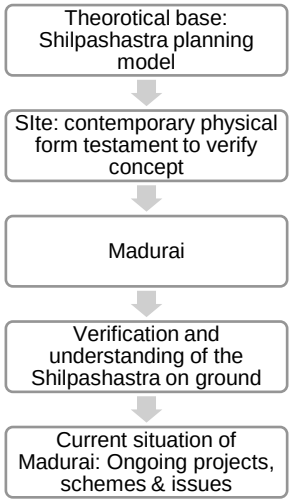
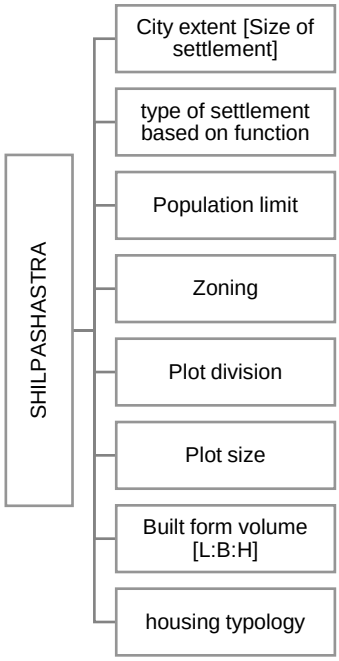
The Mayamatam[3] book, compendium of architectural, city-building and engineering practices based on the Hindu philosophy had been taken as the theoretical base from where the study started. The area of interest was to find planning models existing in the Indian landscape since ages.



Flowchart 1: Methodology

Results and Inferences: The differences between the prescribed form and existing/executed raise the question of level of stringent implementation of the agama guidelines. They may have served merely as a framework subject to interpretation with respect to each individual site.



Flowchart 2: Various guideline categories provided under Shilpashastra

Criteria	Prescribed	Deviation in contemporary form : madurai
Size of settlement	300-8000 poles[4]	800 m x 900 m[5]
Type of settlement	Rajdhanya	Rajdhanya+Nandyavarta+sthaniya
Plot size	121 blocks[6]	
Volume	L:B:H= B+2:B: 1 to 2B	Contemporary: B: H= B: 3 TO 4B[7]

Table 1 : Prescribed versus deviation [Shilpashastra]

The probable causes for deviation between the prescribed and the ground model could be:

- Scale of the city being humungous as compared to the machine scale: the human.
- Technological limitations to execute the desired layout
- Mode of execution being manual and on ground; limitation of capacity
- Discrepancy of various overlapping criterion, each generating individual layouts: the resultant city form is a mixture of all the layouts and unidentifiable with any one particular layout.

The reason for undistinguishable submerged state of the contemporary city form of Madurai:

- Adaptive-evolutionary changes
- Different politico-administrative structures
- Changing economic base through time
- Changing people's aspiration

Madurai happens to be an overlap of three mapping categories prescribed in the agama – Rajdhanya [capital city] which largely impacts the zoning and hierarchy, Sarvotabhadra layout which regulates the street layout, blocks and accommodates its fort-city capacity. Madurai also being a major economic center, in places displays zoning pertaining to the market in Shilpashastra.

The current form of the city exhibits a crooked concentricity as compared to Srirangam, which displays

[3] Later version of ManasaraShilpashastra

[4] 1 pole= 5.02 m

[5] UptoMasiveedi

[6] Sarvotabhadra town is prescribed to have 121 blocks; whether these blocks are same as plots is ambiguous.

[7] The paper notes observable patterns of change in deviations

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concentricity to the maximum and deviation to the minimum. Madurai as a model in the timeline of city-building in the Indian context is considered to be a part of learning and working process, hence is given the leeway for its deviant form.

The ring roads- *Aadi veedi*[8], *Chittiraiveedi, Avvani Moola veedi, Masiveedi and Veliveedi*[9]*;* follow their ceremonial function of processions even today. The central temple has been prescribed to be the highest [point] and largest [block] in the city's cultural landscape, followed by the palace and the rest of the landscape. In the contemporary landscape, the temple still fairly remains the highest and largest point, even amidst the new development.

The plot division and sizes as prescribed in the Shilpashastra provided a regulation for capacity of land to supply and sustain. There are a few areas of old vernacular building stock that display uniformity or hierarchy in the form along with regulated volume and capacity.

Category	Element	Use/function	Value
Street system	Ring roads-concentric	Procession	R C H
	Axis roads	Avenue and axis to the temple	R C H I
	Outcrop roads leading to outside of the core	Transit lines	C H I
Central foci	Meenakshi Amman Temple	Congregation, religious space	R C H I
Tanks	Perumal Theppam	Subordinate shrine	R C H I E

Table 2: Charting the elements to their corresponding function and value. [basic primary elements as observed in Madurai] R: Religious value, C: Cultural value and H: Heritage/historic value, I: Contemporary value, E: Ecological

Although the entire prescribed form is not projected onto ground in case of the agama-planned cities, the Shilpashastra acts as a guiding framework, right from the location of the city at macro-scale to the Vastushastra operating at an individual house level at a micro-scale.

Conclusion: The topic of agama-based city is to be further studied. It becomes critical to address all the aspects of the morphology prescribed in the agama as well as those that are a product of evolutionary adaptation in order to atleast balance out the contemporary action if not improve the situation.

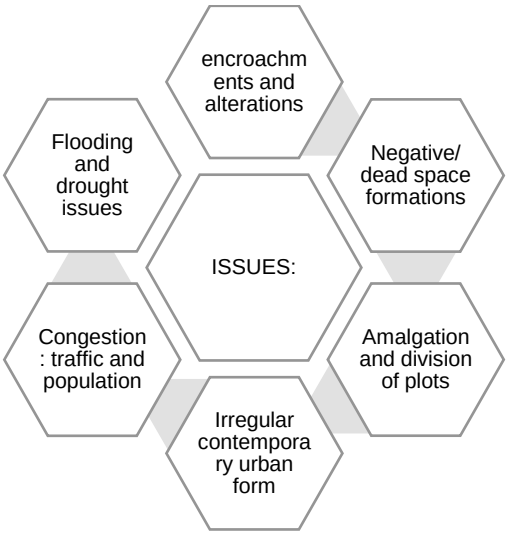

Fig 4: Critical issues of the contemporary urban form

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[8]Veedi meaning street
9 Veliveedi being a later addition during colonial times for city expansion

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Analyzing The Rehabilitation Of Landslide Affected Village By Application Of Sustainability Indicators

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Abstract: The focus of paper was on landslide disaster rehabilitation in rural region, as these areas lack infrastructural development due to inaccessibility and are in much need of innovation and aid. Existing literature suggests that the rehabilitation housing projects lack cultural appropriateness and considerations of local needs of disaster victims. Aim of the research was to analyze current impacts of rehabilitation housing project on people and environment, using sustainability indicators such as Social appropriation, infrastructure, construction materials, future risk minimization and low impact on environment. The methodology of research included, background study of landslide disasters in Maharashtra and current disaster mitigation system, as this state, specifically Western Ghats come under moderate to high risk of landslides. It presents the findings of a live case study at Malin village located near Pune in Maharashtra. Analysis of rehabilitation housing project was done on basis of survey and interviews of villagers rehabilitated and further issues faced by them. The research concludes with issues of current rehabilitation process and gives future direction to make rehabilitation process more sustainable, so that further impact on already affected village can be minimized.

KEYWORDS : Disaster, Vulnerability, Landslide, Rehabilitation, Sustainable Indicators, Housing

1. INTRODUCTION

India is advancing towards the future, where disaster such as floods, earthquakes, landslides, cyclones, tsunami's, heat strokes etc are becoming more and more frequent (International Disaster Database - EM DAT). The major cause behind this is climate change caused by global warming and pollution (Alexander, 2019). This paper explores various impacts of landslide disaster on different aspects of society and surroundings. The factors such as social, economical, infrastructure and environment are under study. The focus is on disaster in rural region, as such areas are generally less accessible from well developed infrastructure.

Existing literature suggests that the rehabilitation housing projects lack socio-cultural appropriateness, considerations of needs of local disaster victims and effect of such rehabilitation on surrounding environment (Barenstein, 2008). Sustainability factors play an important role in having long term positive impact on wellbeing of rehabilitated people. This research analyses such positive and negative impacts of rehabilitation housing project in terms of sustainability indicators. The research concludes with issues of current rehabilitation process and provides recommendations in order to minimize negative impacts. Following section reviews various concepts related to the study.

1.1 Hazard, Vulnerability And Disaster

When we talk about disaster, it is the combination of two factors, i.e., Hazard, which is defined as, '*an event or physical condition that has the potential to cause fatalities, injuries, property damage, infrastructure damage, agricultural losses, damage to the environment, interruption of business, or other types of harm or loss*' and Vulnerability, which is defined as '*The degree to which a person, system or unit is likely to experience harm due to exposure to perturbations or stresses* (Vijayalakshmi Viswanathan, 2019).*'*

In general, disaster involves many factors, both natural and man-made. In case of landslide, natural factors such as soil type, weather, rain are involved with manmade factors such as, deforestation, farming and construction development on slope, soil extraction etc.

1.2 Landslide and it's impacts

Landslide near human development can create impacts on many aspects of environment, which can become hazardous to local residents. These can be categorised as social, economic and environmental impacts (Highland, 2009).

Social impacts include loss of livelihood, heritage and social structures, weakened social structure etc. (Highland, 2009). Environmental Impacts include, changed surface topography, groundwater flow alterations and poor water quality, destruction of vegetative cover and natural habitat (Gouagna, 2012).

Economic Impacts include destruction of farmlands, Soil contamination leading to barren lands, Physical assets destruction giving major economic setback to villagers (E. N. C. Perera, 2018).

1.3 Landslide Vulnerability profile of India

NDMA (National Disaster Management Authority) has published report on disaster vulnerability of India. It depicts the landslide sensitive zones all over in India. It

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can be observed that northern regions including Himalayas, northeast regions of Assam and south western region of Maharashtra and Karnataka including ranges of Western Ghat are major landslide prone areas. The landslide prone areas are located prominently in geologically active zones of India. (NDMA, 2018)

The National Disaster Response Force (NDRF) has been established to provide immediate response to disaster. NDRF is further subdivided till regional and local levels for more efficient response to disaster event as well as keeping up to date records of disaster activities throughout India.

1.4 Rehabilitation aspects and norms for landslide affected village

In general, ideal rehabilitation should include physical, economic and social aspects as well as psychological upliftment of the livelihood in the disaster affected region. Hence following aspects are considered while planning rehabilitation.

Social rehabilitation

Considering the vulnerable sections of society like elderly, orphans, single women and young children would need special social support to survive the impact of disasters.

The rehabilitation process should be sensitive about the fact that victims may have already gone through much of social strain, as many people in their neighbourhood may have heavily suffered in disaster.

Psychological rehabilitation

Dealing with victim's psychology is a very sensitive issue and must be handled with care. Thus, counselling for stress management should form a continuous part of a disaster rehabilitation.

Economic rehabilitation

To economically sustain rehabilitation, analysis of existing livelihood and economical opportunities is to be done by planners. Rehabilitation should be economically feasible for Vulnerable families, as to stabilise and grow stronger. There should be some business opportunities at local level or alternative income jobs and commerce.

1.5 Sustainable rehabilitation

Sustainable development is concept of livelihood security. Sustainable development will create long term positive impacts on every aspect of rehabilitants lives (Adams, 2002). Following major aspects are included in this development -

- **Increasing awareness** of people to offset risk, absorb shocks and Training them to avoid any further disaster i.e., Disaster preparedness.
- **Including affected villagers** in decision making and construction process and planning of rehabilitation project. Keeping check on rehabilitation process by continuous assessment of such project with expert supervision and technical help, Which will strengthen the overall future of rehabilitation.
- Designing and planning of rehabilitation project with consideration towards rehabilitants actual needs and requirements.
- **Proper and well maintained services** are very important for functioning of rehabilitation project. supply of electricity, water, waste management are much important factor for better livelihood of villagers
- **The aim of rehabilitation project should be** to make rehabilitant economically independent and integrated with the host population; to re-establish true home.

1.6 Advantages of people centric approach to rehabilitation-

- It is more cost effective as **owner knows exactly what he wants and don't want** in house.
- Building may be **used for occupancy** already before the house is fully finished.
- Active participation by rehabilitant will increase joint community feeling which is essential for long term rehabilitation.
- Construction activities keep people occupied and gainfully employed**.** which helps in stabilizing economical state of people.
- Due to participation of rehabilitant, attachment is formed between owner and house. Which is essential as that person maintains the house increasing lifespan of project.
- Increased social involvement creates and heals the social bond, and helps in re-establishing cultural heritage and identity.

2. METHODOLOGY OF RESEARCH

Methodology included following steps -

- live case study of disaster rehabilitation project is done to understand the current methods applied by government for disaster rehabilitation.
- Through field study on rehabilitation project, Primary data was gathered by using structured questionnaire from residents of the affected regions; the questionnaire data gives detail information about the livelihoods and issues at the household level.
- Before data collection, a pilot survey was conducted on disaster site for creating baseline/ framework of detailed survey, and the questionnaire was revised according to the responses.

3. LIVE CASE STUDY OF MALIN VILLAGE

The case study was selected after the background search of disaster incidents in Maharashtra state. As the focus of the research was assessment of rehabilitation of disaster

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affected people at village level, The incidents were selected on criteria of following -

- Accessibility - As the aim of the research is to assess the rehabilitation project in remote level and with lower accessibility.
- Location - The village should be situated in Western Ghats region as, this region is considered to be under moderate to high threat of landslide disaster.
- Time period - The incidents of landslides from 3-4 years back are selected, as research requires case study of fully rehabilitated village, So that after effects of such rehabilitation can be studied.

3.1 Background of landslide disaster

Malin village is the northern part of Western Ghat of Deccan Trap and is located on the one end of the reservoir of Dimbhe dam, situated on Ghod river, a tributary of Bhima river in the Ambegaon Tehsil of Pune district in Maharashtra, India. It is located about 40 km from the famous Bhimashankar temple and about 150 km from Pune.

The incident of landslide happened early in morning of 30 July 2014, more than 134 people from Malin village died and many more become injured. almost 70 percent village got buried under mud, destroying households and land. Following are the causes of landslide -

- The major cause of landslide can be considered as cutting down the trees on slopes of downhill, for expanding farmlands.
- due to which soil which has low holding capacity became unstable.
- due to heavy rain soil became saturated and muddy.
- Which lead to sliding of entire soil cover downhill and causing disaster.

3.2 Temporary rehabilitation

The Temporary Structures for landslide affected villagers of Malin were built in nearby school compound. The sheds needed to built as fast as possible hence the construction is done with corrugated metal sheets put over steel frame work.

- The Basic unit size is 12 ft x 15 ft. The unit is simple rectangular structure, without any internal partition (as shown in Figure 1).
- There are Window for ventilation on back side of each room measuring 75 cm x 90 cm in size.
- There are 2 Tube lights and no fans in Room.

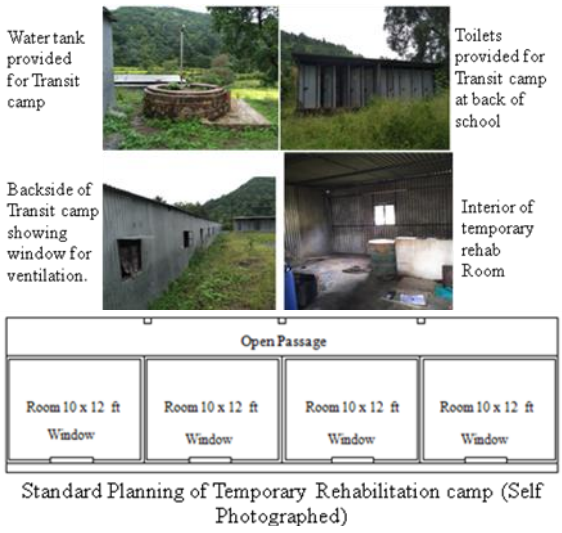

Figure 1 - Temporary Rehabilitation (Source - photograph by Author¹)

3.3 Permanent Rehabilitation

Rehabilitation project was planned on land of nearby village of Ambade.

- It took six month for selection of site that is Ambade village near the Malin .
- Total area **about 8.5 acre** has been allotted.
- **One unit of two houses** is costing **15 lakh**.
- The newly-built 67 houses are **earthquake-resistant.**

- Each house, made up of steel and concrete, has the carpet area of **450 sq feet**. Apart from houses, a school, a Gram panchayat office, a public health centre, public toilets and a boundary wall for the village too were constructed.
- The amenities provided here are school, hospital, Gram panchyat, internal roads, and proper drains.

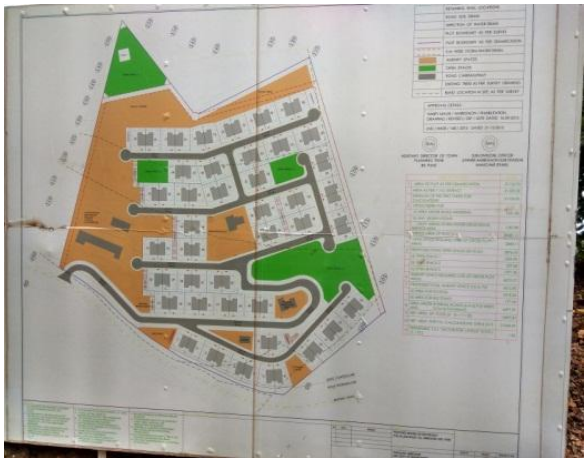

Figure 2 - Permanent Rehabilitation project plan (Source - photograph by Author¹)

Rehabilitation of housing -

- Generally aluminium formwork used for **high rise building and** it is not economical to use in small residential project.
- COSMOS companies aluminium formwork has been used for fast construction (precession engineered

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formwork fabricated in aluminium). So it was possible to construct **67 houses with 2 years**.

- These forms are **strong and sturdy, fabricated with accuracy and easy to handle.**

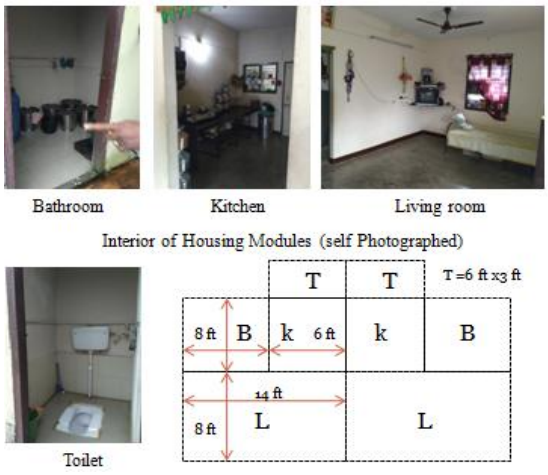

Figure 3 - Permanent rehabilitation housing module (Source - photograph by Author[1])

4. OBSERVATIONS

Infrastructure issues –

- Due to shifting of unstable soil under foundation, roads started to show the Fissure and cracks. Sewage lines getting cracked due to shifting soil pressure and use of low quality plastic pipelines.
- The amenities provided in the village are such as healthcare clinic, community hall, community cattle shed are in general inefficient.
- no convenience shop or market in village.
- Basic amenities such as water and electricity are in irregular supply. The drinking water is supplied from neighbour village, Adivare, once every alternate day for 1-2 hours.
- unsatisfactory size of housing modules, as per feedback of villagers.

Economical Issues –

- The major economical issue is lack of any business opportunity in village.
- Other issue is the location of village, which is quite remote due to formation of reservoir lake of Dimbhe dam.
- Some people have secondary income by cattle farming. But major issue with this is, the rehabilitation is far from original village, due to which people have to take their cattle far for grazing.

Social issues –

- In rehabilitation, the majority of resident belong to Mahadev koli cast. After disaster of landslide the local temple in village got destroyed.
- Under reconstruction and rehabilitation policy, Government has rebuilt the temple in the original place at Malin village. But there is no temple built at the rehabilitation project as till date of survey of this research. There is a community centre in the rehabilitation project, but it is rarely used by people.
- The other issue is that housing provided to families is not proportionate to family size, as each family got an house of fixed size. also there is no concern for neighbourhood system, which was previously present in old village.
- Also people are not attached to the housing module, as they were not involved in decision making process of housing construction. Hence may people find their houses.

5. INFERENCES

Following inferences can be drawn from the case study of Malin village rehabilitation project -

- It is inferred that, major cause behind low success of the Malin rehabilitation project is **lack of future planning** and no concern given to villagers livelihood. Due to which majority of villagers have to relocate to other places for jobs or other income.
- The location of rehabilitation is not an ideal location for project as it repeats **the same mistake of rehabilitating in existing village conditions**, due to which similar treat of landslide still hangs over villagers, even though disaster proofing is done with building retaining walls around rehabilitation.
- The rehabilitation project is sufficiently equipped with amenities at planning stage. But in reality working force or administration behind the village is not efficient. Also the capacity of these amenities and services are not enough for village. This is due to various causes such as -
- Remoteness of village
- Lower number of permanent villagers.
- No job opportunities at local level due to which working class has to shift to nearby town for jobs.
- Low level of farming opportunities due to sensitive land and soil.
- Amenities are not maintained regularly, due to lack of workforce. Hence the rehabilitation slowly leads to failure. The better connectivity and opportunities are required to maintain base population in rehabilitation.
- The rehabilitation is done without any concern for Individual needs of villagers, hence many villagers are modifying the housing modules according to their need. also housing is distributed in villagers as 1 module per family, without any concern for size of family.
- Site selected for rehabilitation was low vegetative grassland with few trees. rehabilitation is done without cutting single tree on site. hence it can be said that environmental concern was there while planning the rehabilitation.

6. CONCLUSIONS

- The disaster management system in India is structured over all stages of society, I.e. from national stage to rural stage. This makes the application of norms and disaster prevention at lowest scale much efficient.

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- It is concluded from case study above that, in Maharashtra state disaster rehabilitation is not done with aspect of sustainable indicators regarding social, economical, environmental.
- The rehabilitation is not all inclusive in terms of decision making and planning. In Maharashtra state, people in disaster affected villages have their own specific needs of livelihood and these needs are to be considered in at design stage only, while planning the rehabilitation.
- The balance between sustainable factors is interdependent and delicate, hence decision makers and planners have to study the rehabilitant area carefully and to consider effects of all aspects and their impacts on livelihood of rehabilitated people, for successful rehabilitation.

7. ACKNOWLEDGEMENT

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Exploration of Bamboo as a Construction Material to Adapt to Parametric Forms

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Abstract ***When the term 'Parametricism' gathered fame, there was a commencement of exploration in the field of architecture. Softwares are used as tools for form finding. Designs are based on various systems and computational scripts based on specific logics and parameters. which can also be termed as a reincarnation of Architecture. Along with the advancements in technology, development of a co-relation between tradition and trending needs to be established for a better India. This paper will aim at discussing the scenarios where Bamboo, a traditional and an eco-friendly source, can be used as a Parametric Material. It is the construction material which beats steel, when ratios of stiffness to strength of both the materials are compared. Bamboo is a fast growing commodity which will be used in future construction industry as one of the sustainable and multipurpose materials. This paper aims to explore the different forms and systems, where bamboo is used as the core material. This study has a case study approach. The possibility of using the computer aided forms with bamboo will be studied making it a potential parametric construction material.***

Keywords – Bamboo Construction, Computational Designs, Parametric Architecture. Form finding, Rhino, Grasshopper, Sustainability, Aesthetics.

INTRODUCTION

The digital era is here and like many other professions, architecture is also under transitional phase. Parametric and Computational design has taken the center stage in architecture and now this culture is fast evolving. By computational design, we relate to the design created with the help of the computer. Design decisions are taken with the help of logic which is set using computer code or a script. It encourages the strategies which would trounce the shortcomings and mundane aesthetics of contemporary building materials, styles and techniques. "Parametricism" (Patrick Schumacher, 2008) is the current movement happening in architecture and is accepted globally as the latest emerging style. It has the cutting edge as the aesthetics is supported by the right construction and functional blueprint. In this way new shapes and forms can be explored and implemented. Among the materials used to achieve the desired geometry, the qualities which are necessary for them to cater are – Sustainability, Affordability, Flexibility, Light weight, Eco-friendly – **S.A.F.L.E.** model. Bamboo is one of the few materials which succeed in having all the above characteristics (Sharma P., et al, 2014). So this paper will aim at studying and exploring new parametric forms which can be achieved using bamboo.

Every month, there is a new construction material is introduced in the market. Many experiments are made in the field of architecture since the commencement of "Parametricism". With the changing trends, one must not forget the traditions. Bamboo is a high potential material having the ability to replace many present day counterparts which are having considerable environmental impact. Maharashtra Bamboo Development Board has a vision of replacing timber with bamboo. It is observed that, there is an unofficial taboo over bamboo being used as a construction material in India. Bamboo is looked at as a material which is used mostly as scaffoldings and supports for a temporary structure (Pandals). This is because people have widely seen bamboo being broken or decompose due to natural forces. The performance and lifespan of bamboo as a construction material largely depends on the age of the bamboo when it is cut, and the treatment it has undergone after it is cut. Treatment of bamboo makes it lose starch. The presence of starch in the untreated bamboo makes it vulnerable to insect attacks and decomposition. There is a need for the study of bamboo as a parametric material and its behavioral traits when it is bent. It is the need of the hour for the people to be aware about the potential of this "Green Gold" to make more eco-friendly structures in the future

Mankind has been using bamboo since a long time. Bamboo stays with human right from the cradle to the grave. Over one billion people worldwide stay in bamboo housing and 2.5 billion people depend on bamboo for a living (Maxim Lobovikov, et al, 2007). When bamboo is compared to steel, concrete and timber it is found that bamboo is more sustainable (Van Der Lugt et al., 2003). Hence it can be an excellent resource in terms of affordable housing. So it is necessary to conduct more exploration of bamboo as a construction material. This

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paper will aim at using bamboo as a construction material which can adapt to different parametric shapes and will have a case study approach

AIM AND OBJECTIVES

Aim - To study different computational forms that can be achieved using bamboo as the core construction material.

Objectives - 1. To understand Bamboo as a sustainable construction material.

2. To understand use of bamboo to adapt to different parametric forms.

CASE STUDY

Location – Bamboo Structures in Bali, Indonesia

The island of Bali in Indonesia is very famous for the bamboo structures. 'Sharma Springs' is by far the tallest structure made in Bali, belongs to an Indian family named Sharma (ibuku.com). The building has six levels consisting of four bedrooms and a spacious living room overlooking the river. The highlight of the structure is that, it is constructed wholly with bamboo. The construction was completed in 12 months. 'Sharma Springs' is designed and built by firm named IBUKU. They tend to use bamboo because of its carbon sequestration capacity. They also claim that bamboo is the most environmentally conscientious building material conceivable. The researcher paid a visit to the Green Village and Eco village in Bali, Indonesia to study in detail the new vocabulary in architecture that Balinese architects are developing. People there are not hesitant to use bamboo as the structural, paneling, flooring, roofing material. Even the furniture is made up of bamboo. Balinese people believe that being surrounded by bamboo enhances their quality of life. When the researcher interviewed the local architects in Bali, it was found that they develop the idea of the form of the structures by sketching as shown in figure 1. Minimal use of tools like (AutoCAD and Sketch Up) is being done for

Figure 1 Sketches made by architect before making the physical model (Courtesy- Chikoliving)

form -finding. The form of the structures though is inspired by product design, making it dynamic. When the sketch is finalized, the design is further worked out by making a physical model of the design. The material used for model is strip of bamboo cut in diminished scale. Using bamboo strip as the material for model gives a perfect idea to the designer as it tends to show the same behavioral traits as the bamboo in its true scale. The model made is so precise that even the number of bamboos used in the real construction stay the same. Figure 2 shows some of the examples of the models.

Figure 2. Models made by the architect (Courtesy-Chikoliving)

Thus the forms are executed to perfection using bamboo as the core structural material. The researcher then visited the ongoing bamboo construction site to study the details of construction and explore the further possibilities of form findings with bamboo. After having the hands-on experience of construction, it was observed that bamboo is a high potential parametric material. After interviewing local architects it was observed that the time of harvesting the bamboo and the treatment it undergoes after that plays a very crucial part that determines the life span of the structure. The structures can last for more than 30 years, with maintenance period after every 3 years. When the structures are studied, use of traditional joinery details can be seen. The possibility of using unorthodox joineries can pave way for more complicated forms

Figure 3. Site Visit – Sundari Village, Bali

METHODOLOGY

Bamboo is a flexible material and may be curved or flattened by the application of heat and pressure (modlar.com). This property of bamboo can be used to adapt to parametric shapes and forms. For analyzing role of bamboo in parametric design solutions, some forms are taken into consideration. The tools used were 'Rhino' and 'Grasshopper'. The shapes/forms were regenerated with bamboo material to understand its behavior as a material.

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The experiment was started with some basic forms and then the complexity was gradually increased.

Singly Curved Surfaces – A curve was first created then extruded in X direction to create a simple 'Barrel vault'. Bamboo of two different diameters can be used to achieve the form as shown in figure 4. **Main Frame** – B. Bambos (B stands for Bambusa) – Hollow, 20m, 100mm Dia, 12 Mm Wall Thickness. **Supporting Members** – B. Wamin (Buddha Belly) – Hollow, 6m, 60mm Dia, 15 Mm Wall Thickness

Figure 4 Bamboo adapting to the shape of singly curved surface Barrel Vault (Courtesy - author)

Then the complexity of the surface was increased by changing the diameter of the outer curve. Two bamboos were used at the edge for stability. **Main Frame** – B. Bambos – Hollow, 20m, 100mm Dia, 12 Mm Wall Thickness. **Supporting Members** – D. Strictus (D stands for Dendrocalamus) – Almost Solid, 12m, 50mm Dia.

Figure 5 Bamboo adapting to the shape of singly curved surface Barrel Vault (Courtesy - author)

Doubly Curved Surface – The form was changed to doubly curved surfaces. The bending quality of bamboo helps to achieve the desired shape. The shapes taken into consideration are Elliptical Paraboloid (figure 6), Hyperbolic Paraboloid (figure 7 and 8), and shell inspired form (figure 9). 'Kangaroo', a physics engine plugin was used for form finding.

Figure 6. Bamboo adapting to the shape of doubly curved surface Elliptical Paraboloid (Courtesy - author)

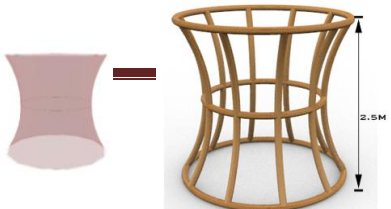

Figure 7 Bamboo adapting to the shape of doubly curved surface Hyperbolic Paraboloid (Courtesy - author)

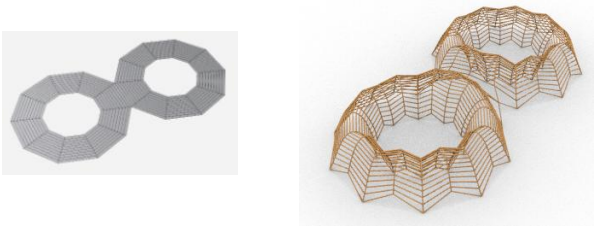

Figure 8 Bamboo adapting to the shape of doubly curved surface shell inspired (Courtesy - author)

Frame used for both Figure 6,7, and 8- Guadua– Semi-Solid, 25m, 75 Mm Dia, 15 Mm Wall Thickness . The nature of Guadua (Semi-solid) makes the structure stable despite the tension that is applied over structural bamboos.

Figure 9 Bamboo adapting to the shape of doubly curved surface Hyperbolic Paraboloid (Courtesy - author)

Main Frame – B. Bambos – Hollow, 20m, 100mm Dia, 12 Mm Wall Thickness **Supporting Members** – D. Strictus – Almost Solid, 12m, 50mm Dia.

Considering the tensile nature of bamboo, it was compared to tensile roofs as shown in figure 10. Bamboo can achieve the shape provided the edge supports or framing is strong.

Figure 10 Tensile roof (Left), Bamboo imitation of form (Right)

Main Frame – B. Bambos – Hollow, 20m, 100mm Dia, 12 Mm Wall Thickness **Supporting Members** – D. Strictus – Almost Solid, 12m, 50mm Dia.

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CONCLUSION

In the present research, the application of bamboo as a parametric material has been studied. The implemented designs of bamboo structures in Bali, Indonesia advocated Bamboo as an excellent structural as well as a parametric material. The bamboo is used to achieve the form of singly and doubly curved surfaces according to the computational study that was carried out.

Promoting bamboo construction is the key to a better future. There are very few structural consultants available for bamboo construction. Skill development programmes for the bamboo contractors and workers need to be conducted. There should be awareness programmes about the benefits of bamboo for the people. So for envisioning a green India in near future, there should be more research and implementation of this "Green Gold".

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Efficient Water Utilization In Mid-Rise Residential Apartments in Pune

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ABSTRACT: ***The water consumption in residential buildings is predicted to rise by 11% by the year 2050. It is of vital importance to develop water efficiency guidelines to limit the current trends of the ever escalating water demand in residential sector. Fresh water availability is decreasing and untreated domestic waste water generation is increasing which requires to efficiently use the resource by minimizing wastage, reusing or recycling to the highest level possible. The study attempts to find the efficient water utilization and concludes that use of water efficient plumbing fixtures, alternative water sources and recycling has significant reduction in fresh water consumption.***

Key words – Water efficiency, recycling, reuse, plumbing fixtures, alternative water sources, residential building, zero discharge systems

INTRODUCTION

Water scenario of India:

The country's total water resources are 690 Billion Cubic Meters from surface waters and 447 BCM from groundwater resources. The urban population of India is expected to reach 600 million by 2030, and it will be a major challenge to meet its water needs and is estimated that the demand-supply gap for the domestic sector will be ~50 BCM by 2030, with demand expected to double by then (Composite water management index, 2019). Through 2015, India had treated just 30% of the country's produced wastewater. Thus, wastewater treatment can provide additional water resources and can help to reduce the supply-demand gap that is likely to occur in the future.

Water scenario of Maharashtra:

During the three year duration of the composite water management index, Maharashtra registered a decline in performance, is a medium-performing state with a score of 41 in 2017-18, and is also one of the largest urban waste water producing state with over 50% waste water treatment capacity. (Composite water management index, 2019)

Selection of residential sector for study:

According to the URDPFI guidelines, "maximum percentage of land is allotted to residential areas across urban centres." The water consumption in residential buildings is predicted to rise by 11% by the year 2050. This will approximately double the per capita consumption from 89 litres per day now to 167 litres per day by 2050. (Composite water management index, 2019)

As per Central Public Health and Environmental Engineering Organization estimates, about 70-80% of total water supplied for domestic use gets generated as wastewater. Thus, a recovery based close loop system is the need of the hour.

City Selection -Pune:

Pune is a classic case of over-consumption i.e. the average per capita supply is around 194 litres per capita per day in Pune (Pune Municipal Corporation). The sewage generated by the city's 3.7 million inhabitants is 756 Million Litres Per Day, 33 percent of which is untreated and mixes with treated sewage before entering in the river, also percolating into aquifers (Pune Municipal Corporation). The total geographical area of Pune city is 450.69 sq. km. Out of the total area, 38.6% is residential area, 1.8% is commercial area, 9.5% is defence area, 11% is industrial area and 9.7% is recreational area. As the growing trend of mid rise residential developments as seen till Dec 2018 i.e. total new supply:2600 developments in 2018, out of which mid rise residential apartments-95%, plots-5%,villas-3%.

Need for study:

In present scenario, to address the problem of water scarcity, no guidelines exist for recycling or zero discharge from the residential site. Domestic,

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industrial and agriculture are water intensive sectors and due to the increasing population growth and rise in mid rise residential apartments led to the idea of this research which is to study and analyze efficient water utilization in order to render appropriate guidelines for a new construction of residential projects.

METHOD OF STUDY:

Literature study is done to identify the current scenario of water utilization in residential buildings to find research gap, data collection and analysis has been done through primary study (2 live case studies) and secondary study to fulfil the following objectives:

- To study water consumption pattern in India.
- To study water usage breakup in residential activities.
- To study water efficiency aspects by green building rating systems.
- To identify water efficiency parameters at all levels.

The data is analysed on the identified water efficiency parameters to render appropriate guidelines at all scales for a new mid-rise residential project.

STUDY AND ANALYSIS:

The secondary data has been collected from reference and relevant research papers, journals and books.

Domestic water requirements:

Use of water for	*Consumption in litres per head per day*
Drinking	5
Cooking	5
Bathing	75
Washing of clothes	25
Washing of utensils	15
Washing and cleaning of houses and residences	15
Lawn watering and gardening	15
Flushing of water closets, etc.	45
Total	200

Figure 1:Average domestic water consumption in Indian cities with full flushing system (Source: IS: 172-1993)

The market for domestic water consists mainly of drinking water, cooking, bathing, washing, toilet flushing, toilet and floor cleaning, gardening, swimming pool etc. Domestic water demand is determined primarily by the total no. of people in a region and their daily water requirement.

According to Figure 2, most water is utilized in bathing and secondly in flushing followed by washing and gardening. Water consumption in these activities can be reduced by using water efficient fixtures and treated waste water can be used in flushing to reduce potable water demand and further supported by native species which require less water.

Water Balance Chart:

A water balance is a no. of the volume of water entering and leaving a site. Detailed information on the amount of water used by each system should be given in a water balance sheet. Water balance is one of the key tool for recognizing and controlling water flows throughout the facility, locating water saving equipments and detecting leaks.

Water efficiency aspects by Green Building Rating Systems:

Green building rating system like IGBC and GRIHA systems in India are gaining popularity and success in construction industry. Therefore understanding their practical approach towards water consumption and resource conservation is of utmost importance. Water efficiency aspect is being discussed considering two Indian green building rating systems i.e. GRIHA and IGBC and one international, which is USGBC LEED.

No.	Requirements	Description
1	Reduce building water use	Indoor use through efficient plumbing fixtures, appliances and in outdoor use through efficient irrigation systems in landscaping.
2	Water efficient plumbing fixtures and fittings	To reduce potable water consumption through low flow and flush fixtures.
3	Water efficient landscaping/irrigation	Elimination of potable water for landscaping and minimizing load on municipal water supply.
4	Waste water treatment and reuse	To reduce load on municipal sewer lines and reuse the treated waste water for non potable water applications
5	Rain water harvesting or storm water management	After water treatment can be used to fulfil potable water demands or else can be used to recharge the aquifer.
6	Water quality	To ensure that potable and non potable water conform to BIS standards and the discharge water from STP should meet CPCB norms.
7	Water monitoring,	Reduce water wastage through

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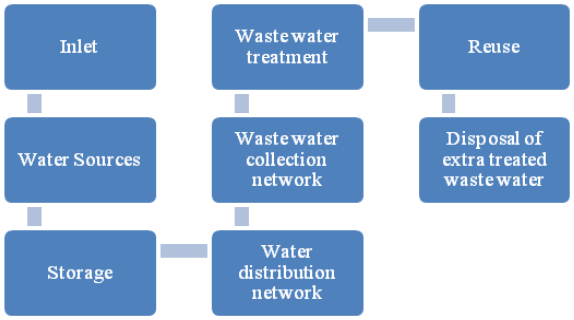
	leak detection and prevention	leaks, overflows etc.
8	Water metering	To measure the water consumption at different end uses and can also be provided for individual houses

Table 1 **Error! Bookmark not defined.**: Identification of water efficiency aspects by Green Building Rating Systems

Efficient Water Utilization:



Stages in Water Utilization

Water can be conserved at each above mentioned level through efficient utilization such as source for non-potable water can be reclaimed water, treated grey water, rain water etc. Dual plumbing systems can be used at distribution level for supplying treated grey water for flushing. Efficient plumbing fixtures i.e. low flow and flush fixtures can be used. Automatic water level controllers can be used for storage tanks to avoid overflowing. Various techniques is specified in the following sections at each level to utilize water efficiently.

RESULTS AND DISCUSSION:

Analysis from literature study:

Parameter	Problem/issue	Efficiency measures
At source level		
Reduce fresh water demand	Using fresh municipal supply for non potable applications	Use of alternative water sources for non potable applications
	Overexploitation of fresh water for landscaping	Drip irrigation for lawns and sprinkler for shrub and tree areas Ground moisture sensors. Limiting lawn areas Hydro zoning Native trees should be planted.
Water metering	Over consumption of water	Building sub metering at various sources like municipal water source, bore wells, treated water etc. Individual household metering.
Water Quality	No discharge of waste water in municipal mains according to Central Pollution Control Board norms.	Regular testing of treated waste water from STP.
At storage level		
Water monitoring	Overflow	Automatic water level controllers.
	Maintenance (Cleaning)	Two independent cells in water storage tank of 50% capacity of total tank volume so that one can be cleaned at a time without any water supply shut off.
	Location of overhead tank	The elevation difference between outlet pipe and highest fixture at topmost floor should be min. 2m to maintain the required pressure.
At Distribution level		
Efficient distribution	Maintaining desired pressure at all levels	Pressure sensors which provide water at efficient pressures at all levels. Pressure reduction valves
	Drain of running water to achieve correct temperature.	Lag pipe work to reduce heat loss/heat gain so as to avoid the practice of running water to drain until it achieves correct temperature.
Monitoring of leaks	Loss of non revenue water	Leak detection systems. Flow meters to measure velocity of water near water intake/head works, transfer mains, storage tanks/reservoirs, distribution network like branch/main/sub lines.
Plumbing fixtures	High flow and flush rates leads to wastage	Use of low flow plumbing fixtures
		Reducing flow rate of fixtures at individual household through aerators, atomisers and pulsators
Waste water management		
Waste water treatment and reuse	No separate collection of black and grey water.	Two pipe drainage system. Dual plumbing system for reuse of

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		treated waste water.
	Cross connection problem	Treated waste water lines should be color coded.

Table 2**Error! Bookmark not defined.**: Water efficiency measures at different levels

Analysis from field case studies:
Two live case studies are done to understand the water utilization and water savings through efficiency parameters implemented by them.

➢ Case Study 1:
Total no. of flats=240
Avg. occupants considered per flat=4
Total occupants=960
So, the total water consumption per capita per day is 163 lpcd(157000/960=163)
Fresh water demand i.e. 163lpcd has been reduced to 120lpcd through treated waste water for flushing and landscaping.

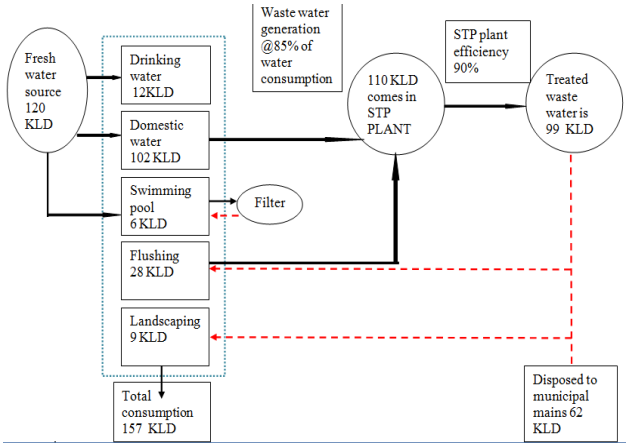

Figure 2:Daily water consumption balance chart

Water Efficiency Interventions and Water Savings:

- Reuse of treated waste water:

Used for flushing and landscaping. Waste water is treated through phytorid technology.
Quantity of water saved(KL/annum) -
For flushing:10,220KL(28X365=10,220)
For landscaping:2187KL(9X243=2187, excluding four months of rainy season).

- Ground water recharging through harvested storm water:

Total 14 recharging pits.
Quantity of water saved(KL/annum)=6149KL
Hardscape area:12010m²
Annual mean rainfall:0.8m
Run-off coefficient:0.8
Evaporation loss:0.8
Volume(cum/yr):12010x0.8x0.8x0.8=6149cum.

- Rain water storage tanks:

Rain water harvesting through roof areas.
Quantity of water saved(KL/annum)=2040KL
Roof area:3543m²
Annual mean rainfall:0.8m
Run-off coefficient:0.9
Evaporation loss:0.8
Volume(cum/yr):12010x0.8x0.9x0.8=2040cum.

➢ Case Study 2:
Total no. of flats=388
Avg. occupants considered per flat=5
Total occupants=1940
So, the total water consumption per capita per day is 132lpcd(257000/1940=132)
Fresh water demand i.e. 132lpcd has been reduced to 87lpcd through treated waste water for flushing and landscaping.

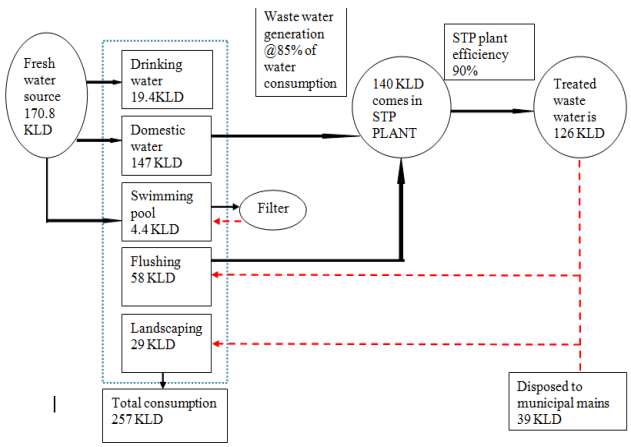

Figure 3:Daily water consumption balance chart

Water Efficiency Interventions and Water Savings:

- Reuse of treated waste water:

Can be used for flushing and landscaping.Waste water is treated through Moving Bed Biofilm Reactor technology.
Quantity of water saved(KL/annum)
For flushing:21,170KL(58X365=21,170)
For landscaping:7047KL(29X243=7047, excluding four months of rainy season).

- Ground water recharging through harvested storm water:

Total 4 recharging pits of 10m depth and diameter 0.15m each.

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Quantity of water saved(KL/annum)=2857KL
Hardscape area:5954m²
Annual mean rainfall:0.8m
Run-off coefficient:0.75
Evaporation loss:0.8
Volume(cum/yr):5954x0.75x0.8x0.8=2857cum.

Analysis from study:

➢ Water saved in KL/annum in non-potable applications
Considering 150lpcd of water demand in metro cities like Pune.

- Activity- Flushing

Per capita per day consumption:30lpcd
Base Case: Through municipal water source
Design Case: Through treated waste water

- Activity- Landscaping

Per capita per day consumption:15lpcd
Base Case: Through municipal water source
Design Case: Through treated waste water
Potable water saving for both activities:45lpcd potable water saving. Fresh water demand reduced to 105lpcd.
Potable water saved (KL/annum):16,425KL (45X365=16,425) saved per person per annum.

Thus, there is a huge potential of using treated water for non potable water applications like flushing, landscaping, car washing etc. which will help to reduce high water consumption of fresh water for non potable applications.

➢ Potable water saved through water efficient fixtures
Considering for 1 person
Considering two star efficient fixtures for design case and National Building Code recommended flow and flush volumes as base case.

- Fixture- Showers

Estimated daily uses per person:1
Duration:8min.
Base Case(litre/min):10lpm
Total daily water use(litres):80
Design Case(litre/min):7.5lpm
Total daily water use(litres):60
Savings:20litre/min saving (25% saving)

- Fixture- Lavatory faucet

Estimated daily uses per person:4
Duration:0.25min.
Base Case(litre/min):8lpm
Total daily water use(litres):8
Design Case(litre/min):5.7 lpm
Total daily water use(litres): 5.7
Savings:2.3litre/min saving (28.75% saving)

- Fixture- Kitchen faucet

Estimated daily uses per person:1
Duration:4min.
Base Case(litre/min):8lpm
Total daily water use(litres):32
Design Case(litre/min):5.7lpm
Total daily water use (litres):22.8
Savings:9.2litre/min saving(28.75% saving)

- Fixture- Showers

Estimated daily uses per person:4
Duration:1 flush
Base Case(litre/flush):6 l/flush
Total daily water use(litres):24
Design Case(litre/flush):4.8 l/flush (full flush)
Total daily water use(litres):19.2
Savings:4.8litre/min saving (20% saving)

Inferences: Reduction in water usage at end uses is achieved through water efficient fixtures as the water savings can be seen as 20% to 28% in all of the above cases.

RESULTS AND GUIDELINES:

Guidelines at Site level: Reduce fresh water demand

➢ Potable water should not be used for non-potable applications like landscaping, flushing and car washing.
➢ Explore the alternative sources of supply that can be rain water, treated waste water, storm water.
➢ Water metering at different sources help to measure the overall water consumption.
➢ Reduce landscaping water demand through planting native species, limiting lawn areas, hydrozoning, using drip irrigation for trees, shrub area and sprinkler irrigation for turf areas.

Guidelines at Building level: Efficient distribution

➢ Maintain the desired pressure at all floors through pressure reducing valves and pressurized systems used for water distribution at desired pressures.

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- Splitting the floors into zones of water distribution of 4-5 floor per zone.
- Combined gravity pressurized systems and hydropneumatic systems are mostly used for efficient distribution of water at all floors.
- Two pipe system to be used for separate collection of grey water and black water and dual plumbing for reuse of treated water.
- Ensure valves and overflows are visible for early detection of water loss and easy to access for maintenance.

Guidelines at Component scale: Efficient Plumbing Fixtures

- Water efficient plumbing fixtures to be used which accounts for overall reduction in water consumption.
- Reduce the risk of uncontrolled water use in community halls by using sensor faucets.
- Use of flow limiters such as aerators and flow regulators.

CONCLUSION

The study conducted shows that using star - rated labeled plumbing fixtures, flow limiters and regulators are presently most effective in minimizing water wastage at component level and reducing water demand at source i.e. using alternative water sources for non potable water applications at all scales of the building.

ACKNOWLEDGEMENT

It is an immense pleasure to thank all the people who made this study possible. I would like to express my deep gratitude to my guide – Associate Professor Aditi Lanke for her constant guidance, encouragement and support in a definite direction. Without her, this study would not have been possible.

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Feasibility study of 'Electronic Toilets' in Pune Municipal Corporation

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Abstract : Public sanitation is one of the basic needs of any developing city. There are several 'Electronic Toilet' units being set up by Pune Municipal Corporation under Sanitation goals. The study is done to evaluate the working efficiency of 'Electronic Toilets'. The functionality of the toilets, in terms of Design, Resources, Operation & Maintenance, are the main issues addressed.A field study was done on selected sites and analyzed as per the parametersderived from the case studies, codes, standards. Issues related to the inefficient working are identified and solutions are provided for the same from case studies and product design studies.

Keyword: Smart toilets, Sanitation economy, Electronic toilets, PMC jurisdiction, Design, resources, Operation & Maintenance

Introduction

Access to basic sanitation is one of the fundamental rights of any human being.

One of the targets for sanitation under 'Sustainable Development Goals 2030' is as follows: Sustainable Development Goal 6:

'By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations' (Sustainable-development-goals: Goal-6-clean-water-and-sanitation:Targets)

Government of India is following the Sustainable Development Goals and is taking actions accordingly. Civic bodies are implementing various initiatives from a national level to ward level to deal with the sanitation issue. When observed at a city level, the rapid urbanization of cities is making the role of the Urban Local Bodies (ULBs) more difficult. There is no efficient planning and sufficient infrastructure to meet the existing demands of the city. Secondly, the rate of growth & development of the city is not matching the speed of the services being offered. There is no even distribution of services and facilities provided throughout the city. The other part is the cultural habits, usage patterns, the income and characteristics of the population to be served, that are equally important, which is true for almost all the cities in India.

For the economic development of any city, employment generation is to be done to create jobs in various parts of the city, which requires people to travel long distances for work. Lack ofsufficient sanitation health facilities along or near the work route might pose health problems.Open public spaces like gardens, parks, plazas, etc attracting a huge amount of crowd lack the necessary infrastructure to provide sanitation facilities.A city-wide, inclusive, safe and maintained sanitation facility is necessary to be provided at the public spaces for able, disabled, children, adult, aged population.The area selected for this study is the Pune Municipal Corporation (PMC) jurisdiction area.This research provides an overview of the 'E Toilets',a study of individual units, analysis of each issue and probable solution for it. The intent is the create awareness in policymakers & designers, regarding the various issues related to design & maintenance of 'E toilet' and its probable solutions.

The scope of the research includes issues arising from usage patternsand solutions (modifications or changes) on a micro-scale are provided, which can be effectivelyimplemented by the ULBs

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Methodology

The overall methodology of the study consists of identifying& evaluating the parameters on which the 'E toilets' are designed as per the relevant codes & standards. Guidelines are suggested for individual cases as well as comprehensivesolutions.

The E Toilets were shortlisted based on the secondary data received from Pune Municipal Corporation.'E toilets' from J.M. road, Model colony, Sinhagad road and Hirvae Garden were selected for the research. The parameters for the studyof 'E toilets' were derived from various National and international codes and standards and field studies were conducted based on the parameters and its subsets.

For design guidelines and comprehensive suggestions, statistical data from Pune Municipal Corporationand relevant codes and standards were followed. Case studies for failures and success stories to identify and apply design parameters were done before developing the 'E Toilet' guidelines.

DESIGN CONSIDERATIONS

- Toilet cubicle size: 900 mm x 1200 mm
- Location: At a convenient walkable distance, safe, visible, provided with access and ramp.
- Signage, Access, Aesthetics
- Contact area: Overall minimum contact area
- Caretaker
- Energy supply: 24 x 7 necessary
- Lighting & Ventilation
- Accessories
- SanPro: Provision & disposal facilities
- O&M: List of equipment, schedules, etc

UNIVERSAL DESIGN

- Access: Avoid grating, manholes near entrance
- WC, WHB sizes & locations
- Taps & Faucets,Sensors, Alarm
- Maneuvering space: 900 mm x 900 mm
- Tactile & Visual information
- Children section: 1 Urinal at a lower height
- Lights: Automatic light systems without timers, minimum illumination 200 lux
- Flooring: Anti-slip, anti-glare, firm

The results from the case studies were individually analyzed and further compared to develop guidelines and suggest effective design and maintenance solutions.

Two types of 'ELECTRONIC TOILETS' approved by PMC were studied (Smart She Toilets – ERAM scientific, E-toilet – ERAM scientific)

Various codes followed were studied to list the parameters for analysis

The following important inferences were derived from various codes & reference manuals.

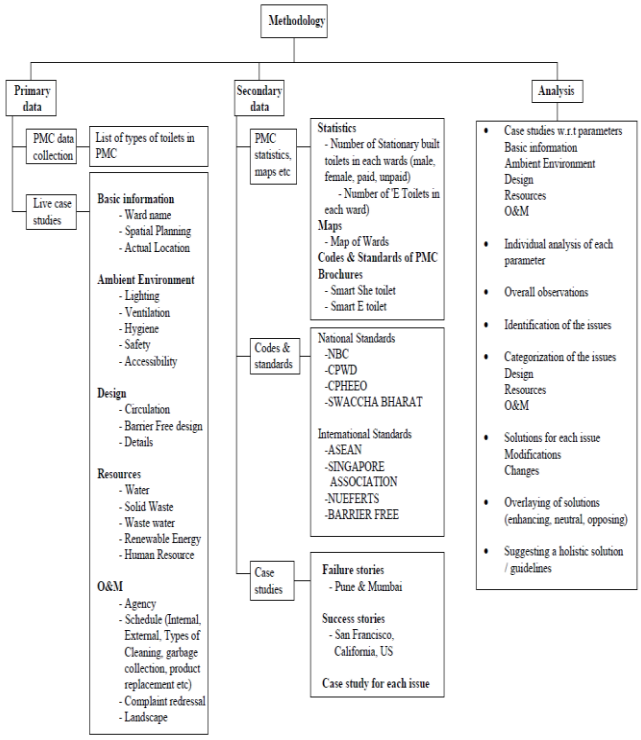

Figure 1: Showing Overall methodology of the research

PARAMETERS FOR SELF SUFFICIENT DESIGN

Following are some of the additional inferences, from the International guides (The Association Of South East Asian Nations & Restroom Association, Singapore)

- Looscaping: Using plants that can be easily maintained inside and outside the toilets

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- Energy conservation
- Products: Use of low VOC products and finishes
- Indoor air quality

Results

Following is the study for J.M. road. One sample aspect from the subset is listed below. Similar study was carried out for the other 3 sites and a comparative analysis was done. Based on the findings, the solutions were suggested and guidelines were formulated.

- Feedback/suggestion box
- Emergency lighting
- User education, Audit

(Bureau of Indian Standards, 2016)

Figure 2: Showing images of 'E Toilet' at J.M.Road

Figure 3: Showing a Curb ramp

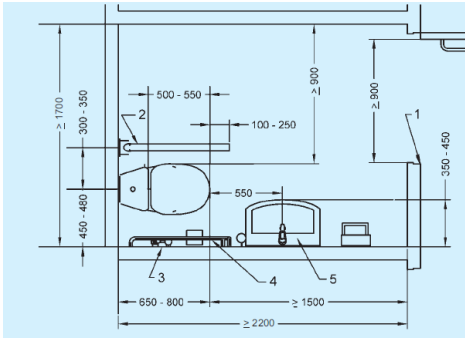

Figure 4: Showing a typical layout for handicapped people

Figure 5: Showing colour contrast between the floor, walls & fittings and grab bars

Figure 6: Showing universally accepted signage related to Public toilet usages

Conclusion

The study resulted in some additional suggestions to enhance the working, operation and maintenance of the Electronic Toilets. The recommended guidelines /suggestions were given on: General surroundings / ambient environment, Design, Resources and Operation & Maintenance

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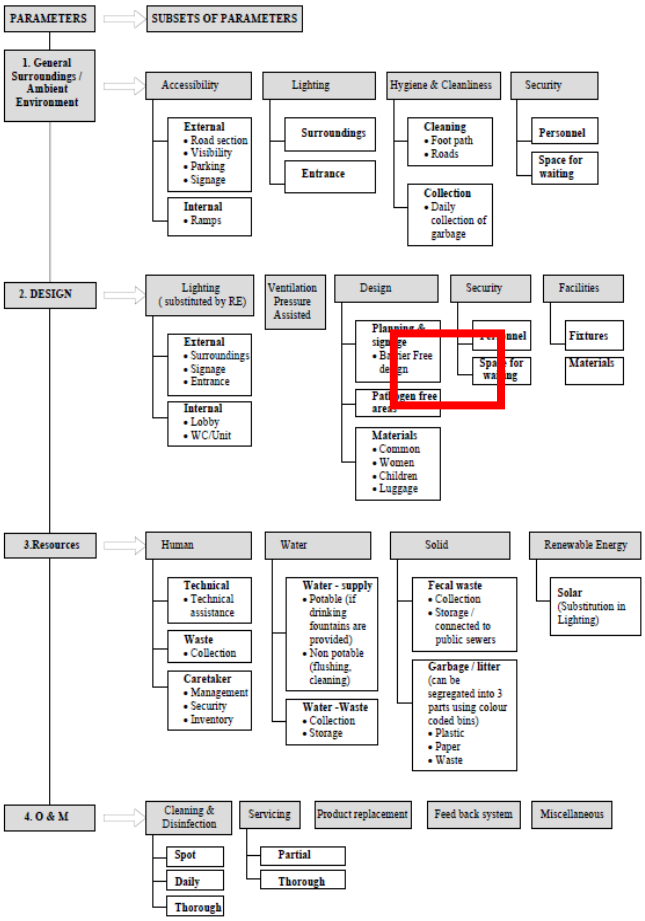

Figure 7: Showing Comprehensive suggestions for all the parameters

Acknowledgment:
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BARRIER FREE DESIGN			
AMBULATORY HANDICAPPED			
CRITERIA	IMPORTANCE	J.M. ROAD	OBSERVATIONS
Ramp provision	Provision of ramp for children in carriers, disabled people, etc	The slope on road is away, bollards at the end of the toilet.	**Only providing a ramp is not sufficient**. A ramp should be provided to allow a handicapped person to reach the plinth of the toilet **with a minimum travelling distance and in minimal efforts**. Here some redesigning of road section might be required **(DESIGN, IMPLEMENTATION – ISSUE)**
Height of door handle /bar	' reach heights'	No handle at a specified height	The push bars are not present **(DESIGN-ISSUE)**
Width of passage	Width of the passage should be sufficient to turn the wheelchair conveniently	Not sufficient	The width is not sufficient **(DESIGN-ISSUE)**
Turning radius for a wheelchair near the entrance		Not sufficient	Difficult for a handicapped person to directly turn the wheelchair, as there is minimum landing after the ramp **(DESIGN-ISSUE)**
Turning radius for wheelchair inside WC, Bath		Not sufficient	The disabled-friendly toilets are rendered useless if they are not able to maneuver inside **(DESIGN-ISSUE)**
Provision of 'Grating'	For passing over grooves &level difference	Not accessible	The disabled-friendly toilets are rendered useless if they are not able to cross the level difference with ease **(DESIGN-ISSUE)**
Range of reach – entrance doors, coin box, grab bars, health faucets, handles	The fixture and fittings should be provided at a height and position convenient to use in a wheelchair /crutches	Not provided	The position to insert the coins, in on the slope of the ramp which makes it impossible for the disabled to stop their wheelchair on the slope and insert a coin, unless accompanied by another person. **(DESIGN-ISSUE)**
VISUALLY HANDICAPPED			
Guiding blocks near the entrance	The enable the visually impaired to find their way without any help	Not provided	There being a difference in the road sections for each toilet, the disabled have to spend time to find the entrance of the disabled-friendly toilet **((DESIGN, IMPLEMENTATION-ISSUE)**
Guiding blocks inside the toilet		Not provided	There are no guiding blocks inside the toilet which causes inconvenience while using. **(DESIGN-ISSUE)**
Audible signages with sensors	To aid in wayfinding (General & emergency)	Not provided	There are no audible signals inside the toilet which causes inconvenience while using. **(DESIGN-ISSUE)**
Colour contrast signages /doors/furniture	For ease of identification for colour blind people	Not provided	Blue, Pink & SS finish are used, which are not contrasting **(DESIGN-ISSUE)**
Information in Braille	Aid in wayfinding	Not provided	There is no information in Braille, inside and outside the toilet which causes inconvenience while using. **(DESIGN-ISSUE)**

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Fire Safety Analysis of High-Rise Residential Buildings In And Around Pune

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Abstract : High rises are vulnerable to fire hazard due to their complex nature. Pune is rapidly expanding with high-rise residential buildings making Fire safety a matter of concern. It is achieved by collaborative efforts of all the stakeholders of the project and the fire department throughout the lifecycle of the building. This paper aims to study and analyse already built as well as under construction high rise residential buildings, provisions in law and preparedness of fire department to understand current state of fire safety. It is concluded that the city needs some retrofitting measures to make it more fire safe.

Key words- Fire safety, High rise, Residential buildings, Pune, project phases ,Fire department, stakeholder's awareness.

INTRODUCTION

Fire is like a silent demon in every house. Fire can start anywhere when fire triangle gets completed and hence the concern of fire safety holds true for every building of any height. But effects or losses differ with the height and occupancy type. Industrial as well as commercial sectors are very anxious about the fire safety as the loss of business is the biggest threat to them. But in residential apartments, fire safety is neglected as everyone feels that there are less chances of fire outbreak . Pune is a rapidly developing city due to its importance in industries, I.T. parks , institutions, defence activities etc. It has been estimated that population will hit 5.6 million by 2031. PMC has amended its development control rules in 2017 by removing height limitation of 100m. One can observe a common pattern of development in residential sector in and around Pune like single towers, residential complexes and residential complexes with consumer shopping on ground floors on building frontage. With changing outlook of Pune city, high rises and luxury towers are getting preference of homebuyers to live in. Punekars are following the footsteps of Mumbaikars, who have already considered skyscrapers as a testament to their success and status in society, apart from the other inherent benefits. But there are many news headlines in local papers about fire outbreaks in Mumbai's high-rise residential towers. Pune, though is in development phase with high rises , is witnessing fire incidences in 1000s every year in residential area. High rise buildings show unique behaviour towards fire safety due to their complex nature. The analysis of behaviour of high rises and issues arise or may arise due to fast development is necessary to forecast the issues in fire safety. Fire safety is achieved on different levels

- By using fireproof or retardant materials in and outside the building to control the outbreak of fire and to contain the fire.
- By implementing safe evacuation plans in case of emergency
- By installing fire suppressing apparatus to control the spread of fire.
- By involving fire department in the fire safety plan for ensuring the easy access of fire brigade in case of emergency.

Fire has been identified as a risk in disaster management plan of the city. Also, the fire safety of high rises has been given a prime importance in development control rules of the city. Maharashtra fire prevention and Life safety act has imposed legal binding on all the developers to adhere to fire safety parameters. The analysis of these regulations with case studies is important to identify the problem areas. Fire department plays important role in fire safety of the city. Fire safety is achieved by taking relevant steps in designing and construction phase and maintaining the facilities in occupation phase. Thus, Fire safety analysis of high-rise residential buildings under construction as well as already built has done to get knowledge of current situation of Pune and make stakeholders aware of their responsibility towards fire safety.

LITERATURE REVIEW

There are varied news article reporting actual incidences, questioning administrators about fire safety, elaborating administrative viewpoint and giving the idea of changing situation of Pune city and its fire safety.

National building code 2016 ,in its dedicated chapter, has given utmost importance to safety of life by covering fire safety in three parts (a) Fire prevention- Covering aspects pertaining to design and construction of buildings (b) Life

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safety- Covering life safety provisions in the event of fire and similar emergencies, that are necessary to minimise danger to life from fire, smoke, fumes or panic; (c) Fire protection - Covering the significant appurtenances and their related components and guidelines for selecting the correct type of equipment and installation meant for fire protection of the building, depending upon the classification and type of the building. It defines the high-rise buildings as buildings with more than 15 m height and elaborates special requirements irrespective of the occupancy of the building.

Maharashtra Fire Prevention and Life Safety Measures Act, 2006, is enforced with the objective of making more effective implementation of the fire prevention and life safety measures in various types of buildings in different areas in the State of Maharashtra . Development control rules of Pune municipal corporation, PMRDA and PCMC also address fire safety issues separately for high rises giving weightage on implementation of life safety measures mentioned in NBC and Safety act.

'Pune Municipal Corporation ,Fire Hazards Response And Mitigation Plan' February 2011- Pune Fire Brigade Pune

This document throws light on the Pune's exposure of Fire risk and its preparedness against fire hazard. Also, it elaborates on causes of fire , the data of man and machine number, working in and for fire rescue, Pune's development and statistics of fire incidences.

'A Review of Pune's Fire Safety in Light of its Smart City Aspirations' Secondary Study by Shashank Pareek. This paper talks about the relation of fire safety and smart city development. its importance while preparing the plans for Smart city. Also, it talks about the fire department of Pune city. **Fire Safety in High Rise Apartment Buildings-By Ken Richardson** This lecture discuss peculiarities of high rises with reference to fire safety and strategies required to be taken to deal with fire hazard in such cases**. Fire Accidents in Buildings – Case Studies**, Mrs. Lilly grace murali. P, Dr . M.M. Vijayalakshmi. This paper has analysed fire incidences and given the solutions.

METHODOLOGY

Study of high-rise buildings with fire safety perspective, analysis of development pattern of Pune city in residential sector, analysis of rules and regulations is done through this literature study. The role of fire department, their preparedness is understood through interview and reports. Live case studies of under construction as well as completed buildings are done in various parts of Pune city and around to understand the gravity of the fire safety issues. Case studies are analysed based on adherence to norms as well as awareness of the users. Based on the findings the conclusions are drawn.

PECULIARITIES OF HIGH-RISE BUILDINGS

High rise buildings need special attention to address fire hazard for the following reasons-

Egress Systems- Overcrowding and slow movement can happen due to a greater number of storeys. Staircase shafts can become the means of smoke rise. Hence the Egress system must provide enough time for the occupants to reach to safe place.

Fire department access-The fire department can reach up to 6-7 floors with modern equipment also. This requires more time for rescue. The fire fighters must use the stairs with the hose reels to fight internal fires at upper floors. Thus, this increase the need of unobstructed fire shafts.

The forces of nature-Stack effect and wind plays an important role in smoke movement in high rise buildings. With increase in height, stack effect increases which helps in fire spread.

Increased density of occupants and fuel loads-By adding number of floors, the occupant and fuel density increases for the given footprint of the building. Fire tends to travel upward rather than horizontal adding more fuel.

Complex vertical utility services-A complex series of conduits for electrical, pipes, cables, ducts run vertically in high rise buildings. This increase the possibility of fire as well as fire spread Fire suppressing as well as detection systems also run vertically through the shafts and ducts. This imposes additional trouble in protecting these services in case of fire to be utilised in emergency.

Zoning of firefighting system –Zoning of firefighting systems to meet functional requirements of hydraulic pressure and flow must be done. This adds to the complexity of the firefighting systems.

ROLE OF FIRE DEPARTMENT IN FIRE SAFETY

There are separate fire brigades working for Pune and surrounding areas such as Pune fire brigade, PCMC Fire brigade, PMRDA fire brigade, MIDC fire brigade and Cantonment fire brigade (Pune, Kirki, Dehuroad).They work together in harmony and help each other in case of emergency. **Maharashtra Fire Prevention and Life Safety Measures Act, 2006** has laid the powers to the fire department to control the fire safety of the city . Thus , any high-rise building needs no objection certificates at construction stage and at occupancy stage. The plans are scrutinised by fire officers, trained in fire safety and give recommendations of fire safety installations in provisional fire NOC. The building is checked after completion and

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fire NOC is furbished for occupancy certificate. The half yearly audit report is compulsory ,after occupancy ,to be submitted to fire department. They can issue 15 days' notice for non-compliance and have the power of cutting light and water connections of the society till they do the rectifications as asked. But due to lack of automation and man power shortage , the record keeping has become tedious job for the fire department. The builder, the chairman and secretary (if society is formed) , all residents (if society is not formed) are responsible for the maintenance of firefighting installations to keep their building fire safe as per Laws. The department constantly upgrades the machinery and currently they are ready for rescue operation of the fire hazard in more than 100 floors also. Presently, there are 14 working fire brigade stations and few in the progress, making total count of 21. Fire brigade stations are located within 10 km aerial distance throughout the expanse of the city to make response time as 5 min. Fire department showed the concern that they have more control over the building till occupancy phase than later. Fire suppressing measures are made mandatory as minimum requirement to increase the time for the fire tenders to reach the spot . But the common experience of the fire officers is that the losses have increased due to failure of these systems because of ill maintenance. But at least due to implementation of the act all the developers have installed the fire suppressing measures in place.Fire department maintains the call record amongst 20 different categories. Only 6 types are considered which are related to fire hazard. From the data generated ,on an average, for last 8 years ,fire department is getting almost 2950 calls out of which 90 % are the calls from residential area including high rise development. The common causes of fire are kitchen fires ,mobile blast, fires caught by cars in basement, electric short-circuit etc. From the numbers it is evident that fire hazard needs attention of all the stakeholders to minimise the losses.

CASE STUDIES

The live case study was made of the building where the fire outbroke in January 2020. The building was done in phases. The single apartment tower (P+10 storeyed) was added with shopping complex of two floors with basement for parking on the front face making entry to the main housing through side lane. The shopping area has not been given with firefighting installations and also the uncontrolled modifications are made in the shopping adding more and more problems to the housing tower. On the day of incidence, the chimney of restaurant in shopping area ,caught fire and the residents and the hotel owner struggled to control the situation due to following points.-

1. There are no firefighting installations in the shopping area.
2. The fire tank in housing was empty as the residents have closed the tank to avoid contamination of water due to drainage leakage in the water tank.
3. Fire alarm system was not working.
4. The chimney fell by blocking the access way of the residents and fire tender as unthoughtful change in the access of the building was made while adding the shops.
5. Though there are no casualties the residents were very shocked by the incidence.

Actual photographs of the spot

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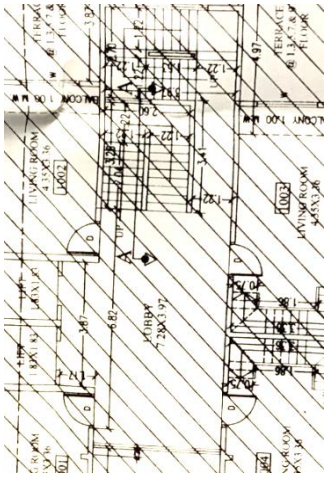


No staircase is enclosed as fire staircase and both are abutting in such way that they cannot be used easily in case of emergencies.

Important aspects derived from literature study considered for analysis of case studies are as follows-

In Pune majority buildings are constructed in R.C.C. frame structure with brick, concrete blocks or concrete walls by using different formwork technology as infill walls. But actual fire resistance of the bricks, blocks and concrete never gets checked prior to construction. Generally concrete/bricks show adequate fire resistance. So, passive measures in planning and active measures as suppression and detection systems are considered for analysis .

Three case studies are analysed under **construction phase**. The parameters for analysis which are applicable to construction phase under sub heads of Fire prevention and protection and life safety are only considered. Findings are-

1. Fire prevention measures are installed in 2 of 3 sites during construction.
2. Electrical shafts are enclosed but stops are not used at slab level.
3. Fire exit staircases are enclosed with fire doors and in 2/3 sites are pressurised. Location of fire staircase is of concern in one of the cases.
4. Fire hydrant piping should be done in separate shaft called as fire shaft. But in 2 /3 cases it is of concern. In one of them fire shaft is not enclosed with walls and in second case it is located inside the fire stair.
5. All fire suppression measures are planned and installed as required.
6. Sprinkler system in flats is also given a thought to reduce the possibility of sprinkler heads being hidden inside the false ceiling in later date.

Five Case studies of already **completed** building are analysed and comparative chart of case studies of **occupied buildings** is prepared. The weightage given is as follows-

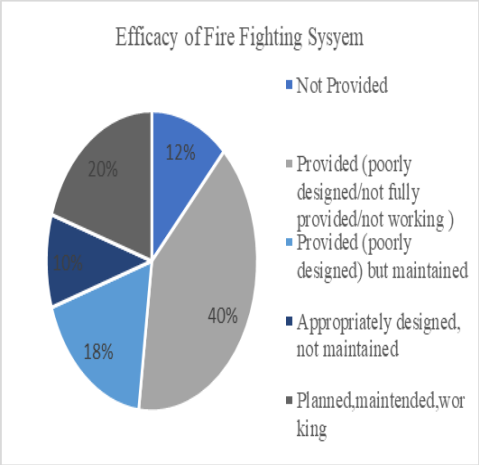
1-Not Provided

2-Provided (poorly designed/not fully provided/not working)

3-Provided (poorly designed) but maintained

4- Appropriately designed, not maintained

5-Planned,maintended,working



FINDINGS

1. Pie chart of analysis of 5 case studies show that in most of the cases the firefighting system was provided as per law but either not designed precisely or not working.
2. Installations of fire suppression and detection measures is mandatory by law to make building safe till fire brigade reach the site. But in the discussion with fire personnel they mentioned that in most of the case these installed systems are not working so the residents have suffered with more losses.
3. From the past fire case studies, it was clear that loss of life is more due to blockage in escape routes and smoke accumulation. But in case studies the thought of these issues found missing.
4. Location of fire shaft, fire staircase needs special attention to use safely in case of hazard.
5. In most of the cases the users are unaware of the fire hazard hence they are not taking part in the fire safety maintenance of the building.
6. Piped gas is popular feature in housing complexes now-a –days. It may turn as source of ignition if not properly provided. Gas leak detectors and heat detectors should be provided.

CONCLUSIONS

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High rise residential buildings are lacking in fire safety due to unawareness of the stakeholders. Hence this paper strongly recommends the need of fire risk assessment of the residential buildings , study of user's behavioural issues while providing for fire safety and working collectively by the stakeholders of the project.

Acknowledgement

I would like to thank my Research guides Ar Laxmi Salgia (Associate professor, D.Y.Patil College of Architecture)and Mr Sudhir Suryawanshi (Fire consultant) for guiding me in writing this paper. Also, I would like to thank Pune Fire Brigade for giving me information and helping me in gathering data.

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Micro-Climate Analysis of Bhopal through Bioclimatic Chart, Radiation Square, Wind Rose and Sun Path Diagram to Evaluate Passive Design Strategies

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Abstract: The concept is to develop climate-appropriate design to make building climate responsive and increase the human comfort level of indoor spaces. This research paper will provide suitable data to analyze the micro-climate of Bhopal to evaluate different design strategies. The average pattern of variation in elements such as temperature, humidity, solar radiation and wind over long periods of time will be measured. The use of Bioclimatic Chart is to identify human comfort and design strategies. Radiation Square provide hourly radiation data to design solar system and facade material. Wind rose provides direction, speed and frequency of wind for different seasons. Sun path diagram will show the path of sun in the sky-dome as projected on to a horizontal surface and to design shading devices. These manual techniques will be interrelated to each other for appropriate passive design strategies and climate responsive buildings.

Key Words: Bioclimatic chart, radiation square, wind rose, sun path diagram, passive design strategies, micro-climate analysis.

I. Introduction

Today's building are more focused on adapting glass construction style without considering the geo-location, micro-climate and surrounding context of proposed site which leads to high energy consumption in various seasons. Buildings are responsible for the 40% of world energy consumption (Serghides, 2014). Therefore, energy conservation is a fundamental concern nowadays. To reduce the energy consumption architects, engineers, public and private sector must have the understanding to make buildings climate responsive which will escalate indoor and outdoor environment quality for humans, animals and living organisms. The goal is to make building climate responsive, initial step will be to study the micro-climate of proposed site so to understand the impact of nature on building throughout the year. And also to achieve good human comfort condition in indoor spaces and evaluate proper design strategies that can help in improving the energy performance of new and existing buildings.

The main aim of this research paper is to use bioclimatic chart, radiation square, wind rose and sun path diagram in order to determine the appropriate technique and strategies to achieve climate responsive building at Bhopal. The climatic data of Bhopal is referred from India Meteorological Department (1971-2000). The data is plotted on quantitative and qualitative bioclimatic chart to identify most critical month in terms of human comfort level. The hourly solar radiation (W/m2) is considered on horizontal roof and differently orientated walls to suggest photovoltaic and hot water solar system to increase energy performance of building. The wind rose helps to design the position and size of inlet and outlet of fresh air. Sun path diagram helps to design shading devices for critical month and to understand percentage of sunlight penetrating from non-opaque surfaces.

According to climatic conditions in which people are bioclimatically comfortable condition consists of: relative humidity between 20% and 75%, temperature between 20°C and 27°C and wind speed up to 5m/s.

Climatic Parameters

Bhopal lies on 523m height above mean sea level. The latitude is 23°17' and longitude is 77°21'. The climate type of Bhopal city comes under composite according to Bureau of Energy Efficiency - Energy Conservation Building Code 2017.Bhopal experience 5 and half months of winter mid-September to February, 3 and half months of summer March to mid-June, 3 months of monsoon mid-July to mid-September. The Dry Bulb Temperature ranges from 14.5°C-38.5°C throughout the year. The lowest temperature 10.5°C in January and highest temperature 40.7°C in May month. The relative humidity ranges from 20% to 88% throughout the year. Lowest relative humidity experienced by May month ranges from 20%-37% and highest in August month

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ranges from 78%-88%. In monsoon maximum rainfall received in July and August ranges from 371.6mm and 402.6mm respectively. Wind speed throughout the year ranges from 6.1 kmph to 16.1 kmph. From this data critical month is identified which is January, May and August in terms of human comfort. The average sky clearance factor is 57.80%. Only monsoon season experiences 85%-95% of cloud cover and remaining months have 25%-30% of cloud cover (CLIMATOLOGICAL NORMALS 1971 - 2000).**II. Methodology**

Description of Bioclimatic Chart

Bioclimatic Chart, when plotted with monthly temperature and relative humidity, identifies potential passive solar heating and cooling strategies appropriate for the building's climate.

On the bioclimatic chat, plot two points: first, the average minimum temperature for one month by the maximum relative humidity; second, maximum temperature by minimum relative humidity. Connect these points with a straight line and repeat the process for each month of the year. Each line represents the change in temperature and relative humidity over an average day. The bioclimatic chart is subdivided into zones that define passive solar heating and cooling strategies. The zones crossed by the lines plotted indicate strategies that may be appropriate for the climate.

There are five cooling strategies represented by the five somewhat overlapping zones above the comfort zones:

1) natural ventilation, which depends solely on air movement to cool occupants; 2) large thermal mass, which depends on the building material to store heat during the day and reradiate it at night; 3) large thermal mass combined with night ventilation, which relies on mass heat storage during the day and ventilation at night to cool the mass; and two types of evaporative cooling, 4) direct, 5) indirect. Direct evaporative cooling raises the humidity and lowers the temperature of indoor space. Indirect evaporative cooling, such as the cooling of the outside of a roof or wall by evaporating water on its surface, lower the temperature of a building element, which then becomes a heat sink for the adjacent space. (DeKay, 2001)

Description of Radiation Square

Solar radiation square is already determined for Bhopal. The hourly solar radiation of horizontal and vertical surface will be used along with temperature, relative humidity and wind speed on bioclimatic chart to determine the potential for human comfort at a particular time and date. Sun path diagram is used to plot radiation levels at different times of the day and month.

Description of Wind Rose

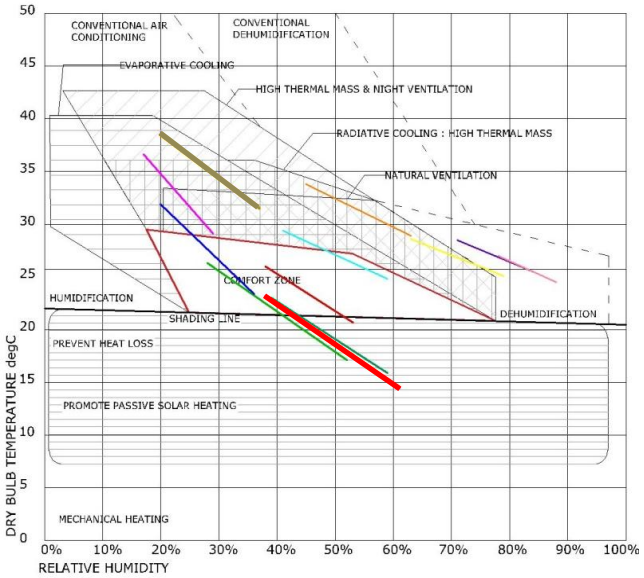
Wind rose gives detailed information on wind speed and direction for a month or a whole year**.** It is prepared from IMD data.

Description of Sun path Diagram

The heavy lines running from east to west represent path of sun on 21st day of each month of the year. Heavy lines running perpendicular to the sun path line indicate hours of the day. The lines radiating from the centre indicate the sun's azimuth. The concentric lines indicate the sun's altitude. Determine the sun's position in terms of altitude and azimuth for any hour of the day and any day of the year. (S.L.Koihatkar)

III. Results and Tables

Qualitative Bioclimatic Chart for Bhopal



Month (Daytime minimum relative humidity, maximum temperature – nighttime maximum relative humidity, minimum temperature)

Legend:

Jan (38%, 23.1°C - 61%, 14.5°C)
Feb (28%, 26.3°C -52%, 17.1°C)
Mar (20%, 31.9°C - 36%, 23.4°C)
Apr (17%, 36.6°C -29%, 29.1°C)
May (20%, 38.5°C -37%, 31.5°C)
Jun (45%, 33.8°C -63%, 28.9°C)
Jul (71%, 28.5°C -84%, 25.5°C)
Aug (78%, 27.0°C -88%, 24.5°C)
Sep (63%, 28.6°C -79%, 25.1°C)
Oct (41%, 29.4°C -59%, 24.8°C)
Nov (38%, 26.0°C -53%, 20.7°C)
Dec (39%, 23.0°C -59%, 15.9°C)

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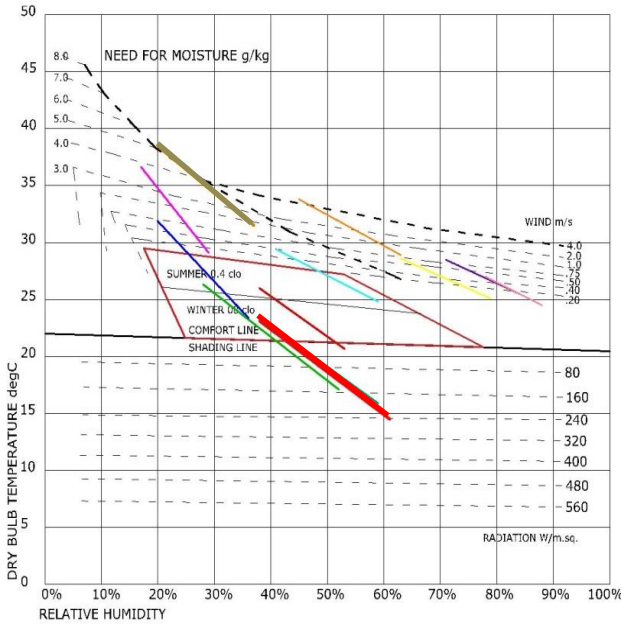
Quantitative Bioclimatic Chart for Bhopal



Qualitative Bioclimatic Chart of Bhopal

The most critical month in terms of human comfort is May and January which is in bbrown and red line respectively. In May month, the relative humidity is 20 - 37% and temperature is 38.5°C - 31.5°C which leads to dryness in the air and creates hot winds. To achieve human comfort in May, evaporative cooling and radiative cooling: high thermal mass design strategy suggested by qualitative bioclimatic chart.

In January month, the relative humidity is 38 - 61% and temperature is 23.1°C -14.5°C which leads to coldness in the air. To attain human comfort in January, prevent heat loss from indoor spaces. Remaining monsoon and summer months will be designed for natural ventilation. Good insulation is required in winter month to avoid heat loss from indoor spaces. This data provides designer to understand the required building treatments to make building climate responsive.

Table 2. Horizontal Solar Radiation Speed of Bhopal

MONTHS	REQUIRED SOLAR RADIATION (W/m.sq.)	REQUIRED SHADING (%)	REQUIRED WIND SPEED (m/s)
JAN	80-240	20	-
FEB	80-160	53	-
MAR	-	100	0-0.5
APR	-	100	1-3
MAY	-	100	2-4
JUN	-	100	0.75-4
JUL	-	100	0.2-0.75
AUG	-	100	0.2-0.5
SEP	-	100	0.2-0.75
OCT	-	100	0-0.4
NOV	0-80	90	-
DEC	80-160	23	-

Quantitative Bioclimatic Chart of Bhopal

This chart provides quantitative data which is used further to accomplish strategies from qualitative bioclimatic chart. For critical May month, required wind speed is 3-5 m/s and for January, 80-320 W/sq.m solar radiation required. Mostly all month requires shading devices. This data gives the idea about required solar radiation, shading and wind speed to make building more efficient.

Table 1. Passive needs from Quantitative Bioclimatic chart for Bhopal

Radiation Square for Bhopal

The total radiation received from the sun, of a horizontal surface at the level of the ground for a serene day, is the sum of the direct and diffused radiations. For Bhopal, solar radiations for horizontal surface are considered. Color scheme depicts various intensities. Higher the solar radiation value indicates high intensity and bright color. Lower the solar radiation value, lower is the intensity and darker color. The solar radiation square is designed from 6am to 6pm hourly radiation annually. Low radiation is coded as 260 W/sq.m and high as over 700 W/sq.m.

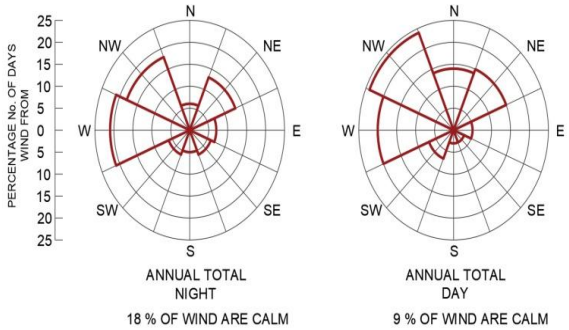


Figure 1. Annual Wind Rose

The critical May month, has higher solar radiation intensity which can lead to higher heat gain from the roof or horizontal surface. To avoid heat gain from horizontal surface appropriate insulation is to be designed with correct U-values. This solar radiation square value is used to design photovoltaic system and hot water system to increase the energy performance of the structure. While designing the solar system other factors also to be considered such as temperature, sun angle, shade, and shadow and panel efficiency. This data will simultaneously use with other design tools.

Wind Rose for Bhopal

Figure 1 indicates primary wind direction and percentage of wind coming from west and northwest. The annual wind speed is 2.88 m/s. Openings of the buildings should be designed on windward direction and outlet should be faced towards leeward direction. Factors considered while designing an opening are surrounding noise level, privacy,

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view, dusty, cold and hot winds. Wind rose is made for critical month May and January. Studying wind rose will help building more contextual to their site.

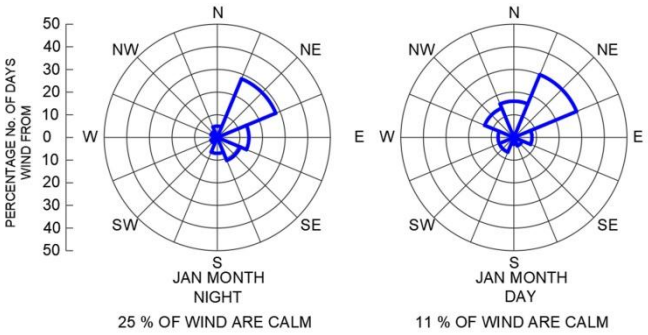

Figure 2. Wind Rose of January

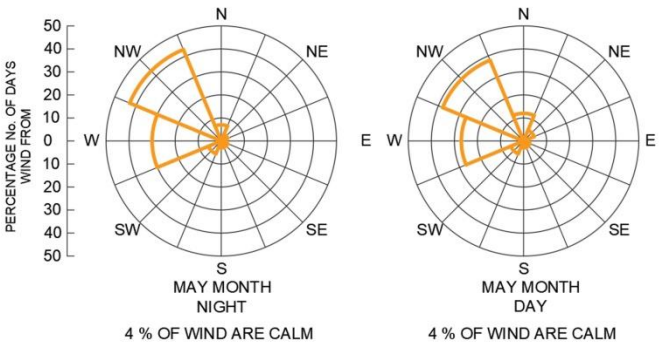

Figure 3. Wind Rose of May

Wind direction throughout the winter is from northeast. In the month of January, cold winds are experienced due to low dry bulb temperature 14.5 °C at night. To avoid heat loss from structure trees plantation can be act as a buffer zone but it should not be blocking the sunlight at daytime. Mean wind speed in January is 2 m/s.

Wind direction throughout the summer is from northwest and west. In the month of May, hot winds are experienced due to high dry bulb temperature 38.5 °C at daytime. To avoid heat gain from surrounding atmosphere the opening should be designed in such a way that warm air must be cooled, then supply to the indoor spaces. Mean wind speed in May is 4.08 m/s. Wind rose helps to design openings orientation and size.

LOCATION - BHOPAL		LAT - 23°17' LONG – 77°21'		M.S.L – 523 m
TIME	SUMMER MONTH - MAY		WINTER MONTH - JANUARY	
	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
6 A.M	73°	9°		
7 A.M	78°	21°	113°	7°
8 A.M	82°	35°	121°	19°
9 A.M	88°	48°	131°	29°
10 A.M	93°	62°	144°	38°
11 A.M	104°	75°	160°	44°
12 NOON	180°	85°	180°	46°
1 P.M	256°	75°	200°	44°
2 P.M	267°	62°	216°	38°
3 P.M	272°	48°	229°	29°
4 P.M	278°	35°	239°	19°
5 P.M	282°	21°	247°	7°
6 P.M	287°	9°		

Table 3. Sun Chart of Bhopal

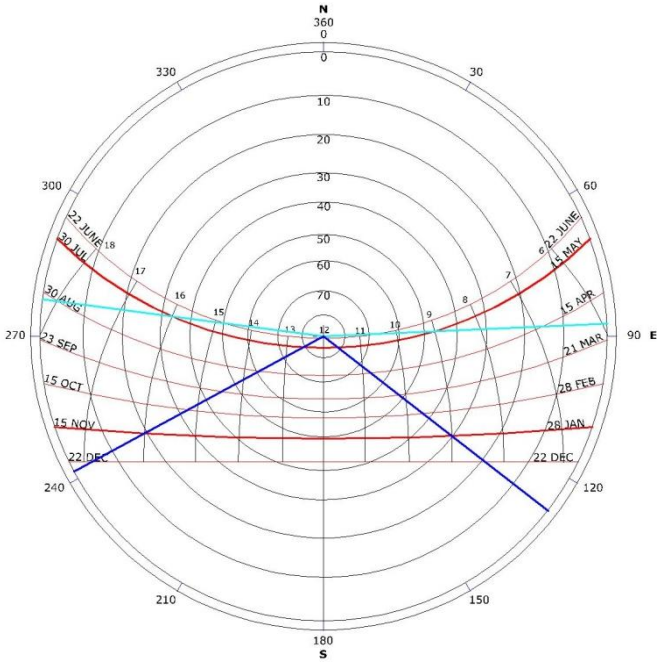

Figure 4. Sun path diagram of Latitude 23°17' Bhopal

Sun Path Diagram

In Figure 4, critical months May and January are marked. The sun's azimuth and altitude are listed down in table 3.

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The sun path diagram helps to design shading devices for critical months. The shading devices will be designed for 9am, 12 noon and 4pm from sun path diagram. The shading devices will cut off the sun wherever it's needed. Horizontal and vertical shading devices are designed with the help of sun path diagram. For horizontal devices, sun altitude angle and vertical devices azimuth angle is needed which is collected from figure 4. The solar altitude, and the solar azimuth, can be read directly for any date of the year and any hour of the day from the solar charts or sun path diagrams. It gives the liberty to understand sun position to plan and design site and building respectively.

Conclusion

Climate is an important context which greatly influences the amount of energy; a building would use and therefore, need to be analyzed accurately. Climate responsive buildings will be designed by using these set of tools. These tools are used to develop passive design techniques at the initial stage of building design in Bhopal to improve human comfort level and energy performance of the building. These data will produce design solutions that are eco-sensitive, energy efficient, climate responsive, user friendly and cost effective too.

Acknowledgment

I am grateful for D.Y.Patil School of Architecture for giving me this opportunity. I would like to thank prof. Shubhada Chapekar for her guidance throughout the research paper. I would also like to thank my colleagues and librarian

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HORIZONTAL												
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
6:00 AM	0	0	0	0	0	31	0	0	0	0	0	0
7:00 AM	0	0	99	113	111	123	24	18	52	0	0	0
8:00 AM	66	83	249	284	278	184	61	44	131	82	75	66
9:00 AM	232	290	398	454	445	246	97	71	209	286	261	230
10:00 AM	432	538	547	624	612	307	133	98	288	532	486	428
11:00 AM	531	662	696	794	780	338	169	124	366	654	598	527
12:00 PM	598	745	746	851	835	368	182	133	393	736	672	592
1:00 PM	531	662	696	794	780	338	169	124	366	654	598	527
2:00 PM	432	538	547	624	612	307	133	98	288	532	486	428
3:00 PM	232	290	398	454	445	246	97	71	209	286	261	230
4:00 PM	66	83	249	284	278	184	61	44	131	82	75	230
5:00 PM	0	0	99	113	111	123	24	18	52	0	0	0
6:00 PM	0	0	0	0	0	31	0	0	0	0	0	0
	427	532	576	656	644	307	140	103	303	526	480	423

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A Study on Improvement of Existing Daylight Level in Studio at D Y Patil College, Ambi, Pune

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Abstract: Construction industry being the foremost consumer of energy resources has great prospect to develop innovative energy saving techniques. Optimum use of natural daylight is one of most important aspect to reduce operational energy and maintenance cost in any building. Educational building where daylight is an essential need, however more specific to the working studio where natural daylight factor plays a very significant role. Intention of this paper is to study effective available daylight in the existing DYPSOA Ambi, more specifically for classrooms where manual drafting work has to be produced. The research investigates the problematic areas which are recipient of insufficient or improper daylight with the help of measurement of actual lux levels and analytical methods. Intention of this rigorous study is to improve the daylight factor with the help of combination of various strategies like light shelves, innovative material and solar tracking system with solar light tube. Intention of providing solution through passive means and complies with National lighting code (SP 72: 2010).

Key words: Daylight factor, IESNA method, Solar light tube, solar tracking system, light shelves.

1. INTRODUCTION

Daylight can be an important energy saving feature of any building by displacing electric lighting demands [i].However it is very difficult to provide even day lighting throughout the enclosed room. To study day light class room cum studio of D Y Patil college of Architectural has been chosen. Selection criteria to choose class room where there is minimum day light and maximum depth is observed. Window is located at the width of room which is external side of the structure, however there are two doors and one window at north side of which opens in the covered atrium but day light intercity from north side negligible. As per the 2.5 m rule of thumb day light is sufficient till the first column from the window side which is enough for the reading purpose. As per the National lighting code (SP 72: 2010) class room lux level should be 300 lux. [iii].

IMPORTANCE OF DAYLIGHT

- Studies show that improper use of day lighting can reduce productivity and increase employee absenteeism [iv].
- Daylight has physiological and psychological benefits for teachers and students. Physiological benefits due to daylight on students are less dental decay (cavities), improved eyesight, and improved immune system [iv].
- A school with insufficient light can also reduce a student's ability to learn due to the effect lighting has on physiology. Poor spectral light can create strain on students' eyes, leading to a decrease in information processing and learning ability, causing higher stress levels (Liberman 1991) [iv].

2. METHODOLOGY

Three methods could have been adopted for this study, the first of which is an actual field survey for readings and feedback of users, while the second could be based on techniques of simulation through computer-generated models, and third could be analytical or calculation based method. Since the case studies are of existing buildings in active use and, correct observations and users' feedback could be obtained, the first method was adopted and other methods are supportive or could be used as verification.

2.1 ACTUAL FIELD SURVEY

North side (Covered atrium) South side

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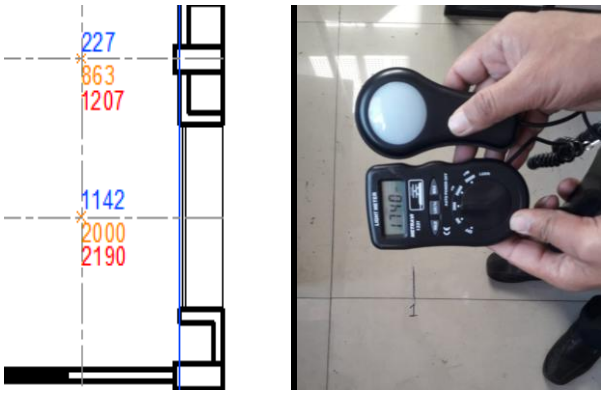

Figure – 1 Actual field survey

- Actual measurements of light has been noted for three different time period of the day that is 9.00 am , 12.00 noon and 3.00 pm and it is indicated in plan with Blue, Orange & Red respectively.
- Actual reading has been taken with the help of Lux meter.
- As the analytical method comprises of IESNA [i] method in which five point / location has been selected to take day light reading at 10,30,50,70,90 percentage respectively from the window centre. Hence for the fair comparison with IESNA method five point reading has been taken in actual measurement.
- Measurements also taken at the centre of two windows.

2.2 TECHNICAL SIMULATION

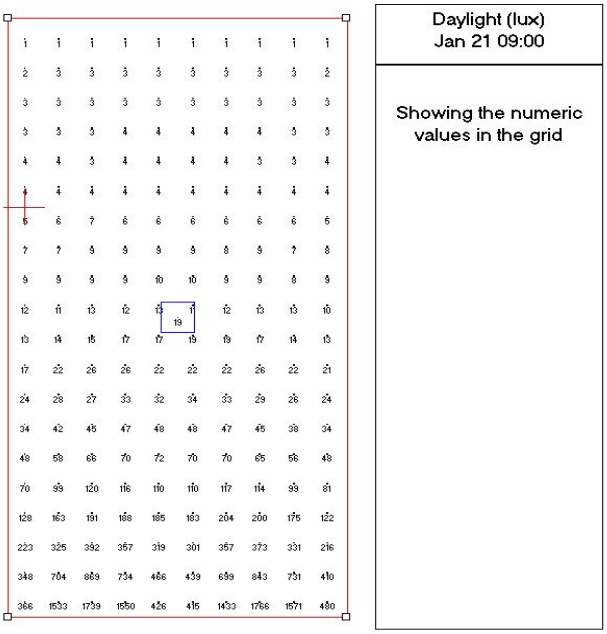

Figure – 2 IES simulation at 9.00 am on 21 Jan. 2020

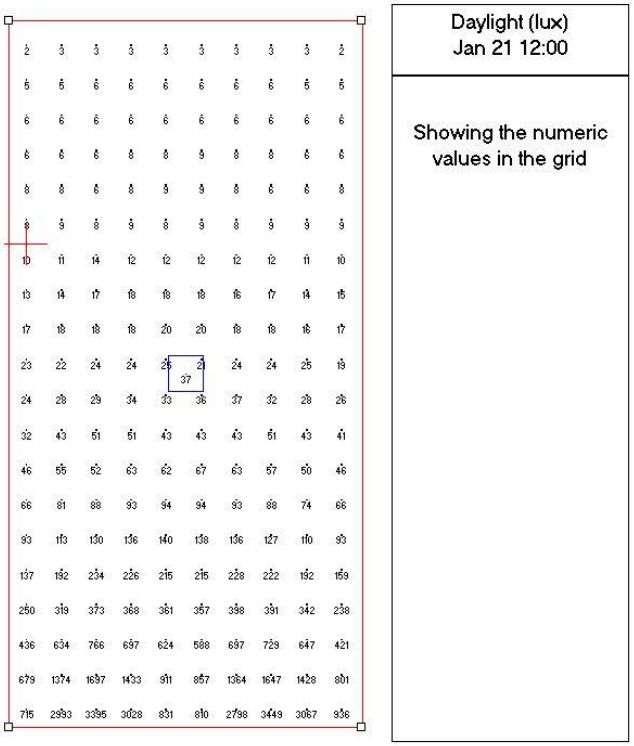

Figure – 3 IES simulation at 12.00 pm on 21 Jan. 2020

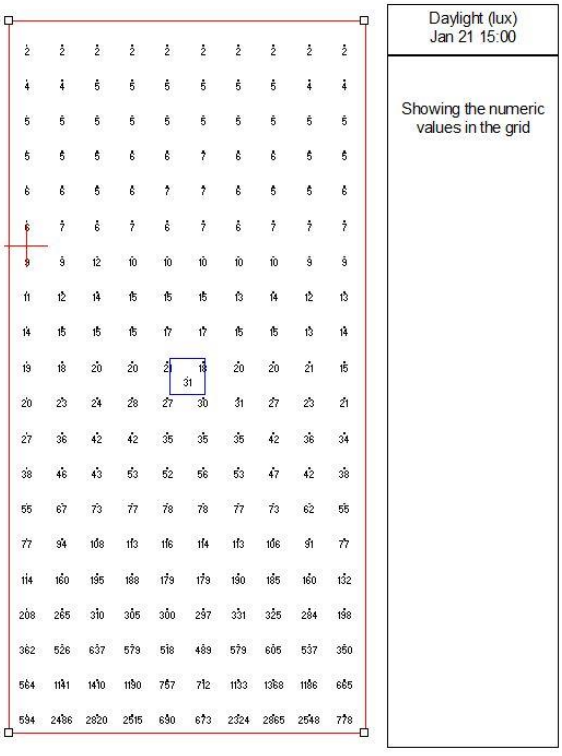

Figure – 4 IES simulation at 3.00 pm on 21 Jan. 2020

2.3 ANALYTICAL METHOD

IESNA [Illumination Engineers Society of North America] developed the lumen method for calculating daylight availability (published as RP-23-89,

Recommended Practice for the Lumen Method of Daylight Calculations) [i].

The IESNA method is probably the most flexible manual technique available. [i].
The method is usable in only one mode; that is, given location and full dimensional data, day lighting can be calculated.
GIVEN:
Location: Pune, Maharashtra
Latitude: 18^0 3' N
Room: 10.10 m width, 20.20 m deep, with a 3.40 m ceiling
Window: 2.35 m above a 1.05 m working plane, total length 3.00 m
Transmittance: 85%, net glass area 92% (assumed)
Ground Reflectance: not previously specified. Assume an extensive area of mixed grass and concrete walkways, with an average overall reflectance of 20%. See Table Below:
Calculation: Illuminance *Ei* will be found at the five points shown in Fig. A-1 for a summer day and a winter day at 09:00 A.M. and 3:00 P.M. Assume that the sky is overcast so that a direct comparison with other methods can be made. Reflectance are assumed to be 70% for the ceiling, 50% for the wall, and 30% for the floor to correspond to the IESNA method standard conditions.
STEP 1: *Determine the vertical and horizontal illuminance on the exterior of the window.*
Using the solar altitude for the summer and winter day (solar data), the vertical and horizontal illuminances can be found from Fig. A-1.

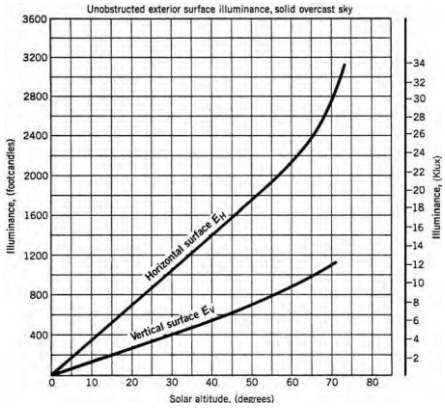

Fig. A-1 Curves giving unobstructed exterior surface illuminance directly from an overcast sky. (Data based on U.S. Weather Service observations; courtesy of Libbey-Owens-Ford.)
Calculate *Exhk*, the half-sky illuminance (a vertical window seasonally half of the sky). The results are compiled in Table below:

Solar Altitude	Vertical Window Illumination Exvk	Horizontal Illumination from full sky ExHk	Horizontal Illuminance from half sky Exhk
May,(Az82)Ver.,(Al-48)Hor.	8,000 lux	18,500 lux	9250 lux
Jan,(Az132)Ver.,(Al-29)Hor.	4, 250 lux	11, 000 lux	5,500 lux

Vertical illuminance from the ground is
$E_{xvg} = RF_g \times (E_{xHk}) / 2 = 0.2 \times 18{,}500 = 9250$ lux for May 21
$E_{xvg} = RF_g \times (E_{xHk}) / 2 = 0.2 \times (11{,}000) = 5{,}500$ lux for Hanuary 21-(E1)
STEP 2: STEP 2. *Determine net transmittance of the window*.
Glass transmittance is 85% ,light loss factor is 0.9 and the net glass area is given as 92%. The net transmittance (τ) of the window is a product of these factors:
$\tau = (0.85)\ (0.9)\ (0.92) = 0.70$
Source - IES Recommended Practice for the Lumen Method of Day-light Calculations, RP-23-1989
STEP 3.*Select coefficients of utilization for* the five calculation locations (10%, 30%, 50%, 70%, and90%) on the basis of room dimensions and the portion of the sky seen by the window. The SC seen by the window is determined by the ratio of vertical to horizontal illuminance at the window.
SC *E*xvk /*E*xhk:
May. 21: 8000 / 9250 = 0.86 (Table C.21)
Jan. 21: 4250 / 5500 = 0.72

The *E*xvk /*E*xhk = 0.86 and 0.72 values correspond most closely to the *E*xvk /*E*xhk = 0.75 value of Table C.21. Use the following values to find the coefficients of utilization, *CUk*:
Room Depth / Window Height = 20.20 / 2.35 = 8.59, use 8.0 (from first column variable)
Window Length / Window Height = 3.00 / 2.35 = 1.27, use 1.0
The ground component vertical illuminance (*E*xvg)is the product of the ground reflectance (Table -T3)and half of the horizontal illuminance (Equation -E1).The sky and ground component values are compiled in Table-T4 for each of the five reference locations.
STEP 4.*Calculate the illuminances for each of the five reference locations*.
(Table -T5: tabulates the illuminance values from this calculation.) The basic equation for each location is
$Ei = \tau\ (E\text{xvk} \times \text{CU}k + E\text{xvg} \times \text{CU}g)$

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Where
Ei = interior illuminance at a specific reference point
τ = net transmittance of the window
*E*xvk = exterior vertical illuminance at the window from half of the sky (an unobstructed vertical window sees only half of the sky)
*E*xvg = exterior vertical illuminance at the window from the ground
CU*k* = coefficient of utilization for sky light
CU*g* = coefficient of utilization for ground light

Table - : ILLUMINANCE Values for summer and Winter in Pune at Five Reference Locations

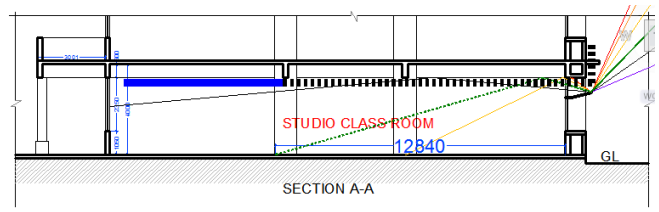
Location	Ei May 21, lux	Ei Jan. 21, lux
10	1970	1080
30	333	**189**
50	**176**	**100**
70	**146**	**83**
90	**140**	**80**

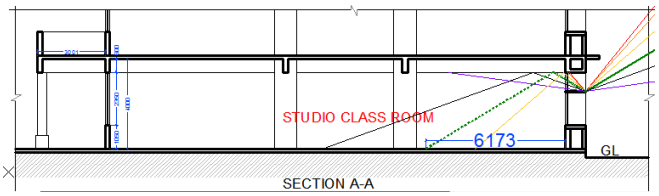
As per IS:10894-1984 (Indian bureau of standards) 300 Lux level is required at class room area. It can be seen that after 10% distance day-light becomes insufficient in May and in Jan. it is 30%.
By considering minimum day lighting period that month of January supplementary passive strategy will be recommended as follows.

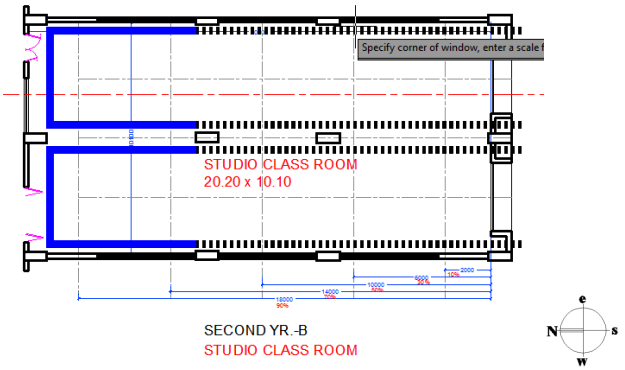
1. Light shelves- To extend day light inside the room with angle variation of 15 degree.
2. Solar tube light – This will act as supplement day light after the limit of light shelves.

Light shelve – Existing window height has divided in two section, first is 1.50 m which is sliding aluminum window and another 0.85 m above part is fixed glazed aluminum window. Hence light shelve is recommended at 1.50 height of the window. Solar altitude angle of January month has been considered at 7am,8am,9am,10am,11am and 12 noon. As per analysis at 9am after 10% distance daylight light deficiency observed. After introduction of light shelve light lux level which almost 2000 at window level when it get reflected from light shelve after 50% light loss it becomes 1000 lux. Then after re-reflecting it from the white ceiling it again loses 50% and 500 to 300 lux level can be achieve at 6m.(30%) distance. However as per shown in upper section if 15 degree tilt proposed to the light shelve then this day light penetration can achieve till 12.84m.(60%).

Solar tube light - The light pipe operates by collecting light through a heliostat; channeling daylight through a reflective tube made of prismatic glass, plastic film, and mirrors; and diffusing light at the end of the pipe. It is an exciting strategy because of the length it can transport light—65 ft (20 m)—from a single- point light source. This strategy can be used for the remaining 8.00 m depth of the room. As solar light outside is approximately 2000 lux and after re-reflecting it inside the solar tube assuming 50% light loss it will give 1000 lux till the end of the pipe. Considering the limit of 20.00 m, outer end of the solar pipe can be installed at the slab projection above the window. As the required lux level is 300 there for solar pipe need to be wrapped till the 12.00 m distance from window and exposed it as per the desired lux level at farther end of the room. In the below figure dark blue color n section and plan indicate solar tube , however black dotted line indicate wrapped solar pipe.







	Existing condition at 9.00am	With light shelve	Light shelve 15° tilt	Solar light tube
Light penetration in percenta	10	30	60	100

ge				
Light penetration in meter	2	6	12.84	20.20
			Recommended	Recommended

DISCUSSION

As per existing class room size if the window size is big enough and there is no scope to increase it further then above strategy is use full till the 20 m depth of the room. As the day light is more important rather than direct sunlight hence the material to be chosen for the light shelve should have 80% of reflectance rather 100% reflective surface. While material selection for the solar tube should have 100 % reflective surfaces inside the tube.

CONCLUSION

From above research study it can be stated that at a given size of the room and window position oriented to south side, combination of passive strategy that is light shelve with 15 degree angle & solar pipe with heliostat could be work effectively. Light shelve can be useful for the 60% penetration of daylight and solar pipe can supplement for the rest of the 40% farthest end of the room till the depth.

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I would like to express my deep sense of gratitude from the bottom of my heart to my guide Prof. S L Kolhatkar sir for his valuable guidance, inspiration and encouragement. His keen and indefatigable indulgence in this work helped me to reach an irreproachable destination.

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A Comparative Analysis of Cost and Energy Performance of Envelope Assemblies Used in Green Buildings and Conventional Buildings

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Abstract : Green building certification is gaining popularity nowadays. Yet for a major percentage of the small scale residential buildings, opting for green materials is difficult due to lack of awareness and knowledge about cost and performance. There is a perception that initial cost involved is higher. While selecting materials, knowledge of the energy performance and cost is required to optimize the benefits. Various combinations of envelope assemblies for roof, walls and windows were analysed for cost and energy performance using calculations and simulations for a live case. The results show that every green material assembly is not costlier than conventional one, but have better energy performance. Optimization of cost and thermal performance is necessary while selecting building envelope materials.

Keywords- Green building materials, Hard cost, envelope, energy performance

1.0 INTRODUCTION

Buildings account for a huge percentage of energy consumption and carbon emissions in its life cycle causing adverse impact on environmental, social and economical sustainability. It has thus become important to design and construct buildings which have minimum impact. Various Green building certification systems give guidelines for sustainable development, so that, overall performance of the building in terms of occupant's comfort & energy usage is improved and environmental impact is minimized. Green building certification systems assess a construction project based on various aspects of sustainable development such as – sustainable site planning, water conservation, material and resource conservation, energy conservation and indoor environmental quality. *(NA, IGBC green homes, 2017)*

The cost of green-rated building involves both hard and soft cost where hard cost is the actual construction cost and soft cost is the cost required for certification process, consultant's fees, etc. There are assessment criterions given for each of the aspect. From the case studies and market trends it can be seen that fulfilment of these criterions requires some additional initial investment which can be termed as hard cost. Also there is a cost involved in certification process which can be termed as soft cost.*(Nurul Zahirah, 2012)*

Government and local authorities provide incentives or tax rebates for certified green buildings to attract people so that they would choose green buildings over conventional ones. *(NA, Green building policy, Maharashtra state, 2018)*. But there is a lack of awareness regarding financial benefits of green buildings. In some of the cities where green building certification systems are not so popular or not regularly practiced, still there are many opportunities to achieve the same goal of sustainable development. This research's objective is to understand current scenario of awareness regarding green construction and its financial benefits amongst architects and compare hard cost involved for green construction and conventional construction. As far as thermal performance and energy efficiency is concerned, the building envelope accounts for a major percentage of heat gain and loss in residential buildings. *(Decay & Brownthird, 2014)* Parameters governing the heat gain or loss in a building include site conditions, orientation, form, materials, window areas, shading devices, etc. In the era where space is the most important constraint for construction, there are limitations on the building design in terms of its orientation, zoning of spaces, window locations, and sizes, etc. Yet, there are opportunities to improve thermal performance by changing materials used for building envelope. There are many construction

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materials and assemblies which are now readily available in the market and can be easily used for the same, even if people are not willing to go for green building certification. But, in most of the cases cost is the major factor governing the decisions related to materials. Hence it is important to compare cost and energy performance of these materials and calculate payback period.

2.0 METHODOLOGY

The research is carried out in three stages. First stage is to understand current scenario and awareness regarding green buildings and its cost and to identify parameters for the study, from literature and interviews of architects. Literature is referred to identify parameters used in assessing a green building and architects practicing at various locations and of varying age groups were interviewed using online forms. Second stage is to identify materials and assemblies through interviews and market availability. Practicing green building consultants were interviewed using telephonic conversations to identify commonly used green building materials and assemblies and market study is done to check their availability and identify cost. Third stage is to compare various combinations of building envelope assemblies using calculations and software simulations to check whether green construction is always costly, and calculate its payback period.

2.1 Awareness

Practicing Architects from various locations in Maharashtra were interviewed to understand current scenario of awareness regarding green building concepts, certification and its benefits.

Figure 2 Floor plans

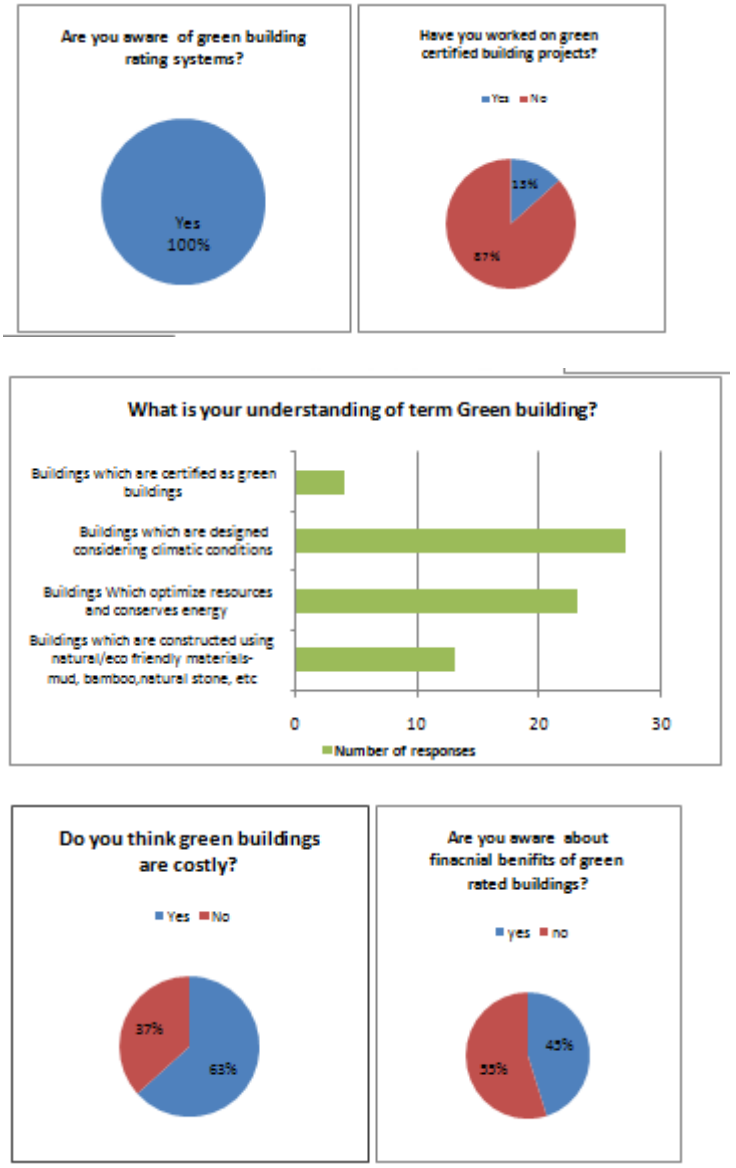

Figure 1 Survey questionnaire results

2.2 Identification of materials and assemblies

Practicing green building consultants were interviewed using telephonic conversations to identify various materials commonly used in Green rated residential buildings. According to them commonly used envelope materials are as follows

- Wall- AAC blocks, Fly ash bricks, Porotherm (in rare cases)
- Roof layers- XPS, PUF insulation, Inverted earthen pots(in rare cases)
- Fenestration- Single glazing, Low E glass, DGU (in rare cases in residential buildings)

2.3 Comparison of cost and energy performance

2.3.1 Case for analysis

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This case is taken for calculating quantities of each material required.
Proposed Bungalow at Aurangabad
Latitude- 19 degree North
Climate- Hot and dry
Ground +1 structure
Site area- 174.25 sq.mBuilt up Area- 159 sq.m.
No. of occupants- 6

2.3.2 Materials and assemblies

Materials and assemblies commonly used in green construction and which are readily available in the market are selected for comparison against conventional ones. Cost per unit of each assembly is identified from market survey and State scheduled rate.

	Conventional	Green building materials			
	Wall				
	Brick	AAC	Fly ash	AAC cavity wall	Porotherm blocks
U value	2.4 W/sq.m.K	0.74 W/sq.m.K	1.23 W/sq.m.K	0.71 W/sq.m.K	1.8 W/sq.m.K
block cost	RS. 6-230*115*75	RS.49-600*200*100	RS. 5-220*110*75	RS. 49-600*200*100	RS. 38-600*200*200
Per unit	6004/cub.m.	6119/cub.m	5412/cub.m.	6119/cub.m	1820/sq.m
labor	1360/cub.m	1662/cub.m	1360/cub.m	1662/cub.m.	466/sq.m
Total	7364/cub.m	7781/cb.m	6772/cub.m	7781/cb.m	2286/sq.m

	Waterproofing/ insulation layers on roof				
	brick bat coba	aac block coba	PUF insulation	XPs insulation	Inverted earthen pots
U value	2.06W/sq.m	1.19 W/sq.m.K	0.34 W/sq.m	0.48 W/sq.m.K	1.8 W/sq.m.K
Material	rs. 700/ cub.m.	Rs.1500/cub.m	2100/sq.m, Vapour barrier-100 /sq.m, , epoxy based waterproofing 350/sq/m	550/sq.m, Vapour barrier-100 /sq.m, epoxy based waterproofing 350/sq/m	
Per unit	937/sq.m	1400/sq.m	2500/sq.m	1100	
labour	482/sq.m	482/sq.m	500/sq.m	400/sq.m	
Total	1419/sq.m	1882/sq.m	3000/sq.m	1500/sq.m	1750/sq.m

	Fenestration			
	Clear- Single glazed unit aluminium frame - 3 track	Clear - Double glazed unit aluminium frame- 3 track	LOW E coating - Single glazed unit aluminium frame- 3 track	Tinted glass - Single glazed unit aluminium frame
Glass U value	5.6	1.9	3.8	5.6
Glass SHGC	0.6	0.25	0.27	0.43
Glass rate	1450/ sq.m	2600/sqm	2250/ sq.m	1800/sq.m
Per unit	4959/sq.m	20450 /sq.m	5700/sq.m	5200/sq.m
Labour	1603/sq.m	-	1603/sq.m	1603/sq.m
Total	6562/sq.m	20450	7303	6803/sq.m

Table 1 Details of materials and assemblies

2.3.3 Calculations and simulations

Total 9 combinations of assemblies are selected for comparison. Total cost is calculated for the required quantity of each assembly and then added together to get total cost of wall, roof and fenestration. Simulations were done for the same combinations considering following conditions-

Rooms which are used for maximum time and where comfort is required in a residential unit are air conditioned include- Living Room, All the bedrooms and study room.

1. As temperatures are above comfort temperature (20.3 – 26.7 degC for Aurangabad) for maximum time, Simulations are done for air conditioned

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rooms in order to derive energy consumption for cooling.

2. Comfort temperature range -20.3degC to 26.7 degC (above or below this range HVAC system is used for achieving comfort)
3. Design humidity- 40%
4. No of people= 6
5. Clothing index= 0.6
6. Illumination Levels=150Lux
7. Air conditioning system –Individual Room unit
8. Air conditioning system efficiency= 90% *(NA, ASHRAE standard 55 and current handbook of fundamental model, 2013)*
9. Operation schedule for various rooms is set as per the usage

Payback period is calculated based on difference in cost of conventional and green material assemblies and cost saving due to reduced energy demand.

3.0 RESULTS

3.1 Awareness

From the survey responses it can be inferred that all of the respondent architects are aware about term green buildings and about green building rating systems. More than 60% of the respondents think green construction is costly and the reason for additional cost is material and fixture cost and certification process both. More than 50 % of the respondents are not aware about financial benefits of green buildings. It is observed from the responses that respondents practicing in Class B and Class C cities like Aurangabad, Yavatmal, Kolhapur are not aware about financial benefits of green buildings.

3.2 Calculation and simulation results

The table indicates the assembly, total cost of wall, roof and fenestration and annual energy consumption when that assembly is used in the construction.

Assembly	Wall	Roof insulation	Fenestration	Total Cost of Wall, Roof, Fenestration in INR	Annual energy consumption in kWh
1	Brick	Brick bat coba	Clear single glazing	601566.95	14418.917
2	AAC	AAC bat coba	Double glazing	1087130.40	7104.19
3	Fly ash	Inverted earthen pot	Low E coated single glazing	630183.51	10074.946
4	Porotherm	PUinsulation	Tinted single glazing	824549.95	13182.035
5	AAC cavity wall	XPS insulation	Low E coated single glazing	673100.36	6541.804
6	AAC cavity wall	PUF insulation	Double glazing	1234259.83	6119.746
7	Porotherm	Inverted earthen pot	Tinted single glazing	729524.95	14002.825
8	Fly ash	Inverted earthen pot	Tinted single glazing	613178.51	13834.815
9	Porotherm	PUF insulation	Double glazing	1288684.42	11849.467

Table 2 Calculation Results

The analysis indicates that for some cases, there is hardly any difference in per unit cost of construction in comparison to conventional building envelope assemblies.

Following Graph indicates annual energy consumption of various combinations of building envelope assemblies, when they are arranged in ascending order of initial cost per unit.

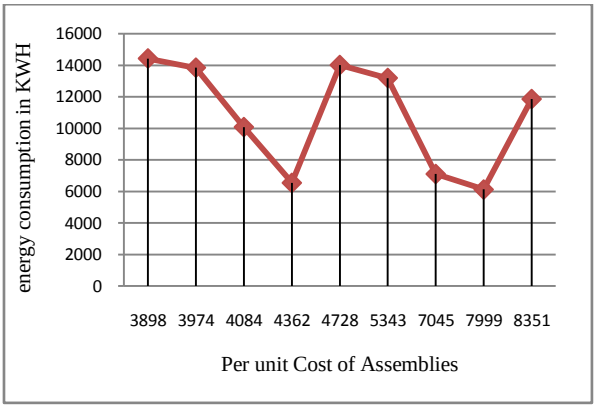

Figure 1 Graph- Per unit cost vs Energy consumption Source- Author

From the graph it is observed that General perception is costlier assemblies might have the best energy performance, but it is not true.

3.3 Payback period

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Assembly	Cost per unit	Annual Electricity consumption	Monthly average consumption	Cost of electricity	Energy cost saving per month	Payback period in months
	(Rs/sq. m)	(kWH)	(kWH)	Rs	**Rs**	Months
Conventional	3898	14419	1202	15020	-	
2	7045	7104	592	6808	8212	59
3	4084	10075	840	9655	5365	5
4	5343	13182	1099	13731	1288	173
5	4362	6542	545	6269	6269	11
6	7999	6120	510	5865	8750	72
7	4728	12003	1000	12503	2517	51
8	3974	13835	1153	14411	608	19
9	8351	11849	987	11356	3664	188

Table 3 Results of payback period calculations

From the analysis it can be inferred that the payback period depends on both initial investment and energy performance

Following Graph indicates Payback period of various combinations of building envelope assemblies, when they are arranged in ascending order of initial cost per unit.

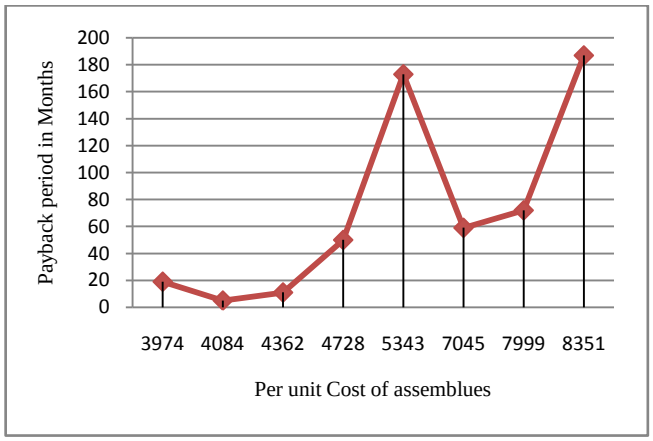

Figure 2 Graph- Cost per unit vs payback period Source- Author

It can be observed from the graph that costlier assemblies will not necessarily have more payback period

4.0 CONCLUSIONS

There is a lack of awareness regarding financial benefits of the green building certification and green building materials. There are green construction materials available in the market which are less expensive than conventional ones. General perception is costlier the better ,but it is not true in this case. Optimization of cost and energy performance is necessary while selecting building envelope materials.

5.0 ACKNOWLEDGEMENT

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Building Envelope Design Components and Its Role for Designing An High-Performance Office Building: A Review

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Abstract: Building envelope refers to as the skin of the structure that separates the indoor conditioned space from the outdoor unconditioned space and it is responsible for most of the energy consumption that occurs in the building. Designing of building envelope and its components plays a very important role to attain energy efficiency of a building & reducing energy consumption without compromising on user's comfort. The aim of this paper is to describe the various components that help to achieve energy efficiency or high performance office building by reviewing the research papers of the past researchers, books, author's guidelines and recommendation as per ECBC for various building envelope components.

Key words – Building Envelope, Office Building, Energy Efficiency, Design components, Materials and Thermal Comfort, Energy Conservation Building Code (ECBC)

I. INTRODUCTION

Building envelope is the outer shell of the building which comprises of walls, windows, roof, opening, skylights which separates the indoor conditioned space from the outdoor unconditioned space of a building. The building envelope acts as a thermal shield which protects the interior and the occupants from the prevailing extremities of climatic conditions. Creating a high-performance building envelope means each component and design element is designed to minimize the transfer of thermal energy, which in turn creates an energy-efficient building. The main goal of energy efficient building envelope should be to minimize the heat loss in winter and heat gain in summer. As in today's scenario of the contemporary office building visual comfort, thermal comfort, and physiological comfort are the major concern while designing and office space.

About 39% of energy consumption has been residential and commercial sectors. Out of this consumption, HVAC (Heating, Ventilation, Air Conditioning and Cooling) systems was 39%,lighting 25%,office equipment 22%, domestic hot water 1%,lifts 4%,others 9%.HVAC system contributed to most usage of energy. The amount of energy that HVAC systems consume depends on many factors such as the building location, climate, temperatures during the day and night, timing of the use of the spaces, building envelope, material, U- Value, windows and insulation, etc.Energy conscious design considering the prevailing climatic conditions , help the building occupants and the owner's to reduce the operating costs, improve the comfort of the occupants be it visual comfort, thermal comfort , physiological comfort which directly have an impact on the work output of the user's.

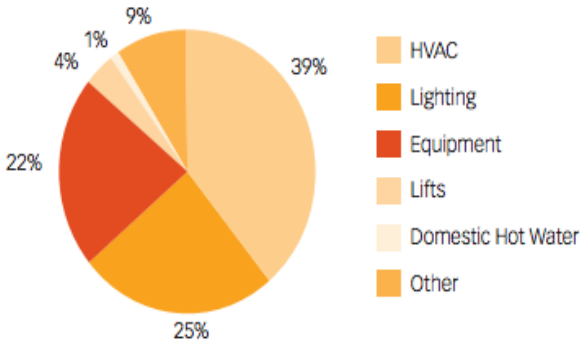

Fig 1 Typical Energy Consumption In An Office Building.

II ROLE OF HIGH PERFORMANCE BUILDING ENVELOPE OFFICE BUILDING

With the current rate in urbanization and subsequent increase in energy demand, energy efficiency in building has a significant role to play in contributing to energy security in developing countries. There has been a tremendous growth in IT Sector, resulting in corresponding growth in commercial floor space. The commercial building sector currently contributes to about 695 million sqm , a growth of 5% to 6% per year commercial building space growth is expected to reach to about 1932 million sqm by year 2030.

Energy consumption can be reduced by energy consumption measures taken during the design phase. Energy consumption measures are approached through which energy consumption of a building can be reduced while maintaining or improving the thermal comfort in the building. They can be categorized into

•Reducing heating and cooling demand;

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•Reducing the energy requirements for ventilation and use of
HVAC system;
•Reducing energy use for lighting;
•Reducing electricity consumption of office equipment and appliances, heating water for domestic uses.

The designing of building envelope components with respect to climatic condition plays a very important role. By improving the building envelope, the energy demand can be reduced.HVAC systems are electrically driven and have a significant impact on green house effect. The use of passive solar design can have a great impact in reduction of energy consumption. In passive solar designed building the building components collect, store and distribute the solar energy in the form of heat in winter and reject solar heat in summer.

ECBC encourages energy efficient building systems such as building envelope, lighting, heating ventilation and air conditioning (HVAC), service water heating and electric power distribution within the building facilities while enhancing the thermal and visual comfort and productivity of the occupants. ECBC recommended measures on improving energy performance of commercial buildings in the five climatic zones of India. High performance buildings in India would be defined as buildings that have integrated low energy/solar passive architectural design strategies and energy efficiency measures as recommended by the Energy Conservation Building Code 2007(iv).

III METHODOLOGY

The review began with the searching of relevant data base and terminology for the high performance building, building envelope design components, factors that affect the performance of the building, role of high performance office building, energy consumption statics. A number of research papers, articles and books were studied with the relevant data. Based on the finding and study from the literature review, case studies a number of finding are been put across that could determine the design components of a high performance building.

The Energy Conservation Building Code (ECBC) of India ECBC recommended measures on improving energy performance of commercial buildings in the five climatic zones of India. Energy saving opportunities, the types of the building envelops components has been reviewed and identified for office building with the help of few case studies.

IV BUILDING ENVELOPE

A building interacts with the environment through its external facades such as walls, windows, projections, and roofs, referred to as the building envelope. The envelope acts as a thermal shell, which if thoughtlessly constructed, would result in energy leaks through every component. Hence, each component needs to be properly chosen to ensure an energy efficient building [i]

V DESIGN COMPONENTS OF A BUILDING ENVELOPE

The building envelope and its components are key determinants of the amount of heat gain and loss and wind that enters inside the building [viii].They primary elements affecting the performance of a building envelope are

BUILDING SHAPE

The volume of space inside a structure that needs to be heated or cooled and its relation with the area of the envelope enclosing the volume affects the thermal performance of the building. This parameter, known as the S/V (surface-to-volume) ratio and it determines the building form. The more compacts the shape of any given building, the less wasteful it is in gaining/losing heat. Hence, in hot, dry, regions and cold climates, buildings are compact in form with a low S/V ratio to reduce heat gain and losses respectively. The depth of a building also determines the requirements for artificial lighting - greater the depth, higher the need for artificial lighting. High performance design should aim first of all to reduce building energy consumption for heating, cooling and electric lighting. In larger commercial buildings there is a greater need for cooling than heating over the seasonal cycle especially with the one with deep floor plates planning. This is due to high occupancy rate and less natural light reaching the interior spaces.

ORIENTATION

The orientation of a building determines its exposure to sunlight. Building orientation should be determined at early design stage, keeping in mind the shape of the building, location, climatic zone. The most preferred orientation and shape in the tropical countries will be elongated along east- west axis, so that the maximum facade is faced to north-south direction. West orientation should be avoided since afternoon the temperature and solar radiation reaches its peak. Also the windows east-west allow maximum heat gain, and increasing the load on HVAC.The planning of the rooms and spaces which require can be done accordingly.

MATERIAL

Improving thermal performance of the building envelope and minimizing thermal bridge is one of the criteria for selection of material. Thermal bridging is an area of a building construction which has higher heat transfer than

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those of the surrounding materials. Material selected should have the least negative impact on the environment. The life-cycle assessment approach determines the environmental impacts of material selection, where material contents, production methods, energy requirements, and waste are analyzed to identify the real cost of a material and its environmental impact. Selecting materials based on the embodied energy data is an appropriate method for considering environmental impacts. The embodied energy is the amount of energy required to extract, process, transport, install, and recycle or dispose of a material [ix].

WALL

Walls are the major part of building envelope and are directly exposed to solar radiation. Building wall generally consists of several layers with different thickness and thermal properties. The combined value of conductance (k) and resistance R-value of each material layers determine the overall thermal properties of the wall, which can be represented by the U-Value The lower the U-Value the better because of the lower thermal transfer (ii).the thickness of the wall and the material can be selected based on the heating and cooling requirements of the building.

Table 1: Opaque Wall Assembly U-Factor and Insulation R-value Requirements as per ECBC

Climate Zone	**Hospitals,hotels,call centre's(24-hours)**		**Other Building Types(Daytime)**	
	Maximum U-factor of overall assembly (W/ m²-K)	Minimum R-factor of the overall assembly (W/m²-K)	Maximum U-factor of overall assembly (W/ m²-K)	Minimum R-factor of the overall assembly (W/m²-K)
Composite	U-0.440	R-2.10	U-0.440	R-2.10
Hot And Dry	U-0.440	R-2.10	U-0.440	R-2.10
Warm And Humid	U-0.440	R-2.10	U-0.440	R-2.10
Moderate	U-0.440	R-2.10	U-0.440	R-2.10
Cold	U-0.369	R-2.20	U-0.352	R-2.35

FENESTRATION

Fenestration of the building is significant with respect to energy efficiency and aesthetic. A better combination of glass & solid, shading, reflectance, view, solar control affect the overall consumption, occupants well being, health comfort and productivity. While choosing Fenestration material properties should be taken into consideration such as U-value, SHGC and visual transmittance. In today's time a lot of new products with new advances in building technology allow transparent glazing with defense against solar heat gain. The spaces between the glasses can be filled with inert gases to low the U- Value of the unit. Low-e, reflective coating can be applied to glass to reduce the heat gain. Window to wall ratio (WWR) is another important characteristic, the ratio of glazed to opaque area. It plays a very significant role in determining the energy consumption of the building. The reduced amount of WWR i.e. less percentage of glazed façade with respect to opaque facade improves the energy efficiency.

ROOF

Roof is the most important building envelope component in modifying the heat again, ventilation &daylight as it is directly exposed to the solar radiation. Roof material should be decided considering the climatic zone. In hot region roof should be properly insulated to minimize the heat gain. Few Insulation techniques are earthen pots/filler slab, covering the top layer of terrace with china mosaic tile, green roof, and white wash of the roof during summers.

Table 2: Roof Assembly U-Factor and Insulation R-value Requirements as per ECBC

Climate Zone	**Hospitals,hotels,call centre's(24-hours)**		**Other Building Types(Daytime)**	
	Maximum U-factor of overall assembly (W/ m²-K)	Minimum R-factor of the overall assembly (W/m²-K)	Maximum U-factor of overall assembly (W/ m²-K)	Minimum R-factor of the overall assembly (W/m²-K)
Composite	U-0.261	R-3.5	U-0.409	R-2.10
Hot And Dry	U-0.261	R-3.5	U-0.409	R-2.10
Warm And Humid	U-0.261	R-3.5	U-0.409	R-2.10
Moderate	U-0.261	R-3.5	U-0.409	R-2.10
Cold	U-0.261	R-3.5	U-0.409	R-2.10

THERMAL COMFORT

Thermal comfort can be defined as condition of the body that expresses its satisfaction with thermal environment. Thermal comfort is measured with parameters like Dry Bulb Temperature, Air Velocity, Relative Humidity, Wet Bulb Temperature, and Calorific Value.

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THERMAL MASS

In region where the daily temperature swing is high, thermal mass plays an important role as the heat gained during the day time gets absorbed and radiated during the night time.

HEAT AND MOISTURE MOVEMENT

The transfer of heat follows a basic principle of heat flow from higher temperature to a lower temperature .This takes place with the help of following process

A) Conduction (heat flows between two facade materials in contact with each other)

B) Convection (heat is conveyed by air currents within the facade);

C) Radiation (heat flows as electromagnetic energy through materials and air spaces within the facade);

D) Air leakage (heat is conveyed by air passing through the facade).

Design strategies for controlling heat flow include using a continuous insulation layer, filling air gaps between material layers to prevent conduction, providing a continuous air barrier to prevent heat loss through air leakage, and avoiding thermal bridging. Air leakage can affect a building's overall energy consumption.

DAYLIGHT

The orientation and WWR influence the availability of daylight, illumination requirement in the interior spaces. While designing, the designer should consider the daylight, protection against glare and harsh sunlight, illumination requirement for a workspace. Analyzing daylight during the different seasons is a critical part for high performance building design. Light shelves have been successful and economically viable option .during summer months the direct sunlight is blocked by the light shelves and redirect the diffused light to roof which further reflects to the interior spaces.

GLAZING

Glazing connects the building occupants to the outdoors spaces and affects the visual comfort, thermal comfort of the users. At the same time the use of glass affect the energy efficiency & cost saving of the building in long run. The Selection of glazing, placement of glazing with respect to orientation of the building ,climate zone, WWR(Window wall ratio),U-value, SHGC(Solar heat gain coefficient) and VLT(visual light transmittance) are some of the integral factors to be considered by the designer. Low –E coating can be used with high-level of visible light transmittance and low U-factor &SHGC. Use of double and triple glasses with air in between reduces the transmission of solar radiation.

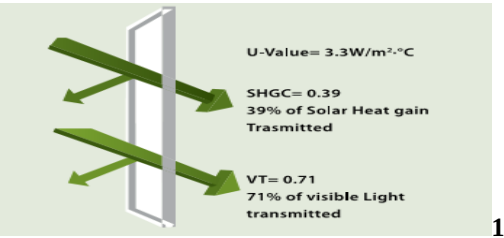
Table 3: Vertical fenestration U-factor and SHGC requirement as per ECBC

Climate Zone	Maximum U-factor of (W/ m²-K)	Maximum SHGC	40%<WWR<60% Maximum SHGC
Composite	3.30	0.25	0.20
Hot And Dry	3.30	0.25	0.20
Warm And Humid	3.30	0.25	0.20
Moderate	6.90	0.40	0.30
Cold	3.30	0.51	0.51

COLOUR AND SURFACE TEXTURE

The nature of the external surface finish determines the amount of heat absorbed or reflected by it. A smooth and light-colored surface reflects more heat and light; a rough textured surface causes self-shading and increases the area for re-radiation. White or lighter shades have higher solar reflectivity and therefore are ideally used for reducing heat gain in warmer climates. Moreover, a heavy texture on these light-colored surfaces helps to reduce the glare. Dark colors absorb more radiation, which increases heat gain through the surface, and can thus be used in cooler regions (i)

VI CASES OF BUILDING ENVELOPE COMPONENTS OPTIMISED FOR ENERGY EFFICEINCY



1. COLLECTOR OFFICE, PUNE

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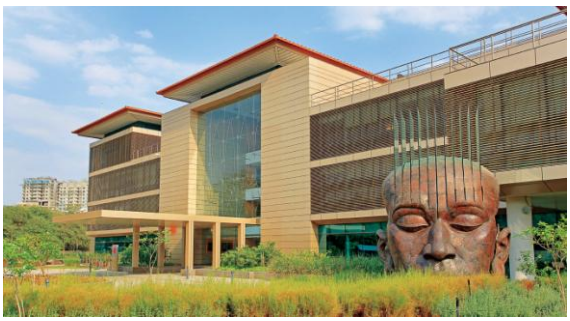
The building is designed based on solar passive &climate responsive strategies. The office consists of 4 masses, wing A, B are placed in such an arrangement to form a semi open plaza with fourth mass, wing C on the top of wing A & B which form the covering to the central plaza.. As major part the building envelope faces east –west the facade is protected with vertical fins to reduce the solar radiation with the use of materials like acc blocks and fly ash providing visual and thermal comfort. Wall assembly U-factor 0.13 Btu/hr, Roof assembly U-value 0.08 Btu/hr, WWR (Window to wall ratio) is 38% with DGU glass having SHGC 0.23 optimized shading device to control the glare and improving the visual and thermal comfort for the occupants and the users

2. HPCC+CCCR, PUNE

The two building, HPCC & CCCR are rectangular form building oriented such that the longer façade of the building faces north and south direction and reduce the heat gain in the building. The building consist of layered envelope – combination of single glazed window and aluminum louvers which help control the heat and wind flow. On the east and west side of the building envelope double layered cavity wall is used to reduce heat load .the external wall composition is of 230 mm fly ash blocks with 30,external stone Crete plaster and 5 mm gypsum finish inside.

3. SUZLON, ONE EARTH

Maximum blocks in the campus are oriented north, south, North West and south east. The curtain walls are of full height, covered with louvers to avoid glare, direct heat radiation & maximize day light .Use of siporex fly ash blocks for obtaining good insulation. The glazing used has a low-e value which substantially reduces the heat gain.



CONCLUSION & RECCOMENDATION

Urbanization and growth of buildings are responsible for use of large amount of resources, energy, and green house emission. Designers should design considering the macro climate of the site , Building envelope & its components to obtain maximum efficiency. There is vast scope in saving energy with the use of climate responsive building design strategies and use of ECBC recommendation.

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Life Cycle Energy Assessment : Green Rated Home vs Neo-Vernacular Home

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ABSTRACT: ***The Life Cycle Energy (LCE) of a building comprises mainly of EmbodiedEnergy (EE) and Operational Energy (OE), of which, EE is of utmost importancehaving direct impact on environment and resources. Today, the Green Building Rating Systems are providing a pre-define set of instructions to build Sustainable Buildings. However, in some parts of the country there still exists climate responsive Vernacular Architectural Style, which can be adopted in a new way (Neo-vernacular) by fulfilling the needs of current generation. This paper presents finding of the study conducted to know which among a Green Rated Home and a Neo-Vernacular Homehas greater environmental impact by assessment of EE specific to building construction materials. The results drawn show that the Green Rated Home resulted in high EE as compared to Neo- vernacular home.***

Key words – Life Cycle Energy, Embodied Energy, Building Materials, Sustainable Building, Green building Rating Systems, Green Rated Home, Neo-Vernacular Home

INTRODUCTION

The comparison between a Conventional building and a Green building have been done many times, with results always in favour of green building for low energy consumption(Reddy, Prseeda, & Mani, 2017). But, when it comes to comparison of two buildings, both claimed to be climate responsive and Green Buildings, but are built with different materials and techniques, which one actually consumes less energy is generally not known.

The idea of this study was generated from the same observation to compare between both a Green rated home and Neo-vernacular home through calculation of EE of sample field case study of each type, so as to set a benchmark for future construction of buildings.

In India, the construction sector is responsible for the largest contribution of carbon-dioxide emissions (22%) in the atmosphere. Besides offices, commercial and industrial buildings, more than 20,00,000 residential buildings are built annually. Demand and supply gap for residential buildings is increasing every year (20 million units in 1980 to 40 million units in 2000), **cement** (> 75 million tons per year), **iron** (> 10 million tons per year) and **bricks** (> 70 million tons per year) are the largest and bulk consumption items in the Indian construction industry(Jagdish & B.V. Venkatarama Reddy, 2003).Reducing the use of conventional materials with high EE, by using alternative materials, methods, and techniques with low EE, can result

in scope for considerable energy savings as well as reduction of CO2 emissions.

Today, the building materials in different parts of the world are slowly being replaced by new materials, which are essentially the most affordable in the market but not necessarily environment friendly or low energy consuming.In the construction process, the abandonment of vernacular building methods was first realized by utilization of cheap and abundant concrete and reinforced concrete instead of stone and wood, which were the vernacular structural materials. This is where, there is a need to draw a line and return to natural or hybrid materials that require energy-saving construction techniques with low pollution and low environmental impact. Therefore, the need is to assess EE of the building materials due to excessive use of energy throughout the Life Cycle of buildings.

The following various concepts are discussed in this study.

Green building Rating Systems in India:

Green building rating system like IGBC and GRIHA systems in India are gaining popularity and success over both the conventional and traditional part of construction industry. Therefore understanding their practical approach towards energy consumption and resource conservation is of utmost importance.

Neo-Vernacular architecture:

Neo vernacular or new vernacular is not a new style of architecture but simply a shift in attitude whereby, studying vernacular morphology, structure, technique and materials, a new system can be developed with the help of a professional that is compatible with contemporary reality but pays tribute to the traditional building principles.

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Life Cycle Energy (LCE):

Total energy consumption throughout a building's entire life span is called its Life Cycle Energy (LCE) of a building, mainly consists of its Embodied Energy (EE), the energy required in manufacturing, processing and transportation og building materials, Operational Energy (OE),the energy used to operate a buildingand Demolition Energy (DE), energy at the end of life cycle of a building, which accounts for only about 1% of the total LCE(Praseeda, Reddy, & Mani, 2017).

Today, there is more importance of EE in buildings running on Renewable Energy for operation & maintenance, because in such buildings the OE becomes nearly zero whereas EE increase from 10% - 20% to almost 100% as building material and construction would still need energy for manufacturing, processing and transportation(Praseeda, Reddy, & Mani, 2017).

Literature Case Study:

Four book case studies have been taken from two different research papers. One of them has researched on rural dwellings in India (vernacular architecture)(Reddy, Prseeda, & Mani, 2017)and the other has researched on urban residential buildings in India (Conventional building)(Praseeda, Reddy, & Mani, 2015).

The EE of construction materials of some dwelling units from the literature study are shown in table 1 below.

Table 1 EE Assessment of Literature Case Studies

Literature Study Analysis		
	Materials Used	**EE (MJ/m² of built up area)**
Rural Dwelling study 1	Adobe + Mud roof + Tin sheet	170
Rural Dwelling study 2	Adobe + Burnt Clay bricks + Tile Roofing	510
Urban Dwelling study 3	AAC blocks + R.C.C. slab	1027.16
Urban Dwelling study 4	FALG Blocks + R.C.C. Slab	1131.82

The results from literature study shows that Case Study 1 & 2 i.e., rural dwellings made of traditional building materials (like adobe, mud roof etc.) requires nearly **half the EE** of case study 3 & 4 i.e., urban dwellings made of conventional materials (like R.C.C).

METHODOLOGY

A detailed survey and field study of a Green Rated Homes in Pune and a Neo-Vernacular Home in Pune was carried out. The detailed survey questionnaire and observation list was prepared, which included personal interviews of Architect of the house, to understand the materials and design strategies of the house. The detailed sections of wall, roof, and slab were drawn, detailing every material used for construction of building.

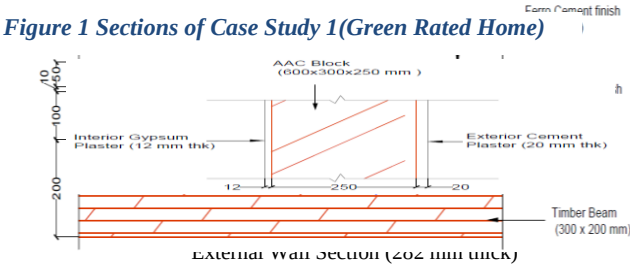
The measurement drawings for case study 2 (neo-vernacular home) were generated using AutoCAD, unlike Case study 1 whose readymade drawings were made available from the resident.

EE Assessment:
The EE assessmentwas carried out in following three steps:

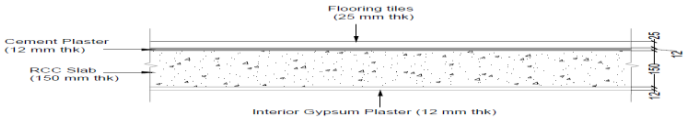
Step 1: A Bill of Quantities (BOQ) was prepared for all slabs, doors, windows and walling material of both the sample houses.

Step 2: Detailed sections of walls, slabs and roofs were prepared mentioning every material used in their construction as shown in fig. 1 and 2 below. Then total EE of each individual material was estimated as a product of EE of material and total quantity of material used in units m² (Area) or m³ (Volume) or Kg (Weight), depending on the material and its application.

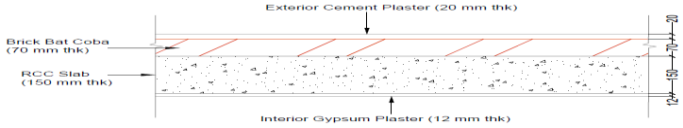
Figure 1 Sections of Case Study 1(Green Rated Home)



External Wall Section (282 mm thick)



Floor slab Section (200 mm thick)



Roof Section (252 mm thick)

Figure 2 Sections of Case Study 2 (Neo-Vernacular Home)

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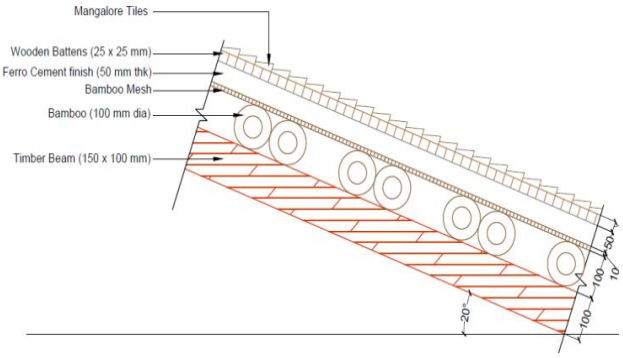
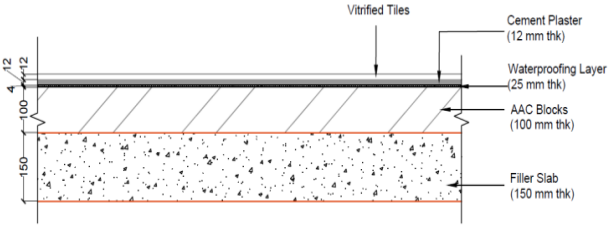
First floor Slab Section (360 mm thick)



Sloping Roof Section (285 mm thick)



Toilet floor Section (278 mm thick)

Step 3: All the value from step 1 are added up and the sum (in MJ) is divided by the total built up area (in m²) of the respective building, to get the final value of EE of the building expressed in MJ/m² of built up area. The reason for acquiring the final value as in units of MJ/m² of built up area is because the scale of all Field case studies might not be the same, so to compare the final values of EE, the total value needs to be break down to per unit area of built up.

The EE of all relevant materials observed in case studies has been taken from research journals (Jagdish & B.V. Venkatarama Reddy, 2003)(Deepak, Singh, & Sawhney, 2013)(Reddy, Prseeda, & Mani, 2017)(Reddy, Prseeda, & Mani, 2017). The EE used here is inclusive of the Energy used during various phases of manufacturing, processing, transportation (within 50km and within 100km).

Table 2 EE Assessment of Field Case Studies

Material	Measurement Unit	EE (MJ/Unit)	Quantity of Material	Total EE (MJ)
Case Study 1 (Green Rated Home) - Built up 742 m²				
AAC Block	m³	255.55	217.50	55582.13
Cement plaster	kg	6.7	18963.89	127058.08
Gypsum Plaster	kg	1.8	53037.04	95466.68
Cement Mortar	m³	1268	10.44	13237.92
Brick Bat Coba	m³	2515	13.40	33695.97
RCC	m²	730	933.50	681455.00
Glass	kg	25.8	293.16	7563.56
Painting	m²	29.06	1493.16	43391.23
EE of Home				
Case Study 2 (Neo-Vernacular Home) - Built up 200 m²				
Adobe	m³	51	81.81	4172.16
Cement soil Mortar	m³	849	5.45	4630.28
Mud Plaster + Lime rendering	m²	0.87	40.90	35.59
Cement plaster	kg	6.7	1207.90	8092.96
Ferro cement	m³	158	8.133	1285.01
Bamboo	kg	1.5	3409	5113
Glass	kg	25.8	104.46	2695.02
Mangalore Tiles	m²	227	83.66	18990.82
Timber (Flooring+Battens)	kg	3.06	2030.00	6211.80
Burnt Clay Brick	m³	2515	8.962	22539.43
Filler Slab	m²	590	148.11	87384.90
Mud Flooring	m²	0	108	0.00
AAC Block	m³	225.55	3.5	789.43
EE of Home (MJ/m² of built up area)	**809.75**			

RESULTS AND DISCUSSION

Results from Live Case Study are discussed below:

In Case Study 1 i.e., the house constructed on Neo-vernacular principles made use of local materials (like Bamboo) and on-site production of materials (Like Adobe blocks) has consumed nearly **half the EE** of the Case Study 2 i.e., Green Rated Home, constructed of some modern materials with recycled contents (Like AAC Blocks) and some conventional materials (like R.C.C slabs). Although, AAC blocks requires much less energy for production, but the overall energy consumption along with other materials in the Green Rated home have much higher EE.

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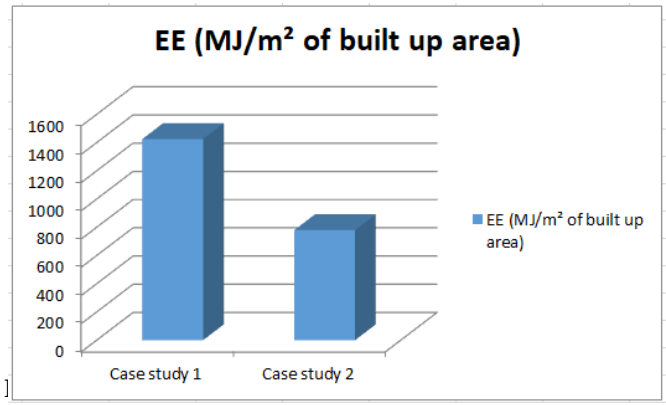
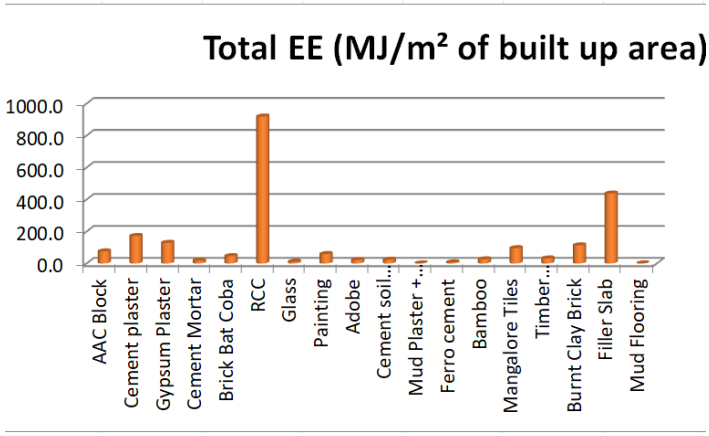
Figure 3 below shows the graphical representation of field study analysis.

Figure 3 Field Case Study Analysis



Thecomparison between EE of each material used in construction of the buildings of both field case studies carried out, is shown in the graphical representation in the given figure 4 below.

Figure 4 Total EE of all materials used



Results:

The result drawn from the (*figure 4)* shows that RCC(918.4 MJ/m²) in a high-energy intensive material which can be substituted by filler slab(436.9 MJ/m²) which consumes nearly half its energy. Among walling materials burnt clay bricks requires comparatively more energy than AAC blocks, while adobe blocks consumes the least energy. Other materials like cement plaster, gypsum plaster also have high EE.

Therefore, the traditional and local natural materials (like bamboo, mud, timber, Ferro cement) should be included in building construction more due to very less EE.

The literature and live studies both shows more than 50% of EE reduction in houses built with natural or vernacular materials as compared to houses constructed using the conventional materials.

CONCLUSION

The study conducted shows that the overall EE of buildings mainly depends on the EE of individual materials along with their quantity. The study also concludes that the other low EE alternatives can be used in place of R.C.C., which is high energy intensive.

ACKNOWLEDGEMENT

It is an immense pleasure to thank all the people who made this study possible. I would like to express my deepgratitude to my guide – Professor Archana Gaikwad for her time, encouragement and guidance in a definite direction. Without her, this study would not have been possible.

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Feasibility Of Groundwater Recharge For Maintaining Groundwater Table In Charholi Budruk, Pune

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Abstract: Groundwater is the main source of domestic water requirement in India and its overexploitation has led to water scarcity. Because of rapid urbanization, land uses have changed which is affecting low infiltration rates of rainfall into the soil and has diminished the natural recharging of aquifers. To respond to the growing crisis of groundwater, the artificial recharge of aquifers has become widespread in India. In this paper, the feasibility of Groundwater recharge for the Charholi area was assessed. From literature review, it was found that in rainy season groundwater table in this area is 2-5m but the level goes down up to 10m in the summer season. Case studies from Maharashtra were studied to identify how effective groundwater recharge methods are and which type of methods are suitable in this area and also the relation between recharge methods, geographical conditions and topography are studied. The research paper gives various methods for groundwater recharge in Charholi area.

Key words – Groundwater, artificial recharge, water table, Charholi

I. INTRODUCTION

The main resource which is needed to survive on earth is Water. Only 3% of the world's water is freshwater and the problem of water scarcity is worldwide. Groundwater is the major source which is used for domestic purpose. In the last three decades, exponential growth in the number of groundwater structures has been observed. This has lead to an enormous withdrawal of groundwater for various uses of agricultural, industrial and other domestic needs (CGWB,2011). Increased use and limited recharge have contributed to the lowering of the water table (Ramaswamy, 2007). Groundwater recharge is a hydrologic process**,** where water moves downward from the surface to the underground. There are two types of Groundwater recharge-

1. Natural Groundwater recharge- through rainfall, water bodies like lakes & rivers. The natural replenishment of groundwater reservoir is slow.
2. Artificial Groundwater recharge- The term artificial recharge refers to the transfer of surface water to the aquifer by human interference. Therefore, any man-made structure which adds water to an aquifer is called as artificial recharge. Artificial groundwater recharge is becoming increasingly important in India, where over-pumping of groundwater has led to underground resources becoming depleted.

Recharge is an important process for sustainable groundwater management since the volume-rate abstracted from an aquifer in the long term should be less than or equal to the volume-rate that is recharged (Ajoy Mishra). An aquifer is a geologic formation that contains sufficient saturated, permeable material to yield significant quantities of water to wells and springs. There are generally two kinds of aquifers. 1. Unconfined Aquifers- It also called a water-table aquifer, which is an aquifer that has the water table as its upper boundary. Unconfined aquifers occur near the ground surface.

2. Confined Aquifers- A confined aquifer is an aquifer that is bounded above and below by confining beds. Confined aquifers generally occur at significant depth below the ground surface (Molly Maupin & Nancy Barber, 2000).

As cities grow urban area expands geographically, characterized by impervious surfaces like roads, pavements and buildings. Rapid development and construction in these areas result in the loss of greenspaces. This decreases the cities capacity to absorb water, decreases groundwater, causes urban flooding, worsens the status of wetlands, disturbs the entire hydrological cycle and ecological area. Proper pre-planned groundwater management in urbanizing areas can save these areas from water scarcity in the future hence preplanning of artificial recharge methods is important in Urbanizing areas.

II. THE STUDY AREA

According to 2011, the Census of India, Pune district is the fifth urbanized district in Maharashtra state. Rapidly increasing population in the Pune city is creating a burden on natural resources like water. Pune city and its neighboring villages which are urbanizing are already facing water scarcity problems. The study area is Charholi Budruk, an ancient village near Alandi, in Pune district adjacent to Pune city. Charholi lies in the southern bank of the Indrayani river with 1752 Ha. Area. The main occupation of people living in Charholi Bk. is farming and water used for farming is from wells hence, maintaining

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the groundwater table is very important in this village. The annual rainfall in this area as per IMD is 757mm. As per the Water Resources Information System of India depth of Post monsoon water table in Charholi is in between 2-5m. whereas, post monsoon water table goes down up to 10m (Fig 1).

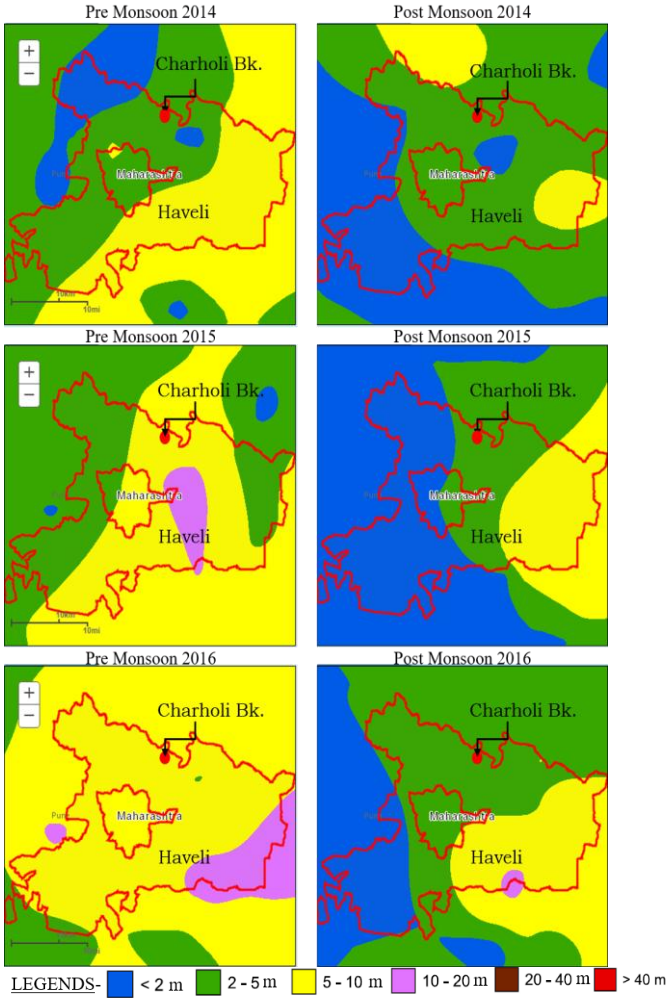

Fig 1. Haveli taluka groundwater table

III. METHODOLOGY

In the present study, the groundwater table of Charholi Bk. is assessed by studying the pre- and post-monsoon groundwater level maps from WRIS India and rainfall data for the years 2014, 2015 and 2016. Maps of soil type & geology of the area are collected and relation with the groundwater is studied. Also, the prioritization map by Groundwater survey & development agency is analysed with the other two maps. The topography of the land is identified by site visits and the slope of terrain is identified from google earth software. The watershed area is identified from GIS software. Approximate groundwater recharge capacity has been calculated based on case study & recharge methods used.

IV. DATA COLLECTION & FINDINGS

A) RELATION OF GEOLOGY, SOIL AND GROUNDWATER

Geology is the science which deals with the physical structure and substance of the earth, their history and the processes which act on them. Understanding geology while studying groundwater is important. Rock type controls the depth and degree of weathering as well as controls the types of water-bearing discontinuities that may be formed in the bedrock, they also define aquifers locations. Geologic structure influences the distribution, nature, and yield of water-bearing zones by providing the framework along which weathering and possibly stress-relief can occur. The water bearing properties depend upon the intensity of weathering, fracturing and jointing which provides availability of open space within the rock for storage and movement of groundwater. The geology map of the Charholi area shows three types of geology formation- Alluvium, Bushe and Khandala formation.

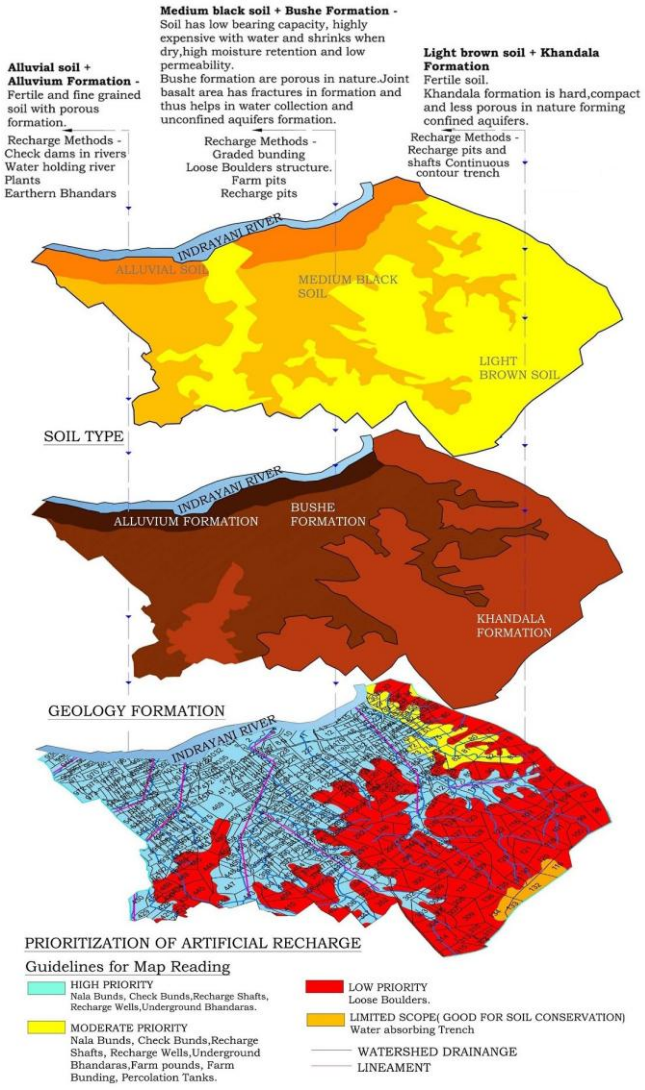

Fig 2. Map of geology, soil & prioritization of recharge

Soil properties play an important role in water infiltration in the ground. For recharging Aquifer, the water has to

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pass through the soil before reaching the water table and the amount of recharge is therefore largely governed by the hydraulic properties of the soil. The amount and timing of runoff from a catchment is also considerably influenced by these hydraulic properties. The soil map of Charholi area shows Alluvial soil along riverside above Alluvium formation, Medium black soil is on Bushe formation in the middle part of the map & Light brown soil on Khandala formation is in the lower part of the map. Alluvial soil & Alluvium formation is rich in minerals and it is permeable with good water holding capacity. Medium black soil has clayey texture, high fertility, good moisture retention capacity hence farming is done mainly on these two types of soil. Bushe formation also has high porosity. Light brown soil & Khandala formation has low permeability as compared to the other two soil types. The soil type also affects the vegetation of the zone and the evapotranspiration cause from the surface.

B) ARTIFICIAL RECHARGE METHODS –

1. WATERSHED MANAGEMENT-

A watershed is a land area that drains to a common point. Normally, rainwater flows out along the natural drainage lines from watershed area.

Watershed management is the process of implementing water management practices and land use practices which helps to improve and protect the quality of the water and other natural resources within a watershed area.

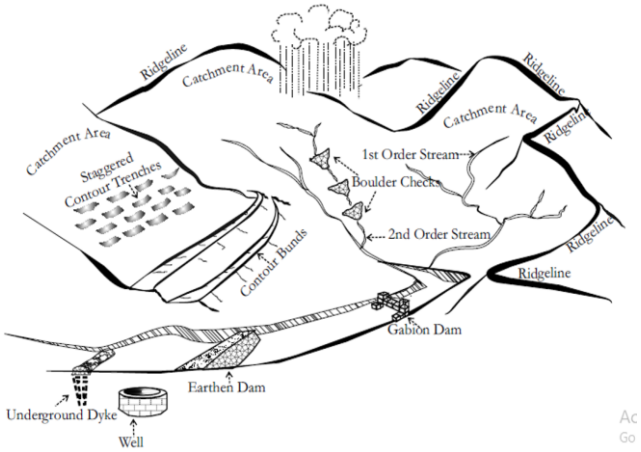

Fig 3. Schematic representation of Watershed management

2. CONTINUOUS CONTOUR TRENCHES

Trenches made on hill slope along contours and perpendicular to the flow of water are called continuous contour trenches.

It reduces the rate of runoff, results in an increase in percolation rate & reduction in soil loss. Which eventually helps in increasing green cover over the area and soil quality. The method is applicable on Slope of 0%-33% and it helps to develop the degraded lands. The Water percolation capacity of one trench having a size of 0.6mx0.45mx30m is 5400 Lit. The CCT is proposed on a hill slope in the area of 1ha.

3. LOOSE BOULDER STRUCTURE AND SMALL EARTHEN BANDARA

A Loose Boulder structure (LBS)and Earthen Bandara is a small barrier constructed of rock, gravel bags, sandbags or reusable products, placed across a constructed swale or drainage ditch. It stops the soil loss. LBS is provided on a slope of 4%-33%. Small Earthen Bandara is provided on a slope of less than 8%. It reduces the rate of runoff, results in an increase in percolation rate. It also helps to develop the degraded lands.

4. WELL RECHARGE-

To recharge aquifer directly, a well recharge is done. Recharge wells are similar to pumping wells. The abandoned tube wells can be used to recharge the aquifer but sometimes the method becomes costlier as wells are required to be bored. Also, flowing surface water and rooftop rainwater can be filtered and allowed to recharge the open wells.

5. RECHARGE PIT FOR AGRICULTURE LAND (FARM PIT)

Unconfined aquifers can be recharged using farm recharge pits. In the agricultural field, mostly the top layer of soil is less permeable. Due to this, the surface flooding methods of recharge do not show satisfactory performance. In such cases, the recharge pit is excavated which is sufficiently deep to penetrate the less permeable strata.

6. AFFORESTATION

Vegetation can significantly impact groundwater recharge due to transpiration and by intercepting rainfall and overland flow; changing land use can therefore, affect recharge patterns. Maximum groundwater recharge occurs at intermediate tree cover in seasonally dry tropical areas. Soil evaporation and surface runoff become high without trees, which leads to low groundwater recharge. Afforestation on hills is proposed.

7. Roof Top Rainwater Harvesting

In urbanized areas where open land is not commonly available, the water from the rooftop can be used for groundwater recharge. Urban housing complexes, historical forts, and institutional buildings generally have large roof areas and can be utilized for harvesting rooftop rainwater to recharge the depleted aquifers.

Methods of Rainwater Harvesting in Urban Cities-

1. Store the rainwater in containers above or above grounds or below grounds;
2. Recharge into the soil for withdrawal later by groundwater recharging basis.

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Any rainwater harvesting will have four elements: - Catchment area, Conduits, Settlement Tank, Recharge facility or storage facility.

C) CASE STUDY FINDINGS-

In the drought-prone Ahmednagar district of Maharashtra lies Hiware Bazaar. In the village of Hiware Bazaar, a rain shadow area with an annual rainfall of 400 mm, the villagers have demonstrated the benefits of artificial groundwater recharge & rainwater harvesting.

Watershed Development Program – Under the comprehensive watershed development program, implemented by Zilla Panchayat, the water conservation structures are constructed in the village given in chart 1. The concept of the ridge to the valley is implemented under the watershed development program. Under this program, various structures constructed like cement check dams, gully plugging, gabion structure, loose boulder structure, nalla bunding, etc.

Rain Water Harvesting and Artificial ground Recharge -

Borewell Blast Technique (BBT) –It is an unconventional method developed by Groundwater Surveys and Development Agency in the village to increase groundwater storage and recharge.

Rain Water Harvesting –A rainwater harvesting structure on the school building and two farm ponds were constructed in the village.

Shallow soak pits were created in the areas where CCT was not possible. This helped in collecting the rainwater and through seepage the water would be available to surrounding plantation. Farm bunds & roadside tree plantations were also taken up with the help of the Forest Department and People Participation.

Water conservation structures of the village					
Sr. No	Type	No	Capacity	Percolated water	Store water
1	Percolation tank	2	100	10	140
2	Cement bandhara	4	2	0.4	5.6
3	Gabbian bandhara	0	0.5	0	0
4	Farm pond	3	7	1.05	14.7
5	Earthen Dam	52	0.5	1.3	18.2
6	CCT	210	Ha	37.8	0
7	Underground bandhar	0	0.5	0	0
8	Looze boulder	3035	0.01	1.52	21.25
9	Kolhapur type bandhara	6	2	0.6	8.4
Total				52.67	Cr,.ltrs

Chart 1- Details of recharge methods used in Hiware bazaar

D) SITE MAPS

Site maps of a watershed, the terrain is generated from GIS software and overlapped on one another to find out the suitable locations for artificial recharge.

Fig 3. Overlay map of google earth, watershed, terrain.

V. GROUNDWATER RECHARGE PROPOSAL

After studying Geology, soil, groundwater levels, watershed, terrain and existing built up area following methods are proposed in Charholi Bk. for artificial groundwater recharge. Chart 2 shows the details of water percolation capacity of different techniques and Fig.4 shows the location of proposed recharge methods.

A) WATERSHED MANAGEMENT-

Watershed management is proposed in the Charholi area after studying current land use and watershed maps. Under this management plan following techniques are proposed. The location of these structures is proposed such that it helps in the irrigation of farmland.

1. Continuous contour trenches- This method is applicable on a Slope of 0%-33% hence it is proposed on three barren hill slopes in the area of 10 ha. The Water percolation capacity of one trench having a size of 30mX0.6mX0.3m is 54000 Lit.

2. Loose boulder structure and small earthen bandara- LBS are suitable for a slope of 4%-33 hence 20 LBS are proposed on the first order watershed as the width of the first order is 3-6 m. 24 Small Earthen Bandaras are proposed on second order watershed wherever the slope is less than 8%.

B) Well recharge- It is proposed near the watershed area so that the retained water from the watershed can be filtered in a pit and diverted towards well for well recharge. 20 well recharge structures are proposed with a chamber of size 1.5mX1.5mX1.5m. This will have a total percolation capacity of 4L Lit.

C) FARM PIT-

20 nos. of farm pits are proposed in the farmland of size 2.5 M x 2.5 M x 2.5M which has a percolation capacity of 1 L.Lit and storage Capacity of 15000 Lit. each.

D) Roof Top Rainwater Harvesting-

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Pimpri - Chinchwad Municipal Corporation has made RWH mandatory by enacting building bye-laws. Hence it is mandatory for any new construction to provide roof top rainwater harvesting.

Sr. No.	Type of work	Area/ Nos.	Water Percolation capacity (L. Lit)
1.	Continuous contour trenches	10 Ha	180
2.	Loose boulder structure	20	-
3.	Small earthen bandara	24	-
4.	Well recharge	20	80
5.	Farm Pit	20	20
	Total		280 L. Lit

Chart 2. Details of proposed recharge methods

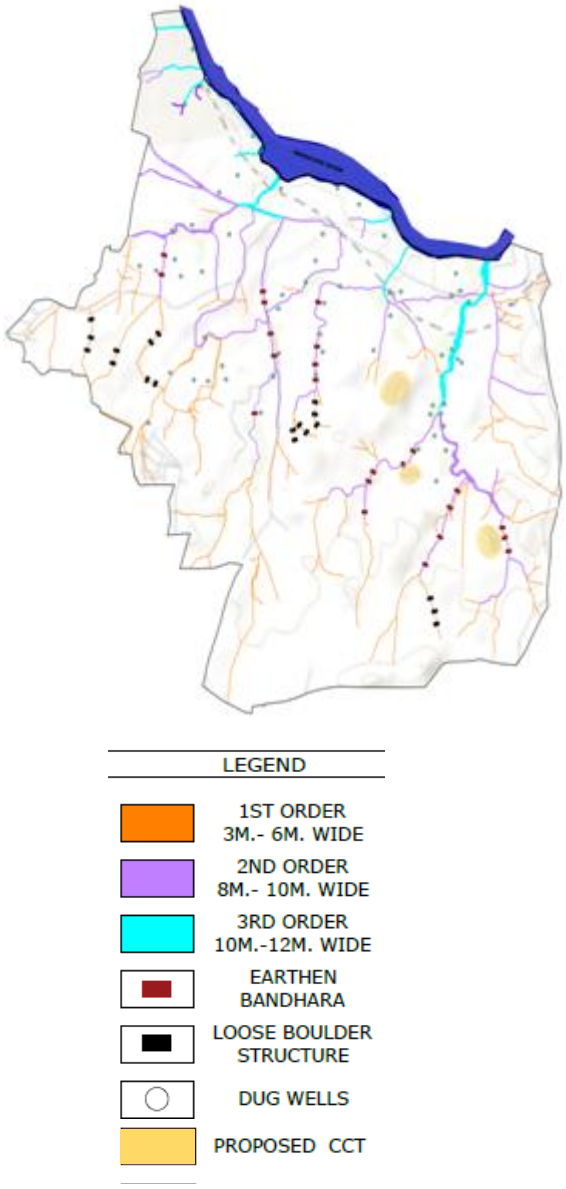

Fig 4. Map with location of proposed artificial recharge methods.

VI. CONCLUSION

The groundwater level of haveli taluka is found to be reducing every year. The various artificial techniques which are used for groundwater recharge are proved to be effective. Since the Charholi area is not completely urbanized, there is a scope of artificial recharge. If the proposed recharge methods are implemented, approximately 280 L lit. water can be percolated.

ACKNOWLEDGEMENT

We thank Central Ground Water Board, New Delhi for making the water table data available for use in this study. We would like to thank Prof. Aparna Mhetras for guiding through the research process. We would also like to thank Ar. Sakshi Suhalka for helping in the research & Ar. Kasturi Sankpal for helping with GIS maps.

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Carbon Sequestration by Treesfor Case –Hinjewadi Village, Pune District, Maharashtra State, India

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Abstract : Carbon sequestration involves the capture of CO2 from the atmosphere and storage in the plant tissues in the form of carbohydrate by the process of Photosynthesis. The biomass of the trees also increases and can be computed to know the amount of Carbon sequestered. The sequestrated carbon plays a major role in compensating in ever increasing the pollution. The simultaneous growth in transportation sector has given a rise to various kinds of pollutants, CO2 emission amongst the major one causing global warming.

In this paper, the research will be carried to estimate carbon sequestration by estimation through numeric formulafor calculating species biomass in Hinjewadi village Pune.Total biomass and carbon sequestrated in the tree species have been estimated using non-destructive method.

Keywords: Biomass, Carbon Sequestration, Natural Sink, Carbon emission, Urban streets, Ecosystem.

Introduction

The current environmental disasters like global warming is creating havoc in the behaviour of all the living organisms including man on the earth. Today's global warming is the outcome of lot of unnatural processes taking place since last many decades. Many manmade gases are responsible to disturb the natural form of air and atmosphere. Among all these gases, dominance of Carbon dioxide is mainly responsible for global warming. Maintaining the optimum level of CO2 in the atmosphere is the major challenge in today's modern world FSI (2009).

Trees are most important elements on the earth as they play a significant role in ecosystem dynamics. They absorb carbon dioxide, reduces their level, improve the property value and contribute to aesthetic beauty. The plants are important sinks for atmospheric carbon as they have about 50%carbon dioxide in their standing biomass (Ravindranathetal. 1997). The industrial revolution and increasing urbanization in the modern world are leading to increase the concentrationof different air pollutants especially greenhouse gases (GHGs) *i.e.* Methane (CH4), Nitrous oxide (N2O) and Carbon Dioxide (CO2) in the atmosphere. CO2 is a major contributor to global warming. Thus increasing CO2 emission is one of the major environmental concerns and it has been well addressed in 'Kyoto protocol'.

However, in the modern era due to industrial and technological advancement the vegetation has undergone destruction and degradation by human activities. This development has resulted in emissions of carbon in the atmosphere. Therefore, there is an urgent need to deal with environmental issues. In appreciation of the importance of trees an attempt has been made to study the sequestered carbon in trees of Hinjewadi village of Pune city.

Materials and Methods

Study Area:

The study area is located in Pune. The elevation of the study area is about 580 metres above mean sealevel and situated at 18.5917° N, 73.7456° E. The village islocated in the north-west outskirts of Pune is within the commuting distance from the heart of the Pune City. Hinjewadi village is close to Pune-Mumbai Express Highway.

In this study, the amount of carbon in standing woody biomass of trees in the village was calculated. The random sampling method was used for sampling the above ground vegetation. Plot method is used, which is one of the most commonly used for all kind of vegetation sampling. The method is versatile, cost-effective and applicable to baseline as well as project scenario. "Plot method" is also among the methodologies approved by the Clean Development Mechanism for afforestation and reforestation projects under the Kyoto Protocol. The fig1: shows the geographical image of study area which is Hinjewadi village.

Fig1: The Geographical Image of Study Area

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Methodology: (Sampling Method)

In all 60 plots of 20 m size were laid randomly, measuring the indicator parameters (e.g. tree DBH, or height), using different approaches such as algometric functions to calculate the biomass and extrapolating the value to per hectare and for the total project area.

Tree Height and Diameter at Breast Height (DBH):

DBH can be determined by measuring tree Girth (measurement at middle of tree) at Breast Height (GBH) approximately 1.3 meter from the ground.

Above ground biomass (AGB) of trees:

This including of branches, leaves, flower & fruits. Calculated by the formula:

AGB kg = volume of tree (m3) x wood density Kg/m3

$V = \pi r2H$

V= volume of the cylindrical shaped tree in m3

r = radius of the tree in meter.

H = Height of the tree in meter

Radius of the tree is calculated from GBH of tree.

The density of wood will be providing by the website www.worldagroforestycentre.org/sea/products/AFDbases/WD/.

Belowground biomass (BGB) of tree:

Includes all biomass of live roots excluding fine roots having < 2 mm diameter. The BGBhas been calculated by multiplying AGB by 0.26 factors as the root shoot rati

RESULTS AND DISCUSSION

The present study has calculated the standing biomass of the above ground woody parts of the trees in the Hinjewadi village. Table 1 depicts the species wise carbon sequestration of the study area.

In village 3700 trees of 28 species are present.the total organic carbon of each species in tones and the total organic carbon sequestrated in 3700 trees have been summarized.The organic carbon sequestrated in some common species like Ficus amplissima (221.0 tons). The othermajor carbon sequestrating species were Mangifera indica (95.2 tons), Dalbergia lanceolaria (73.082 tons), Ficus racemosa (57.96 tons), Pongamia pinnata (60.48 tons), Lagerstoemiamicrocarpa (43.0 tons), Syzygiumcumini(41.36 tons), Acacia spp (24.0 tons), Dendrocalamusstrictus (19.5 tons), Memecylon umbellatum (18.6 tons), and Bombax ceiba (11.7 tons). The remaining tree species were having organic carbon content below 10 tons/species. The Gnidia glauca has lowest carbon sequestration potential (0.0808 tons).

CONCLUSION

It can be strongly concluded that during afforestation, tree species like Ficus racemosa, F. bengalensis, Parkia biglandulosa, Swietenia mahagoni, Acacia nilotica, Cassia siameaand Samanea saman should be planted more.

All thesehave a high potential to sink atmospheric carbon which will help to reduce the greenhouse effect. These data are also helpful to estimate the organic carbon stock present in Pune city and forest covers by using a non-destructive method.

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Table no. 1: Field data of trees from study area

Sr No	Name of plant species	Number of individuals	Average GBH (cm)	Average Height (meter)	Average organic carbon (t/individual)			Organic carbon (t/species)
					Above Ground	Below Ground	Total	
1	*Acacia concinna*(Willd.) DC.	10	60.0	15.3	0.266	0.069	0.335	3.35
2	*Acacia* spp	100	62.2	8.95	0.191	0.049	0.24	24.0
3	*Allophylus cobbe*(L.) Raeusch	20	32.0	5.1	0.033	0.008	0.041	0.82
4	Albizia procera (Roxb) Bth.	20	101.0	5.1	0.248	0.064	0.312	6.24
5	*Bombax ceiba* L.	900	20.0	10.2	0.011	0.002	0.013	11.7
6	*Bridelia retusa* (L.) Spreng.	20	56.0	3.4	0.042	0.011	0.053	1.06
7	*Carissa congesta*Wight	20	20.0	6.8	0.012	0.003	0.015	0.3
8	*Catunaregam spinosa* Tirveng	80	32.5	5.46	0.027	0.007	0.034	2.72
9	*Cordia dichotoma*forst.	40	67.5	3.4	0.073	0.019	0.092	3.68
10	*Dalbergia lanceolaria*L.	20	175.0	17.0	2.900	0.754	3.654	73.08
11	*Dendrocalamusstrictus*(Roxb.) Nees	1200	17.8	8.5	0.012	0.003	0.015	18
12	*Diploclisiaglaucescens*Diels	20	36.0	3.4	0.021	0.005	0.026	0.52
13	*Ficus amplissima*Sm.	20	300	20.4	8.770	2.280	11.05	221.0
14	*Ficus racemosa*Sm.	60	140	8.2	0.767	0.199	0.966	57.96
15	*Gnidia glauca* (Fresen.) Gilg	20	20.0	1.7	0.0032	0.00084	0.00404	0.0808
16	*Lagerstroemia microcarpa*Wight	20	132	20.4	1.71	0.44	2.15	43.0
17	*Mangifera indica* L.	140	114.2	8.84	0.54	0.14	0.68	95.2
18	*Memecylon umbellatum* Burm.f.	110	69.0	5.38	0.123	0.032	0.155	17.05
19	*Meynalaxiflora*Robyus	20	120	5.1	0.350	0.091	0.441	8.82
20	*Nothapodytesnimmoniana*(Grah.)Mabb.	40	18.5	2.25	0.0036	0.00095	0.00455	0.182
21	*Olea dioica* Roxb.	20	50.0	1.7	0.020	0.005	0.025	0.5
22	*Osyrisquadripartita*Salzm.exDecne.	60	26.6	6.8	0.022	0.005	0.027	1.62
23	*Pongamia pinnata* (L.) Pierre	140	97.3	6.80	0.343	0.089	0.432	60.48
24	*Stereospermumchelenoides*(L.f.)	20	80.8	8.5	0.258	0.067	0.325	6.5
25	*Syzygiumcumini*(L.) Skeels	220	61.45	7.10	0.15	0.038	0.188	41.36
26	*Terminalia bellirica*(Gaerth.) Roxb.	180	131.34	17.58	1.445	0.376	1.821	327.78
27	*Terminalia chebula*Retz	60	47.33	5.66	0.096	0.025	0.121	7.26
28	*Zanthoxylum rhetsa*(Roxb.) DC	120	32.16	5.66	0.027	0.007	0.034	4.08
				TOTAL Carbon Sequestered:				1038.35 (t)

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Review about traditional courtyard as a micro climate in the improvement of human thermal comfort in hot and dry climate

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Abstract: Courtyards as a traditional strategy were used to create a suitable microclimate for dwellers, but in contemporary architecture, inadequate knowledge of form and features of courtyards makes them deficient to serve the purpose as an element to provide thermal comfort. This paper focuses on traditional courtyard considering them as a micro climate and discusses about the various physical parameters affecting the human thermal comfort such as courtyard geometry, orientation, wind effects and features of courtyards like its height, etc. for hot and dry climate. Each parameter is discussed in detail along with various factors affecting those parameters. The key findings of this research paper are identifying the optimized contemporarily-built environment with the climate based on traditional factors to reach sustainable contextual courtyards the for achieving and improving the human thermal comfort in hot and dry climate.

Key words – Traditional courtyard, microclimate, thermal comfort, physical parameter.

Introduction:

Several studies reported that, in past ten years, the earth surface temperature has increased drastically, and human are facing a heat phenomenon as global warming. This heat creates negative impact on city residents and causes a severe thermal discomfort [i]. Currently, the energy demand for construction industry is 34% of total energy in the world comparing it to global industrial and mobility energy needs, which is also emitting significant greenhouse gas emissions [ii]. Therefore, residential buildings have the major impact in global climate change. Courtyards in residential buildings have a major role in providing thermal comfort and space quality for inhabitants. In various climatic conditions, courtyard control temperature and energy consumption rates in buildings. Hence, courtyard is considered as a heart of the house in hot and dry climate. Courtyard must be compatible with environment and act as a temperature regulator and microclimate in spatial structure [iii]. But in contemporary architecture, inadequate knowledge of form and features of courtyards makes them deficient to serve the purpose as an element to provide thermal comfort.

This paper focuses on traditional courtyard considering them as a micro climate and has compiled the literature review of research papers which had discussed about the various physical parameters affecting the human thermal comfort such as courtyard geometry, orientation, wind effects and features of courtyards like its height, etc. for hot and dry climate. Each parameter is discussed in detail along with various factors affecting those parameters. The key findings of this research paper are identifying the optimized contemporarily-built environment with the climate based on traditional factors to reach sustainable contextual courtyards for achieving and improving the human thermal comfort in hot and dry climate.

Research Method:

In this paper quantitative type of research method is used to address the theme by using combination of simulation and experimental results derived from various case studies available in the literature. This paper is an attempt to review about the various physical factors affecting the human thermal comfort for traditional courtyard like direction and orientation of the courtyard, wind speed and courtyard height, solar radiation, vegetation and albedo. These factors are addressed one by one along with related articles along their significance from which the results and conclusions are drawn as discussed below.

Literature Review:

The history of courtyard uses, and its application goes back thousands of years and extends across different parts of the world. Courtyards are the microclimate transformer in the house due to their capability to moderately maintain high temperature, wind breeze and adjust the relative humidity. Various design elements of courtyard such as size, shape, details, proportions, and surrounding wall vary based on hot and dry climate. These variations arise from various external factors like social, economic, cultural and environmental factors [iv]. The courtyards not only serve the purpose of social economical gatherings, but also, they induce the source for airflow and maintain the thermal comfort to inhabitant. Also, the thermal lag and the properties of self-shading are used to reduce the heat gain. The courtyard surrounding walls and floor is a very good

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radiator of heat depending on the material used. Thus, the courtyard provides a cool air especially in hot and dry climates where the clear sky condition and maintains lower temperature in the court [v]. To understand the environmental conditions and performance of courtyard, in context to microclimate, various physical factors like orientation, direction, height of courtyard, wind speed, vegetation and albedo (reflection) which are affecting the level of human thermal comfort are reviewed and key findings are reported below.

Physical Factors:

Direction and Orientation of Courtyard

Zamani et al [vi] in his article investigated the effect of a building's orientation on the level to which thermal energy is received along with the effective internal heat, by performing simulations in three traditional houses. The results (as shown in figure 1) clearly indicates that the northern front -among the other parts- always has received the highest radiation and the lowest internal temperature.

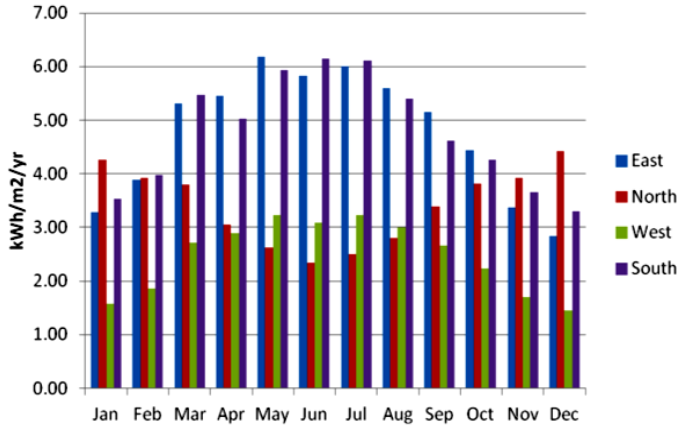

Figure 1: The average heat energy per square meter in four dimensions [6]

Totally in the three houses, the eastern and western fronts show the highest received solar gains per year (relatively 23.4 and 23.8 kilowatt per hour in square meter). While the northern front with 23.2 kilowatt per hour in each square meter always shows the most ideal climatic condition. This information provides ideal concepts and innovative procedures while selecting types of courtyard in planning architecture designs. Furthermore, it is clear that if the construction length is eastern to western side and also if less width is allocated to the eastern and western sides, the most efficiency would be gained from the courtyard. Soflaei et al [vii] concluded that appropriate courtyard orientation considered as North West –South East with 10-45-degree tilt (as shown in figure 2a) or East - South direction, but the longitude / latitude should be taken care of concurrently. For dimension and proportion, that length to width ratio of courtyard varies between 1.09 to 1.68 and for courtyard walls and windows, the opening on north and south has been focused more as compared to east and west, the maximum opening is given on north (as shown in figure 2b) and in some cases it is 94 % but normally it varies between 17 -33 % average. Muhaisen et al [viii] concluded that for hot dry region the optimized courtyard ratio should be between 4 - 8. Courtyard ratio is defined as the courtyard which allows maximum amount of radiation in winter and minimum in summer. It is also found that rectangular orientation of courtyard is best for hot and dry climate. In hot dry area the longer axis should face in between NE-SW to N-S as shown in figure 3.

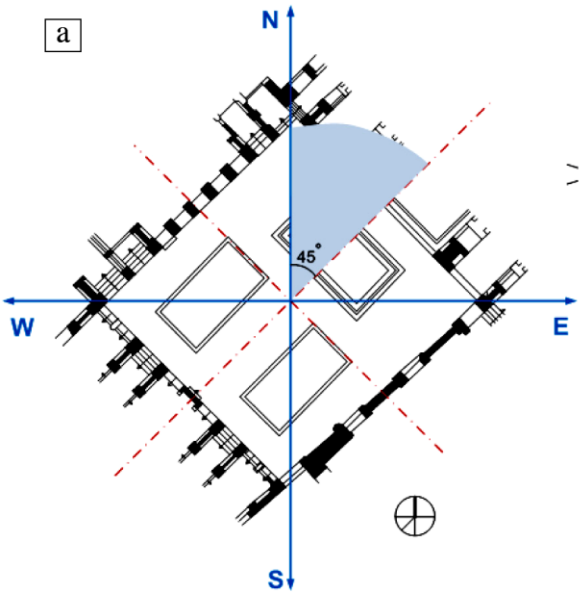

Figure 2a: Orientation and rotation angle of the courtyard [vii]

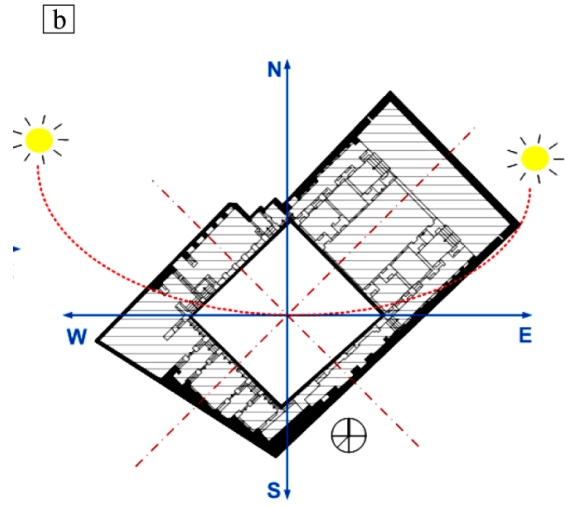

Figure 2b: Orientation and rotation angle of the house [vii]

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Soflee et al [ix] made an environmental analysis of courtyard in traditional Iranian houses. There are many criteria for evaluation such as symmetry between solid space (occupied space) and void space (courtyard space), the rotation angle and extension direction, the proportion related to physical bodies of courtyard such as earth and water, proportion associated with dimension of courtyard, symmetries of opener in artificial bodies (openers in four elevations) and symmetries of artificial bodies (quadruple elevation of courtyard). It is being concluded that in all courtyards the occupied space to unoccupied space (courtyards) is 60:40%, the proportion of northern surface is around 37 %, southern surface 33 % and rest is eastern or western surface, orientation mainly depends on wind direction, the proportion of water is around 10 % and earth is 20 %. The opening on north surface 22%, southern side 28% and eastern, western side is 39 %.

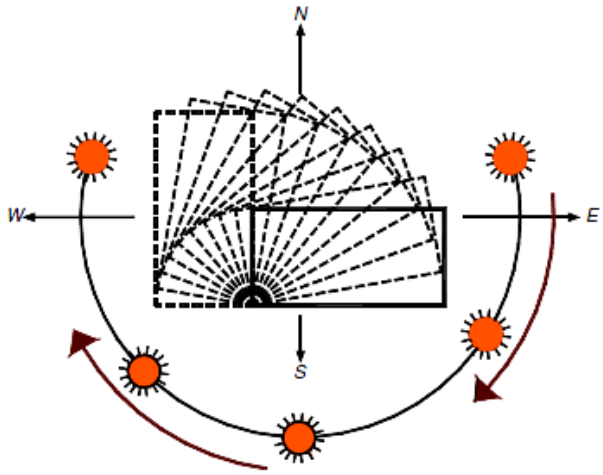

Figure 3: Changing the orientation of the courtyard form from 0^o to 90^o [8]

WIND SPEED AND HEIGHT OF COURTYARD

Almhafdy et al [x] identified that the orientation of courtyard is directly proportional with the ventilation and wind speed, such that the direction of wind and speed to the courtyard causes a decrease in temperature of 1.5 degree Celsius. Al-Masri et al [xi] reported that the building direction and determination of appropriate orientation of courtyard is the major parameter for maintaining an optimal thermal comfort in courtyard. The orientation and height of the perimeter wall surrounding the courtyard have substantial effects on the thermal conditions of the courtyard and the adjacent spaces. Jamei et al [xii] identified the optimal orientation of courtyard varies according to the various climatic conditions and the need for the need for the varying extents of radiation absorption and reception of heat from the sun, as well as the degree to which a building needs to be shaded or needs to receive optimal levels of wind. Yasa et al [xiii] described courtyard forms affecting the energy performance and thermal comfort status in different climatic regions hot –dry, hot –humid and cold climate. The research is being carried through CFD (Computation Fluid Dynamics). CFD is a simulation tool to calculate the convective heat transfer through building surfaces. The stimulation is done by varying the height of the courtyard H, 1.5H, 2H, 2.5 H options. It is concluded that gaining solar radiation in winter is more critical then escaping the heat in summer, required energy demand is parallel to its length, in case of square the energy demand is less, annual energy consumption increases as the courtyard building shape gets longer as a direction of prevailing wind.

SOLAR RADIATION

Hussein et al [xiv] proposed a methodology to maximize the solar radiation in winter and reduce the solar radiation in summer. The study conducted for three traditional houses for direct solar heat gain and shading (21st June and 21st December) in courtyard on walls, floors and openings. It is being concluded that the projection and enclosure ratio have major effect on increasing shaded area. The average height in all courtyards does not exceed 1.5 times the width of courtyard except one case. Each façade of the courtyard has its own design, opening ratio and arrangement as per solar radiation, the north façade has maximum opening. Tubes et al [xv] analyzed the shape of courtyard in determining the energy consumption. Circular form courtyard gets affected easily for shading only through minor change in dimension, the shallow courtyard is good for winters and deep courtyard are good for summer. The solar radiation absorbed on the surface of courtyard affects the required cooling and heating.

VEGETATION

The use of plants, trees and proper vegetative cover can improve a courtyard's functional conditions in residential buildings. The green areas and the vegetative cover bring a reduction in the energy consumption, besides improving the thermal comfort of the inhabitants by reducing the temperature and the creation of shaded areas [xvi]. The presence of greenery influences the temperature, transpiration, relative humidity and wind speed [xvii].

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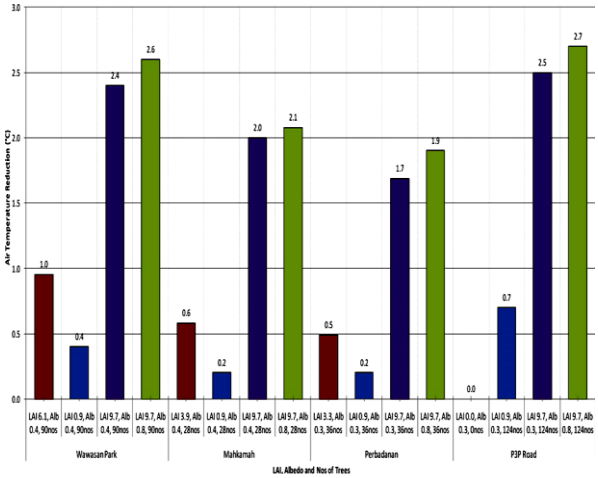

Figure 4: Air temperature reduction influence by variation of tree canopy density, quantity and types of tree [18]

Shahidan et al. [xviii] investigated the physical characteristics of trees and the effect that these characteristics have a significant involvement on the shade that trees provide. This research made use of simulations and field studies to evaluate the physical features of trees, including the type of tree and the volume of leaves contained (as shown in figure 4). A temperature difference of about 2.85^{o} C was stated compared with the existing conditions. The findings confirmed that the trees' physical characteristics play a major important role in absorbing solar radiation. These vegetative covers can act as a barrier to the diffusion of solar radiation; therefore, it may hamper the extreme absorption of solar radiation, leading to a decrease in the ambient temperature and the exterior spaces via respiration and evaporation. Taleghani et al.[xix] also discovered that 30% vegetative cover plays a predominant role in reducing the temperature in areas featuring higher temperatures and lower relative humidity levels. The shade created by trees is found to have a high influence on the amount of solar radiation absorption and reduction of the temperature, as well as a general cooling effect on the surrounding environment. The quality of the shade generated by trees depends on the height and type of the trees, and on the density of the leaves [xx]. Ghaffarianhoseini et al [xxi] evaluated the ability of unshaded courtyards for providing thermally comfortable outdoor spaces according to different design configurations and scenarios, including the orientations, height and albedo of wall enclosure, and use of vegetation. The study shows that according to design parameters such as the building height ratio, abundance in the amount vegetation the courtyard can achieve an acceptable level of thermal comfort for the tropics and may be enjoyed by its users for a long duration of daytime even during the noontime.

ALBEDO

In general albedo is referred as the portion of thermal radiation reflected by a surface. Considering the optimal use of masonry and reflection rates, the usage of high thermal characteristics of masonry [xxii] is an effective method for maintain thermal comfort. The ratio of reflection of light is different for every material and it can be used in determining the absorption rate or solar radiation on various surfaces. In real life situation, the masonry with bright surfaces absorbs lower radiation rate and it less likely to preserve day temperature. Materials with high reflection rates can cause reduction in various surface (as shown in figure 5) and environmental temperatures through convection [xxiii]. Taleghani et al [xxiv] studied the measurement of reflection rate and evaluated effect of reflection rate effect on degree with respect to change in temperature variations. It is concluded that bright materials with 0.9 reflection rate increases the global temperature of 1.05^{o} C and also increases mean radiation temperature of about 3.06^{o} C on comparing with dark materials, which caused increases in global temperature and mean radiation temperature by 0.52^{o} C and 1.45^{o} C, respectively. Benrazavi et al [xxv] investigated the effect of various masonry types commonly used for floors with surface temperature in hot and dry climate region. Information on materials that causing higher reductions in the ambient temperature are reported. Cotana et al [xxvi] proposed a novel methodology to alleviate Global Warming by artificially enhancing earth's Albedo. Such methodology allows quantifying the maximum environmental benefit achievable through the installation of Albedo control technologies, as a function of local meteorological conditions, the geographical features of the installation site, radiative properties, orientation of the surfaces and tilt angle. This benefit is directly quantified in terms of CO_2 eq offset.

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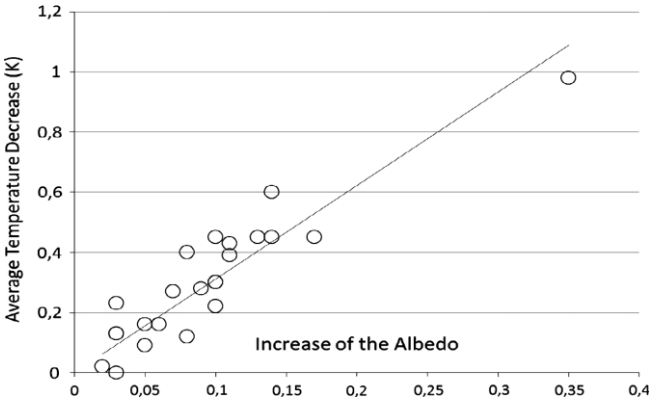

Figure 5: Correlation between the albedo change and the corresponding decrease of the average ambient temperature [23]

RESULTS AND DISCUSSIONS:

By continuously controlling the shadow on the courtyard surfaces, suitable dimensions and the direction of the building, it is possible to reduce the transfer of heat from the sun to the buildings. Based on the various literatures it is found that having a rectangular geometry is always better for hot and dry climate. Also by increasing the ratio of length to width of the courtyard and increasing the height of the walls of the courtyard increases the percentage of shading. For orientation, it has been proved from many simulation results that, a northern courtyard orientation is best to avoid direct solar radiation even in early morning hours with significant wall height. It is also reported that by increasing the height of the walls, the noontime temperature decreases, and the night time air temperature is higher than in the courtyards with lower walls.

CONCLUSION:

The human thermal comfort mainly depends on design features of courtyard, materials used to build and technologies available, as well as on the climatic conditions on various regions. Therefore, based on the available literature, it is concluded that, for hot and dry climate a courtyard with rectangular geometry, northern orientation, 30% tree coverage, high wall enclosure and more reflecting surface materials are recommended for maintaining human thermal comfort.

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Use of Perforated Screen as Double Skin Façade for Office Building in Jaipur

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Abstract: Jaali as perforated screen for light and ventilation in buildings have been extensively used in India. Similarly, Double skin facade is an envelope construction comprising of two transparent skins separated by an air corridor. In today's time contemporary building designs use Jaali as double screen façade as a passive method for natural ventilation. This article aims to study the factors that affect Jaali screen façade and understand the effect of Jaali as a passive strategy for building envelope for a composite climate. The research shows that Jaali screens with 30% to 50% perforation on South Facades in a composite climate provide an improved daylight quality in office buildings.

Keywords – Double Skin façade, Perforated Screen, Jaali, Passive strategy, Daylight, Natural Ventilation.

INTRODUCTION

This research study explores the performance of Jaali screen façade as double skin façade in terms of daylighting, natural ventilation and cooling (by shading). The motivation for using double skin façade concept in buildings is a solar passive design concept.

Energy represents a major component in any country's economy and hence it affects the world's economy. Saving energy consumption, especially in buildings, directly affects national economy. The shortage in the traditional energy sources motivates the design of energy saving buildings. Many design treatments are developed to achieve energy saving through buildings.

Building envelope plays an important role in the energy consumption of the building as major parts of the building are exposed to the sun radiation. If treated properly this can considerably help in controlling the thermal comfort inside the building. An energy-efficient building envelope refers to an effective boundary between the conditioned interior space of the building and environment beyond it. Passive or climate responsive architecture uses the natural processes of a site to reduce or replace the need for mechanical systems in buildings.

City Character: Jaipur represents rich and vibrant lifestyle and tradition of Rajasthan. Jaipur being financial center and capital of Rajasthan, is dominated with office buildings. It is famous for its archetypal architecture and beautiful Jaali screens. As per ECBC climate zones Jaipur comes under Composite climate. It means it experiences extreme climate in both summers and winters. The city's climatic evaluation as per the bioclimatic zone necessitates requirement of passive strategies for reducing heat gain and this research paper is a step in this direction.

The Double skin façade is a passive design option for buildings used to improve the energy efficiency and indoor thermal comfort. It consists of a internal façade, an air cavity and an additional external skin. It presents the range of natural ventilation and daylight performance. It is a European architectural trend that is currently gaining momentum throughout the world. The form and construction of façade system have a strong influence on both the energy consumption of a building and the comfort level of its occupants. According to the source book of Belgian Buildings Research Institute (BBRI) "An active façade is a façade covering one or several stories constructed with multiple skin. In this kind of façade, the air cavity situated between the skins is naturally or mechanically ventilated. The air cavity ventilation strategy may vary with time."

'Jaali' means a fine and ornamented web, generally found in Indian, Indo- Islamic and Islamic Architecture. Jaali as a perforated screen is used for permitting light and ventilation in buildings. These screens provide protection from direct solar radiation and regulate social interaction between spaces. Presently, these screens are used in commercial buildings to reduce glare and control solar heat gain through fenestration. When properly designed, these systems can not only improve visual and thermal comfort but also greatly reduce electric lighting, cooling and heating energy consumption (Lee, DiBartolomeo, Selkowitz 1998). Previous studies on the Jaali as Screen façade show that the amount of energy reductions attained varies depending on shading geometry and climatic variations.

METHODOLOGY

This study adopts three tools to reach the outcome. The first method is a case study of existing building, second method is analyzing the Jaali types and perforation found in the traditional architecture of the city and third method employs simulation for daylight of

critical façade for a proposed design office space using Ecotec software to understand the daylight achieved with double skin façade and solar shading on the inner skin of double skin façade.

Method 1- Case Study

Pearl Academy of fashion is a low-rise educational building located in hot and dry climate; 20 km distant from Jaipur city. It is designed by Morphogenesis architects in the year 2008. The building façade represents contemporary use of Jaali façade design which can be used for any building type. The building is protected from direct solar radiation by double skin façade which is inspired from traditional building element Jaali that is found in traditional Rajasthani architecture. The Double skin acts as a thermal buffer between the building and the surrounding as shown in fig 1. The design of the external façade is such that it gives the visual comfort from inside and also breaks the glare coming inside the space. The Jaali screen acts as filter for air, light and privacy.

Fig 1: Pearl Academy of Fashion with double skin façade
Source: Arch daily images

Method 2- Jaali screen

In Rajput architecture for hot climates, floral motifs are incorporated at the center of the module. The fenestration is longer and narrow which allows deeper penetration of light and air. There are different traditional geometrical perforation and depth of Jaali screen found in Jaipur city. Hawa mahal or "the palace of winds" is an icon of Jaipur and has its façade packed with honeycombed patterns facing the main street. It is seen that most shapes are derived from hexagonal pattern in Jaali screen. In order to simplify the process, basic shape of a hexagon was selected for the purpose of comparing the impacts of the different perforation pattern and daylight distribution. As per previous studies on Jaali, perforation of 30%, 50% and 70% are common designs that are observed in screens.

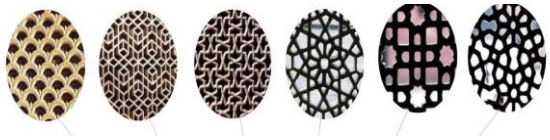

Fig 2: Different types of Jaali pattern found in Jaipur city
Source: idianjalidesign.com

Method 3- Experimental Design

The simulation model used for this study is a U-shaped building with 3 floors on the north side block and 5 floors on the south side block. The building is oriented in North east and South West direction to avoid large exposure on the south façade. The double skin façade is designed only for the critical façade which is found according to the solar radiation chart of the city. The building is oriented such that it reduces solar gain in summers and allows more solar gain in winters.

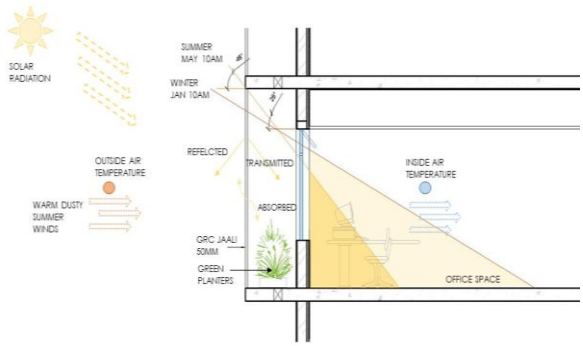

Fig 3: Section showing the outer skin and inner skin reducing the direct sunlight inside the work space and air movement inside the office space.
Source: Author

The inner skin is a composition of AAC block and gypsum board wall with U value 0.285 W/Sqm.K as per ECBC requirement and the outer skin is a GRC Jaali with desired perforation percentage. The perforation was taken as per the pervious study but the design was developed by the author as using computational shadow analysis on Sketchup software based on the orientation of the facades. The outer skin sits 1.2 m away from the inner skin of the building to reduce direct heat gain through fenestration yet allowing for diffused sunlight. The distance between the inner skin and outer skin is kept as per the solar altitude angle taken for the summer month.

The fig 3 shows a schematic section of a Double skin façade and adjacent office space cross section taken from the same building design showing heat transfer and air flow mechanisms in a model. In summers the hot air enters the cavity through the outer skin and gets humidify due to the potted plants in the cavity which helps in cooling the air and thereby improving the internal thermal comfort of the building.

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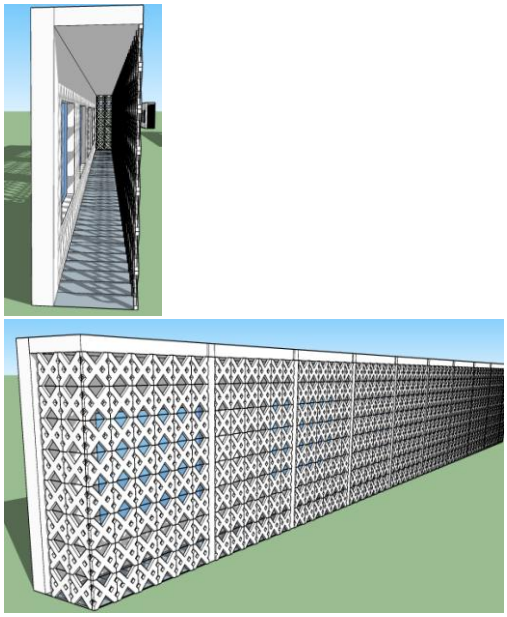

Fig 4: Sketchup Analysis of Shadow cast on the inner surface and Jaali designed for the south façade for the building.
Source: Author

The experimental design is a co working office building with various office spaces range from small offices with 3 occupants to large offices with 100 occupants. The building design is to maximize the effect of natural ventilation and reduce the direct solar heat gain inside office space. The DSF is modelled covering the entire face of the building.

Fig 5: Layout of proposed design co-working office space with workstation furniture.
Source: Author

A co-working office space from the layout was selected for daylight analysis with double skin façade. The orientation of office is such a manner that the two external façades are south east and south west. These façades receive the maximum daylight throughout the day making it critical for heat gain, thus protected by double skin façade. Fig 5 shows the layout of co-working office space with solar azimuth angles indicated for May and January month with 275˚ and 239˚ respectively which shows amount of daylight penetrating into the workstation. Daylight analysis was carried out using Autodesk Ecotec software to find the satisfied daylight achieved for the office space with DSF. For an office space the required lux levels are between 500 lux to 750 lux. This level should be suitable for prolonged work on computer, reading and machinery. The no of perforation percentage of Jaali was taken between 27% to 35% to achieve the optimum daylight. The external façade Jaali is considered to of GRC with 50mm thickness.

Attribute	Input
Co-ordinates	26.92 N, 75.82 E
Time zone	+5:30 Delhi
Weather data	Jaipur.wea
Sky Illuminance	8500 Lux
Working Plane	750mm -900mm

Table 1: Data inputs for Autodesk Ecotec Daylight Analysis

ANALYSIS AND FINDINGS

On basis of above three tools the following results were obtained: -

1. Daylight: Optimum daylight

In the experimental design method, the open work stations for the office layout are placed along the fenestration, which helps in allowing the sufficient daylight to enter the building space.

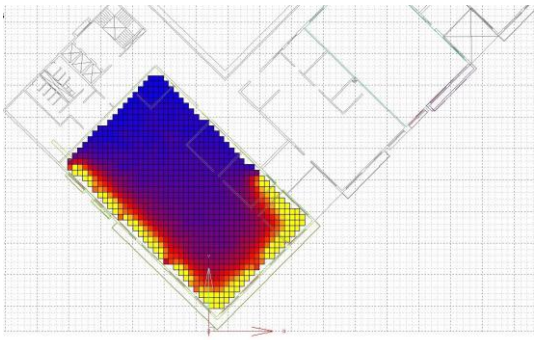

Fig 6: Daylight Analysis of Co working office space with double skin façade for on the southwest side of the building.
Source: Author

The Lux level achieved for open work space area is between 800-450 for office space, which is a suitable range for working and as per ECBC compliance. The area with less lux levels are designed as conference and service area which does not require direct sunlight and high lux levels for function. The achieved Jaali perforation as per the shadow analysis controls the light

entering the work space and cuts off unwanted glare with controlled illumination required for the office space. This helps in reducing the power consumption required to light up inside work space and making it visually comforting to the employees.

2. Reduced Solar Heat Gain: The inner skin is protected from the direct solar radiation by the outer skin and the cavity between two skins. As Jaali controls the light entering in and reflecting some light back from the outer surface this also reduce the heat coming inside. The shadow of the outer skin falls on the inner skin which results in less heat gain from the building envelope, thus reducing the cooling load inside the office space and helping in economizing the cost of HVAC and providing thermal comfort

3. **Improved Ventilation:** The wind in the subject city is mostly dusty entering and presence of outer skin and potted plants trap the dust particles present in the air finally supplying filtered air inside the building and hence improving the quality of natural ventilation inside a building. The small holes increase the velocity of air passing inside through them, similar to the function of funnel effect, accelerating even the mild breeze outside and allows deeper penetration. The air cools down while moving through the small apertures, thus comfort of the occupants is increased.

CONCLUSION

The following study shows that perforated skin as double skin façade and vernacular shading strategies might be well suited to this context and can be successfully adopted to contemporary buildings in composite climate such as Jaipur. External shading provides cost effective passive design strategy to reduce energy demand in composite climate while improving occupants' thermal and visual comfort.

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I would like to express my deep sense of gratitude to my guide Prof. Aparna Mhetras 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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Social Relevance of Architecture : Analysis of Temple as a Representative Built Form

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Abstract : Relevance implies logical connection between what is seen and its interpretations. Social relevanceis a way in which a built form is relevant to the society; as an expression of Human Civilization. Shapes and styles of the built form are influenced by the social norms and as and when these norms changed the characteristics of shapes and forms of the buildings have also changed. As, certain aspects of the social norms are influential in the built form; they are incorporated into the architecture.Religion being the major factor influencing social norms; the changes are predominantly seen in religious built form. The aim of this paper is to find out the social relevance of Architecture, taking temple as a representative of the religious built form.

Key words: Temple, Social norms, built forms, functions, relevance, Architecture, Religion

Introduction

Architecture is the representation in the built form of the needs and desires of the society, with a set of spatial criteria for deciphering its values and systems. It is also a form of non-verbal communication conditioned and regularized by social context to evolve symbolic meaning. For the purpose to find out the social relevance Temple has been chosen as a representative built form to understand the relationship of the social psyche with the functions being performed in the routine manner in the temple and how this routine has helped to evolve the built form. How does the sitting of the oriented

towards the cardinal directions, facing east and the devotee ties to find through them an approach to the Supreme; enclosed in a small internal chamber, the sacred space, Garbhagriha.

The temple architecture represents the outer and inner cosmos. The outer cosmos is expressed in terms of connection between the temple structure and the motion of the sun, the moon and the planets while the inner is represented in terms of the consciousness at the garbhagriha and various levels of the superstructure that correspond to the state of consciousness. In the built form the unfolding takes place, both in the details and at the level of whole composition, and is brought about by temple designs; built form, its surrounding environment, the exterior, the plan within and without, specific building elements etc. of the temple; demonstrate the relevance of social factors?

Temple Architecture, throughout has reinforced religious life in anticipation of an eternity and appealed human emotions through ritual performances, which occur through well defined spaces; these spatial dimensions has acquired meaning through its association with symbols. The repetitive performance of aspects of rituals imbues elements of the built environment with social significance.The shrine becomes key ritual symbol, standing for and evoking sentiments among the devotees; who are already in the minimal space of the ambulatory. The circulation within this space at times creates an intense sensation of unity with the deity such that the devotee looses the sense of his individual bounded self and merges with the social and physical environment of the religious built form.

This transformation within the mindset of the devotee takes place through the rituals. They bring the devotee close to the divinity in an arranged structured pattern of movements along the east-west axis and through a series of increasingly sacred spaces in the architectural composition of temple.The temples are planned with a sense of centrifugal dynamism originating at the apex point of the towering mass called shikhara; progressing down wards towards the base of this vertical axis and a horizontal ground- plane axial system

compositional elements are made to emerge and expand out from shikhara and also from one another. A series of configurations of elements are sensed as a chain of separate entities, seen several times, at different stages, ultimately creating a pre-determined sequential movement of the devotee, to meet the deity, to attain the peace of mind.

Methodology

This paper is based on literary works on ancient treatise and research works on the temple architecture of India: an effort is made herein to bring out the basic socio-religious concept of the religionand how it influenced the design of temple

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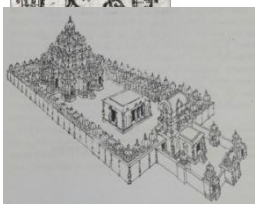
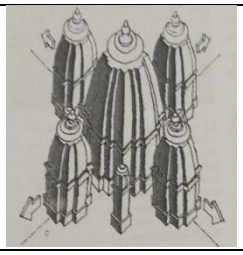
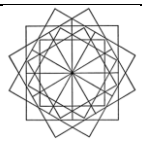
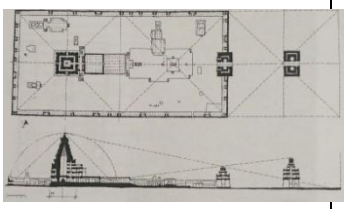
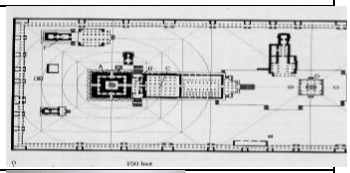
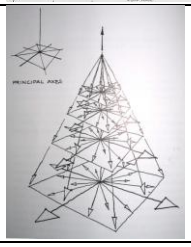
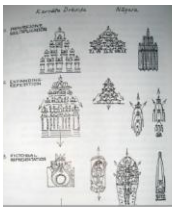
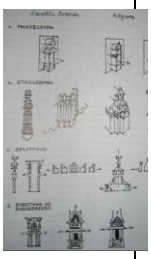
architecture. The object of this paper is to present a frame work for further research on the subject.

The social relevance of the Temple Architecture is explained in the following table.

Concept/quote	Relationship/siting of Built Form
God is omnipresent can be seen in all things	Nature
Elements of temples differ across regions, all based on a single philosophy of design	The concept of Cosmology, the divine Vastupurushmandala
The ideology is to link man with the God. Place where God's presence can be felt through rituals and ceremonies.	The entire built form of the Temple 
Elements are designed to correct proportions with harmony and symmetry	
High degree of outer adornments with matching and mixing of small details with massive structure	To exert positive influence on the surroundings
Decoration: the interior is plainer compared to exterior.	So as not to divert attention from the Icon in the central shrine
The basic form is a square cell, oriented to the four cardinal directions and a doorway on the east.	

Concept/quote	Relationship/siting of Built Form
	
The Central shrine is the heart of the devotee	
Tower represents the flight of the spirit to the heavens	
Movement Projection Staggering Splitting Bursting of boundaries Progressive Multiplication Expanding repetition Pictorial representation	 

(Badami Temple-Wikipedia, others-from Temple Architecture of India by Adam Hardy)

The age old concept in the Hindu religion demonstrates that, God is omnipresent and can be seen in all things, especially in nature; thereby suggests a strong relationship of the natural surroundings, both symbolically and spiritually with the society; and is seen being reflected into the design of the built form. These religious forms developed a typical temple culture within the surroundings called as a Religious culture which carried out a dominant role on the human life, since civilization till today;becoming the life-centre of the society. This temple culture has a multiplying effect on the state and the society; by bifurcating itself in to i) Religious culture and ii) Non-religious culture. The religious culture was related to the daily chores within the four walls of the temple itself while the Non-religious culture contained the service providers for the main Religious culture; thus providing employment opportunities to thousands of the people; starting from priests to deep down to coolies. They were also developed as social and educational centres and

economic institutions; further adding to the cause of social development.

James Fernandez, who used Anthropological theories of Metaphor as applied to the built environment, while explaining social relevance of Architecture states that "Cultural identities are negotiated through the interplay of contrasting and/or similar metaphors in language and built environment. Metaphors allow one to move from the abstract and inchoate to concrete, ostensive and easily graspable. Human predicates pace upon them and obtain qualities that they, in turn, project upon space. These predications and projections transform spaces into place. Metaphor becomes transformed into metonym." The built form thus communicates social culture. Amos Rapoport in his most widely known work 'House Form and Culture' asks 'what do built forms mean and what social processes give rise to built forms?'This paper is a small effort to find out the answer.

Conclusion

Historically, in each of the periods, the related society has created architectureand has evolved its own forms that are distinctive and local in shapes and details and gaining symbolic meaning beyond functionalityand become part of their 'social culture' bringing in the relevance of Architecture and the society.

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It gives me immense pleasure to express my deep sense of gratitude to my guide Ar. Renuka Chutke Chakradeo for her valuable guidance and constant encouragement, inspiration and motivation for timely completion of this paper.

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RESEARCHING CARBON SINK FOR PUNE CITY- TIME TO VALUE THE OLD

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Abstract: As Pune is trying to become carbon neutral city by 2030, it is trying to reduce its carbon emission by adopting all its measures like use of sustainable resources, preservation of natural resources, alternatives to fossil fuels, tree planation etc., this type of rapid development of the city is harming the ecological cycle of the urban system in the city. This study mainly focuses on the carbon sink of the city and how well they can act as a carbon sequester ,if carbon sinks are well studied and planned , it can be managed to make carbon as a resource for the better ecological system of the city. The research will mainly talk on the solutions for the better carbon sink, which is well thought for acceptance and to value the principles of sustainability i.e. Social, economical and environmental dimensions of the city.

Keywords : Carbon Sink, Carbon Sequestration, Native Trees, Ecological cycle, Sustainability, Biodiversity, Indian Culture

INTRODUCTION:

The concept of carbon sink is to capture carbon by growing trees. The Pune city, in hurry to accomplish its carbon neutrality by 2030, started growing native trees which a good step is taken with active support of the citizens. But there is a broad thinking for carbon sink in other countries, which talks about the grasslands and its importance in carbon sink and how ecology plays important role in sequestration with respect to grassland.

India has a long history and connection with its grassland and its ecological system. Due to the invaders and influence of the western culture, the country has lost its heritage of worshiping nature and forgot its rural - urban relationship. In this paper the research is aiming to recall and establish a lost heritage of country , which has emerged as a solution for the carbon sequestration , which will also try to open up connections , linkages with government and support given to public for better establishing relation with biodiversity.

The research will talk about how better the carbon sequestration can be done in different ways by proper management and unique ideas for the storage of carbon, to help not to participate in climate change. Pune Municipal Corporation has an area of 243.84 sq.km. 20 - 22 % of its land area has forest cover, which shows the ideal percent coverageof green area for a city. The World Health Organization recommended the availability of a minimum of 9 m^2 of green space per individual with an ideal UGS value of 50 m^2 per capita. These statistical values correlate with a number of UGS standards, including: linkages between sustainable cities and better health [1]. The Pune city has its population of 3132143 in number according to PMC census data 2011 [2].The present study indicated that Pune city emits 7.8 lakh tons of carbon per year.

The civic body of Pune Municipal Corporation has counted around 4009623 trees in 2019 news reported in Hindustan time's newspaper. The plantation is still in process to increase carbon sink under the notice of PMC. The municipal corporation has also set rules for Townships, NGO's etc. for tree plantation to promote indigenous species of trees to support the native biodiversity in ignorance of exotic species. As Pune is covered by hills and ranges it has good forest cover and green patches of grassland which is home to several animals and support too many herbivores for grazing their food. Grassland to be protected for balancing ecological cycle of animal to human relation, which is degrading day by day impacting humans health mentally and physically as human in its busy urban life has no time even to look at nature around it peacefully. World's healthy milk (27%) and animal breed (23%) comes from grassland [3]. Grassland provides livelihood to many poor people and nomadic

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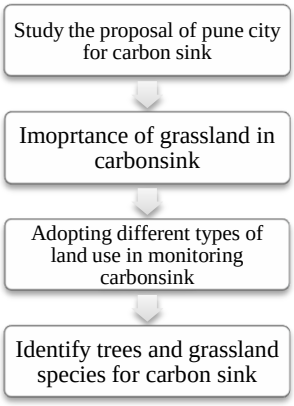
caste (Dhangars) of the state. Dhangars are the pastoral community of Maharashtra state. Farmers invite them to their agricultural land to manure it by their flocks and feed them stubble. The community contributes to the economy of the state or country with their occupation and help to complete the carbon sequestration cycle. Thus we should protect our grassland and the precious community, which are a big part of the carbon sink.

For carbon sequestration of Pune city, it all talked about growing trees, filling empty lands with native tree plantation etc.6, but lack of the focus is noticed towards land use pattern, in terms of preserving grasslands, connecting cattle's and livelihood animals and community back to nature, this research will fulfill the gap and provide a brief idea for sustainable importance of forgotten human culture.

MATERIAL AND METHODOLOGY:

Carbon emission is the strongest contributor for causing global warming in the world, increase in carbon emission is one of the major concerns, for which the citizens and the government should step forward to solve the issue. Pune city has accepted this challenge to become carbon neutral. This study states about how the city is planning to achieve its carbon neutrality by its carbon sink and what on additional it can take steps to manage its carbon sink for better sequestration.



Pune City's Strategy for Developing Carbon Sink

The city has hills like Katraj Hill, Panchgaon Parvati, Ramtekdi, Gultekdi, Range Hills, Dive Ghat, Fergusson Hill, Chatushringi Hill and Vetal Hill. The city has alkes like pashan, katraj, khadakwasla, etc. which has got a grater ecological value. The plantation strategy should also focus and pay attention on urban areas to improve their biodiversity. PMC has developed 111 gardens from which 35 are under development. Below are the names of hills and other areas available for plantation program

1. Taljai hill - (PMC acquired this area for development of forest park under hill top hill slope category) the land area taken is 110 acres and the proposal is to restore the greenery and protect the land from illegal encroachment.
2. Parvati hill - (acquired under transfer of development rights for development of parks) 50 acre of land area is marked to restore the greenery and protect the land from illegal encroachment.
3. Bhamburda hill, panchgaonparvati hill and warje hill area are been issued with amount of credit for tree plantation, erecting compound wall, soil & water conservation etc.
4. Tree plantation and protection under joint forest management project.
    - Work executed by forest department of the city – 987.5 acres
    - Work executed by Pune municipal corporation - 812.5 acres
5. Land acquired from irrigation department for plantation is (along canals) – 30 acres.
6. Land acquired from revenue department for Biodiversity Park is 546.5 acres.
7. Plantation along the rivers, lakes and nallahas under JNNURM program.
8. Plantation by local organizations and NGO's with municipality support
9. Road side plantations, provision of medicinal, fruits, ornamental plants for citizens.

Grassland and Its Importance in Carbon Sinks

Grassland holds 26% of the world land area with 20% of the world's carbon stock in soil [3].grassland stocks around 34%, forest land holds around 39% and agro ecosystem around 17% of world's carbon [3]. Grassland provides resources like food and forage to people and animal, grasslands have been converted into agricultural land since ages. In the recent years we are seeing the increase in carbon emissions as there is

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increase in burning of fossil fuels, pollution from industries, making of homes more comfortable etc. is leading towards greenhouse effect and increasing global temperature. The released carbon in atmosphere is intake by plants through photosynthesis and thus carbon is stored in leaves as well as roots of plant species, as those grass or plants are eaten by herbivorous animals the carbon transfers into animals as food. The plant, grass etc. if dies starts decomposing in soil therefore carbon becomes organic compound of soil. This is how the ecological cycle of grassland for carbon sinks works.Preserving grassland is must, it plays important role in giving livelihood to people, and homes to many animal species. The Dhangar community of Maharashtra state carry forward the old tradition of their nomadic life by roaming with their shepherds, cows, buffalos, goats, camels etc. they roam around with their cattle's in search of fodder. Grasslands are livelihood to these types of people; they are totally dependent on grasslands. Blanket weaving is their main occupation of Dhangara's. Cattle's help in rotation of carbon cycle of the grassland. After every rainy season of the year they come to the place where grasslands are available for grazing their cattle's.

"Grasslands – home to cattle's,
As forests to wild animals"

Grazing management - grassland if managed properly, can improve nutrient cycle of grassland ecosystem and can save forage species also from animal traffic or physical breakdown.

S.No.	Botanical Name	Common Name
1	*Eucalyptus*	-
2	*AlbizaProcera*	White siris
3	*Ailanthus Excelsa*	Mahanimb
4	*Azadiratha Indica*	Neem
5	*Dalbergia Sisso*	Shisham

Fire management – when grassland dies and becomes woody, the land parcel should be clean and prepared for upcoming mansoon for new growth of grass species. Fire management is done to clean and remove unwanted encroachment of woody species also. The left out charcoal after burning is a form of carbon, which later on mixes with soil and become an organic compound of soil.

Different Types of Land Use for Managing Carbon Sink As the land is precious resource for human kind and has high value in urban areas, so that they have to be managed in such a way that it gives out some environment and economical benefit. Empty land parcels of Pune city which falls under green belt can adopt Agroforestry practices like -

- Agri-silvicultural methods - produces agricultural crops & forest products.
- Silvo-pastoral methods - produces both wood products & livestock.
- Agri-Silvo-pastoral methods - mixture of the two systems above, which produces tree products, crops & livestock.
- Mixed garden methods - which integrate trees, crops, and animals on small land parcel for supplying nutrients, materials & marketable products for a family.

The agroforestry practice has potential to sequester more carbon than agricultural farming or grazing grasslands. This agro forestry is economically also vital to practice.Agroforestry produces more organic carbon compound in soil than grasslands. It does not suggest that grassland or agroforestry should replace forests. Forests sequestration of carbon is highest than any other land use. It indicates towards conserving grassland and promotes agro forestry.

Trees for Carbon Sink
Forestry for carbon sink is the best sequester to get level down of carbon emission. Native tree plantation with good carbon sequester property can help to create good carbon sink for the city.

These lists of trees sequester more carbon within short period of time and have agroforestry property also.

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Native tree can help to preserve biodiversity and ecological balance of the place, which further have connection with water cycle, climate issues, soil nutrients etc. and benefits for conservation of natural cycles. There are some native trees listed down with their carbon storage property and can be used in agroforestry practice as well.

The grasslands in the hilly areas of Maharashtra consists mainly of *Cymbopogon martimi, Themeda quadrivalvis, T. triandra, Pseudanthistriaheteroclita, Heteropogoncontortus, Ishaemum indicum, Sehima nervosum* and *Apludamutica.* There are many species of grasses of grassland according to place where it can grow which is further mentioned in GRASSLAND [4]. *Dalbergia Sisso* + *Sporobolus Marginatus* is best example for hortipastoralagro forestry, there common names are shisham + khevaiga grass the combination of these two sequester more carbon.

Agro forestry management and value to animals

RESULTS AND FINDINGS

The World Health Organization recommended the availability of a minimum of 9 m^2 of green space per individual with an ideal UGS value of 50 m^2 per capita, if we calculate green space per individual for Pune city.

The Pune cities area is = 2443840000 sq.m.

Total green cover of the city is = 22%

Therefore,

22% of 2443840000 sq.m. city area = 53644800 sq.m.

Total population of Pune city recorded is = 3132143 individuals

Hence the cities green area per individual is = green space of city / total population of the city

= 53644800 / 3132143

= **17.12 sq.m. Green space per person** is the ratio of

SrNo.	Botanical name	Common Name	Carbon Storage Property	Use
1	*Gmelina Arborea*	Gamhar	24.12 to 31.12 Mg/Ha	Construction, Furniture, Musical instruments etc.
2	*Azadirachta Indica*	Neem	8 to 78 Mg/Ha	Medicinal plant, Organic pesticides, Timber
3	*Dalbergia Sisso*	Shisham	254.72 Kg/tree , 12.84 Ton/Ha	Fodder, Timber, Erosion control, Oil
4	*Acacia Nilotica*	Babul	228.42 Kg/tree	Fodder, Medicinal plant
5	*Albizia Lebbeck*	Siris	219.84 KG/tree	Cash crop, Forage, Erosion Control, Hard wood

Pune city, which is in between of 9 sq. and 50 sq.

The city has to work more potentially to increase its green area per person ratio and become role model for other cities also in nation. City working on hills, gardens, parks, river banks etc. should go with idea of agroforestry, grasslands preservation & management, etc. discussed above to use its land resource more economically and ecologically useful for its species and to sequester carbon more efficiently. Communities reliable on grassland and forests should be made aware of opportunities and schemes made by government for them. The ICAR Indian council of agriculture research should work on this forest land, grassland, cattle preservations for quality breed, etc. for healthy biodiversity.

This hills, biodiversity parks, green river banks etc. can accommodate native cattle's like left over cows, buffalo's, bulls, ox, dogs, horses, donkeys, pigs, goats, monkeys etc., in today's world they are very rare to see in urban sprawl. Ignorance to these creature is also a major factor of climate change and sequester of carbon is in mild swiftness.

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As we have seen carbon stock in grassland 34% and forest stocks 39%, we can understand the value of grasslands and its biodiversity. Therefore grassland can play very important role in lowering the carbon stock from atmosphere and bring it to soil.

Grazing horses after mansoon, lohegoan, Pune

Nomad community, university road, Pune

Nomad community with shepherds, hinjawadi, Pune

Sheeps grazing on hill,lohegoan, Pune

Seasonal watershed canal became grassland for sheep's, environmental friendly urban space hinjawadi, Pune

Silvi pastoral Pathmeda, Rajesthan

Agro forestry

CONCLUSION

It has been understood now that grassland contributes in storage of carbon with increasing soil organic compound SOC. Increase of soil organic compound through land use changes is a low cost economical, sustainable and environmentally beneficial idea for sequestering carbon from atmosphere. Time has come to recall old practices to save our environment from the mess created by us human. These land use practices can be role model for other cities, farmers, and citizens etc. to understand the value of natural elements including animals. Pune city should adopt these ideas to handle its carbon emission and to manage cities urban ecology.

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vii. Ms. Archana Warran& Dr. Ankur patwardhan

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Performance Analysis of an Existing Resort by Use Of Online Assessment Tool And Recommending Strategies For Retrofits And Energy Efficiency

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Abstract: Worldwide, and specifically in India, the overall energy consumption is witnessing an exponential growth. According to recent surveys, buildings contribute to around 30-40% of overall energy consumption. Electrical consumption currently in commercial buildings in India is about 8% of the total supply[1]. Designing and operating buildings in an energy efficient manner is hence the need of the hour, and also leads to several benefits such as energy cost savings and contributing to sustainability. This study evaluates the performance of a resort, using the online EDGE assessment tool, and intends to recommend energy conservation measures to optimize the performance and also put forth recommendations for major retrofits.

Key words – Energy performance index, energy audit, energy simulation, calibration, benchmarking, energy performance analysis, energy conservation measures

INTRODUCTION

Amongst the building typologies, hospitality buildings are responsible for very high energy consumption due to luxury and comfort requirements. This leads to significant rise in energy consumption, especially during peak hours in various metro cities and tourist destinations. The sector is witnessing unprecedented growth owing to better spending capability of local population, demand from tourism and increase in overall travel in the country.

Some World Tourism Data Points

- 9% GDP
- 1/11 jobs are in the tourism sector
- US $ 1.3 trillion in exports
- 6% of the world exports are dependent on the tourism industry
- 6% of the exports are from least developed countries

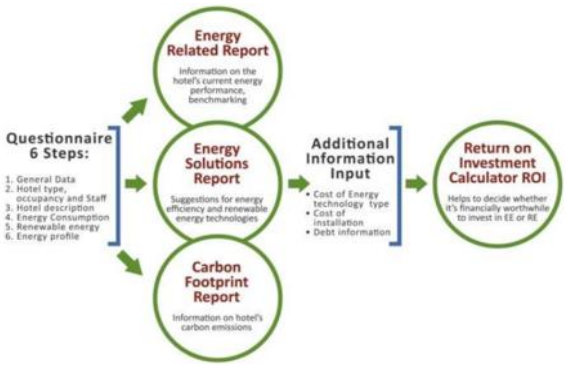
World Tourism Organisation – specialized agency of UN

In India, 70% of the buildings that will exist by 2030 are yet to be built.[2] Buildings already account for two-thirds of electricity consumption and four-fifths of water use in large cities.[3] To achieve a viable future, buildings must be designed to conserve precious natural resources.

Resorts have different building designs, functional facilities and operational requirements because of which energy performance is difficult to evaluate. Much of this energy consumption can be reduced or optimized by changing the way buildings are operated and maintained, renovated and upgraded. To promote effective operations and management of resorts, benchmarking of the energy performance reveals useful information to support strategic decision making and planning. Further investigation in evaluating key energy consumers for the facility can help understand the best strategy for optimum performance. For existing resorts, such informed decision making can help facility owners and managers save on the capital expenditure as well as operational expenditure.

Energy efficiency in hospitality industry will help increase Profits, Competitiveness, Sustainability, Responsibility and Brand Value. It will assist in mitigating the sector's CO_2 emissions, will help decrease - Costs, Energy consumption, Carbon footprint and Tourism's impact on climate change. There is a gap between available Energy Efficiency (EE)/ Renewable Energy (RE) technologies and their actual use in resorts.

Resorts also play a significant role in sensitizing their visitors towards resource efficiency by giving them a first-hand experience of using energy saving technologies. Hence, selecting a resort for the study was considered, as it addresses all these issues comprehensively.



Source : Hotel Energy Solutions

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EDGE – Excellence in Design for Greater Efficiencies

EDGE identifies the most cost-effective ways to reduce energy use, water use and embodied energy in materials by trying to achieve a minimum projected reduction of 20% as benchmarked against a standard building. This certification will help increase the marketability of buildings for new construction, existing and renovations of homes, offices, hospitality, retail industry, ware houses, hospitals and educational buildings. In many countries including India, GBCI administers EDGE certifications and credentialing. EDGE helps determine the optimum combinations of building design strategies for the best return on investment.

Advantages of using EDGE

- Free and easy to use online tool to calculate your ROI for green building strategies
- Advanced database understands local climatic conditions and building usage
- Project and report your savings in energy, water and GHG emissions
- Efficiency simulations are built into the software and certification can be achieved with existing documentation
- Certification is globally recognized and backed by WBG (World Bank Group)

MATERIAL AND METHODOLOGY

A 12 years old existing resort has been selected for the study. There are 3 buildings on the site. Main building houses most of the facilities. Accommodation is separate. They have 8 cottages and 27 rooms. The total plot area is 10,400 Sq.m and the combined built-up area is 4334 Sq.m

Many physical and operational factors influence energy usage (Bohdanowicz and Martinac, 2007). Major factors are considered and summarized below to establish and evaluate the resort energy benchmarks.

Table 1. Major factors considered for this resort's energy benchmarks

Factors	Description
Resort star ratings	A pragmatic approach with some risks, as there is variation in star brands and not every resort is rated.
No. of rooms	This is not an index for resort size; it simply is corelated to the no. of rooms/cottages/suites within the resort.
Floor area	This varies independently of other factors and can be a significant contributor to overall energy usage of the site.
Scale of conference areas	Other independent factors play a substantial role despite it being linked to linked to resort quality.
Swimming pool	It has a marginal correlation to star rating and the scale of the pool varies significantly.
Occupancy	Level of occupancy typically should be a major influencer in energy and water consumption; but many a times is not significant due to resorts remaining prepared for unexpected arrivals.
Other facilities	Gym, house-keeping, administration and accounts

Note: This information has been adapted from Bannister (2008).

Resort operations are majorly equipment-based than people-based services (Jones and Lockwood, 2002). Resorts have very typical and specific operation schedules which may lead to difficulties in energy management.

A resort can be largely classified into three distinct zones:

1. Guest areas : accommodation, washrooms
2. Public area : Reception, lobbies, restaurant, bar, swimming pool, gym, conference areas, outdoor landscaped areas
3. Service area : kitchen, offices, store rooms, staff facilities, service areas

OBJECTIVES

- To estimate the energy performance index of the resort and compare it with national and international benchmarks.
- To identify the energy conservation measures and develop the cost benefit analysis using online tools.

RESULTS AND TABLES

Approach

Data collection was done by conducting a walkthrough audit (ASHRAE Level 1). Based on the site observations, floor plans were updated, inventory of equipment, lighting etc. was obtained and interactions with the facility manager and electrician helped in understanding the schedule and operations of the resort on a daily basis.

DATA Inputs

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Its design aspects were studied and evaluated using the EDGE tool which uses ASHRAE 90.1 2007 as baseline for evaluating energy performance.

As is evident from the EDGE reports, the design is supposed to perform with an EPI of 34.69 kWh/Sq.m/year. In fact; with effective energy saving measures, more than 20% energy can be saved. FIGURE.1

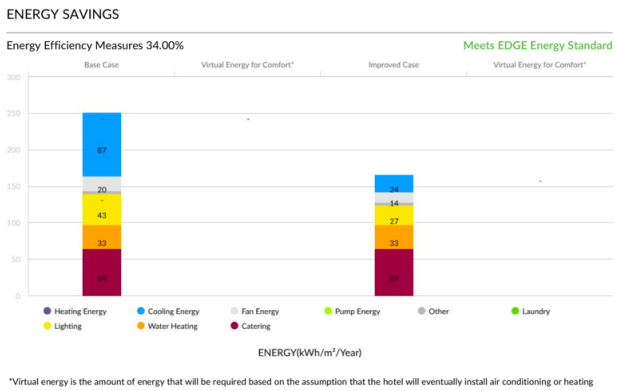

FIGURE.1 EDGE report output for energy savings

In comparison we also have the electricity consumption of the facility for the past 2 years. Average of 2018 and 2019 was taken and after discussions with the facility manager and verification of data related to occupancy, a comparative occupancy graph was derived. FIGURE.2

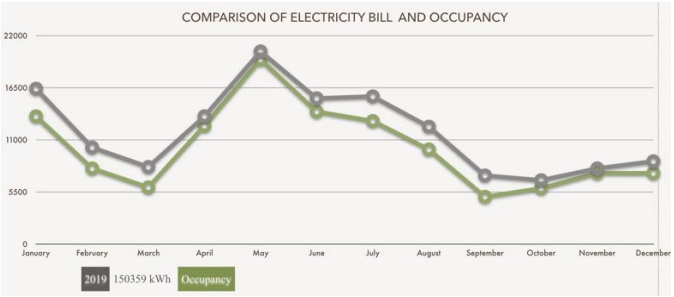

FIGURE. 2 Energy consumption curve derived from monthly Electricity bills and compared with Occupancy at the resort.

This shows that during peak months with high occupancy the energy consumption is high and during non-seasonal months when the occupancy is low the graph drops.

After evaluating the energy use, it is evident that the facility is performing with an EPI of 41.62 kWh/Sq.m/year.

ANALYSIS

The facilities performance has deviated from the predicted performance. The difference in both the EPI numbers shows the potential for energy savings at the facility. Moreover, considering the many changes and upgrades happening over time in facility operations, and the fact that some of the energy consuming equipment is due for replacement/retrofit.

1. VRV system needs a major overhaul, also the split air conditioners which are nearly 10-12 years old.
2. Light fittings are in excess and there is a predominant number of CFL fittings to LED fittings; Changing of these CFL light fittings to LED; illuminance levels as required shall be verified on IES and suggestions for replacement and payback period shall be calculated.
3. Solar panels installation will decrease the dependency on electricity from main grid and green energy shall be used. This will help in cost savings on energy bills and reduce energy usage.

CONCLUSION

Further investigation would be required to evaluate the performance of each of the key energy consuming end uses; to come up with elaborate conservation measures; and also do a cost benefit analysis which will enable the property owner to take informed decisions.

ACKNOWLEDGEMENT

I wish to express my deepest gratitude to my guide, Akshay Pahade for his guidance and technical support. Without his persistent help this research would not have been possible.

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Feasibility Study on Reduction of Energy Usage, Till Construction Completion of Residential Projects at Satara

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Abstract : Energy usage in the building industry has effectively and successfully undergone various improvements but largely it is focused over the lifespan of the project and the energy efficiency in the construction process is evidently ignored. Hence, this paper focuses on finding out and understanding the attitudes, approaches, inclinations, barriers behind improvising the energy efficiency in the construction process for residential projects at Satara.A questionnaire survey was conducted amongst the construction process decision makers and onsite influentialpersonnel to elicit information pertaining to energy usage. The findings of this study focus on key processes to improve efficiency,will guide the decision makers as well as policy makers to channelize attention and bridge the gap towards energy usage during construction.

Key words: Energy, Construction, Residential, Efficiency.

I. INTRODUCTION

Construction projects have undergone lot of innovations to improvise the quality, costing and also the end product throughout the lifecycle of the project. These innovations have increased the use of energy in different forms. Green technological innovations and applications have permitted us to reduce this use of energy to a considerable extent but these are majorly focused on the energy use after the completion of project. Residential sector for India alone, has predicted the rise of more than twice increase in floor area compared to the current residential floor area till 2060 [v] (UN Environment and International Energy Agency, 2017). With the recent signed Paris agreement there are increased pressures on the construction industry to reduce usage of energy in Construction process [vi]. Given the potential quantum of rise of residential sector, the Construction energy requirement is going to increase more than twice of today's requirement correspondingly increasing pressure on energy use reduction in construction process(United Nations, 2017).

Green Building Certification Agencies like LEED & GRIHA are more focused on the energy usage after the construction process so the increase inenergy usage and thereby carbon footprint of any building by just the process happening on construction site is ignored by many professionals.

Also, awareness about these facts, quantum of energy involved, implications and measures for energy usage during construction is somewhere lacking in the construction professionals.

There is a remarkable increase in low carbon construction projects across India. This progress is important for low carbon construction efforts and it is significant for society and specially for construction companies. So to further develop low carbon construction practices, the industry has to be more innovative with how it uses natural resources and current sources of energy in all areas of the construction site.

II. OBJECTIVES:

- To find if the awareness of energy efficiency exists in the professionals working on site
- To what extent the process on their respective sites are formulated to make them energy efficient, and identify the barriers in doing so- if any.
- Knowingly or unknowingly do the professionals follow any streamlined processes
- Policy suggestions if any that can be derived

III. SCOPE

- The area of study is confined to the construction process.
- Although the direction of this study is more directed towards the sustainable approach, the emissions from the construction processes are not incorporated in this study.

IV. METHODOLOGY

Following steps approach is used:

- Identification of types of activities and energies used on the site.
- Understand the basic energy saving processes or approaches that can be used on construction sites
- Formulation of Questionnaire for construction professionals to find the relevant approaches,

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applications and understanding of the energy saving agenda

- Determination of relevant variables by which those replies can be quantified;
- Identification / Selection of professionals for the survey monitoring and collect data.
- Transformation, categorization, quantification and analysis of the collected data
- Arrive on the relevant conclusions / findings based on the above.

V. LITERATURE REVIEW

The research in the construction process energy consumption efficiency is highly segregated and the data from each study needs to be picked up to have a concise understanding of the areas possible to reduce energy consumption.

Energy in the construction industry is fragmented because of the processes and stakeholders involved in the construction process[i]. It has various contractors and subcontractors resulting into subdivision of the whole construction process (Department of Commerce, 2005)

A study by Shrivastava, S., &Chini, A on estimating energy consumption during construction of buildings [iii] incorporates a methodology which BOQ is connected to the work data and it is thereby connected to the labourers and their equipments. So at the end a report that has energy consumption information and segregated areas of high demand energy tasks are identified. The conclusions of this paper concludes on material procurement and energy utilized by equipments as high demand areas. (Shrivastava & Chini, 2011)

In another study of Managing the efficient use of energy on construction sites and cost reduction by AA Talukhaba, B Phungula and MB Manchidi[iv]in which it was concluded that Transportation, hoisting and concreting are some of the processes that demand more energy usage. It is also observed that a lot more effort will be required to improve site management and training of workers to be more conscious of the use of energy for the achievement of onsite energy efficiency. It was further suggested that a logistical transportation system is required for delivery and waste removal on site. (Talukhaba, Phungula, & Manchidi, 2013)

The company named BAM [ii] which focuses on how energy efficient construction process can be. They have included measures like incrementally improving the thermal efficiency of the temporary accommodation, installing zoning and controls to temporary electrics installations to cut out waste and providing staff with reports showing them how they're performing and where they could make savings. (Putzel, 2015)

Areas identified for as scope energy use reduction is available are as follows:

- Energy efficient site
- Construction waste material reusing and recycling
- Transportation fleet economization
- Sustainable supply chain
- Energy Efficient equipment
- Onsite energy monitoring & management

VI. QUESTIONNAIRE

In regards to find the feasibility of energy usage reduction the questionnaire was formulated to the target audience of the decision makers and the persons who can by their set of actions take notable steps towards onsite energy usage reduction. Thus the set of questions wereidentified towards Architects, Developers, Construction Managers &Site Engineers.

The starting question types were also formulated to understand the attitude, acceptance ofenergy crisis and willingness of taking steps against it. The areas where energy reduction can be possible were identified from the Literature Reviews and onsite self- observations. And the further questions were targeted based on these areas to check approaches

- At the moment we are being presented with a picture that we are living in an energy crisis. Do you think this so?
  - Yes
  - No
- Do you think that energy saving is important to you?
  - Yes
  - No
- Have you ever had an opportunity to reduce energy usage previously?
  - Yes
  - No
- If you had to monitor the use of energy, do you think it would help to become more aware about the importance of energy saving?
  - Absolutely yes
  - Maybe yes
  - Not Sure
  - Maybe Not
  - Absolutely No

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- How many of your past completed projects do you consider can stand on the atleast basic certification of GRIHA or LEED?
    - 0-1
    - 2-3
    - 4-5
    - None of the above
- What would motivate you to change your behavior to reduce the energy use? Tick as many as are relevant to you
    - Still increasing cost, eventually savings from them
    - Environmental reasons
    - Public relations
    - Any other_____
- How aware are you about energy efficiency labels and government subsidies related to it
    - Fully Aware
    - Little Aware about labels but don't know about subsidies or Viz
    - Not aware completely
    - Not sure
- Would you prefer to use the solid construction waste generated on site itself?
    - Absolutely yes
    - Maybe yes
    - Not Sure
    - Maybe Not
    - Absolutely No
- What do you consider as a barrier for usage of energy efficient equipment?
    - High price of high efficiency products
    - Energy efficiency products do not always save energy
    - Not cost effective because low electrical price
    - Lifecycle of products is too short, I don't need high efficient product
    - Any other_____

VII. Findings & Proposals

Analysis was done from the responses of 45 professionals of Satara working in residential projects consisting of Architects, Developers, Construction Managers & Site Engineers

Attitude and Acceptance: The analysis of the replies is done in percentages which can be seen in figure 1. It can be observed that the consciousness towards current energy scenario is above 80% in all the replies.

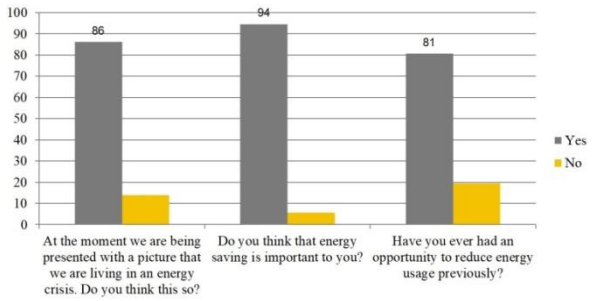

Figure 1: Graphical representation of attitude and acceptance questions replies in percentages

Within which even if 95% of the total respondents agree that energy saving is important to them, the steps towards energy reduction were a bit lacking that can be seen in the next set of replies of opportunity to reduce energy.

Energy Monitoring: Energy monitoring can be a first step towards energy conservation is acknowledged by more than 80% of the respondents. The monitoring process can guide through the understanding and decision making for the processes to make them more energy efficient

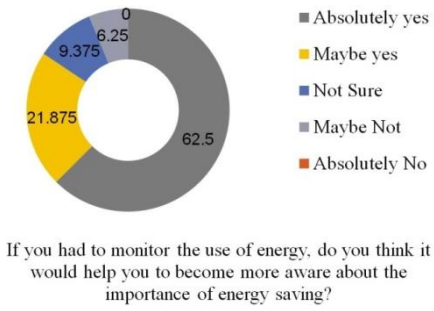

Figure 2: Percentile Representation of Energy Monitoring Replies

Green Building approach : More than 40 % of the respondents believe that more than 2 of their past projects are adherent to green building norms.

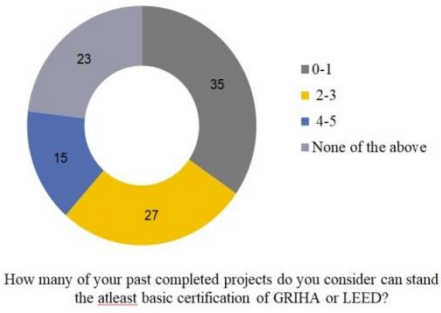

Figure 3: Percentile representation of Green building approach of respondents in past

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Motivational Factor:61% of the respondents claim that environmental reason is the major motivational force for them to change their behavior towards energy usage.

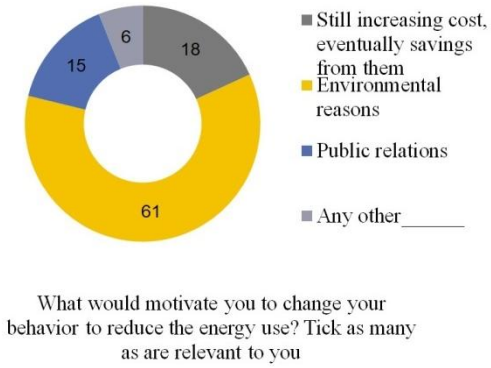

Figure 4: Percentile representation of motivational factors for energy reduction

While 18 % and 15 % respondents believe on increasing energy costs and public relations is their motivational force respectively. This proves that even though energy crisis is not acceptable by few respondents in previous questions but environmental change can be a catalyst. So considering renewable alternatives onsite could a solution generated from this motivational force.

Consciousness of Government Subsidies as motivational factor: Even though it is understood that government does not offer subsidies in the residential commercial sector. In private residences it can be a major expediter since MNRE offers upto 30 % of the subsidies against installation cost.

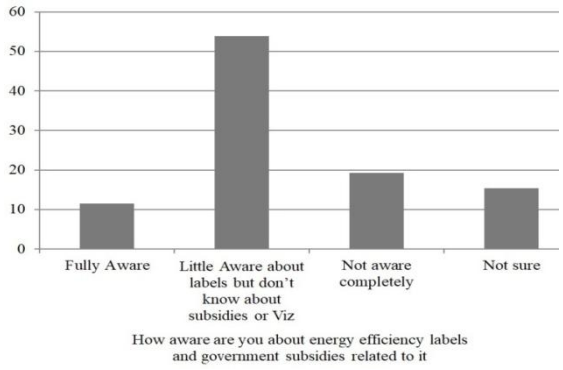

Figure 5: Comparative percentile representation of government subsidies awareness

So the awareness of construction professionals in this regard can be seen in figure 5. where more than 85% of the respondents are little to not aware of the government subsidies.

Solid Construction Waste:

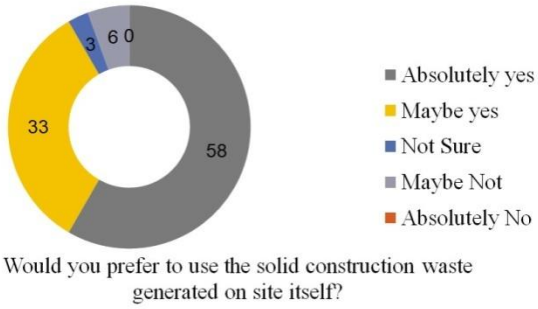

Figure 6: Percentile representation of preference for solid construction waste use onsite

Studies in the literature review have proven that transportation of construction waste is driving factor in increasing energy consumption as well as carbon footprint.In the figure 9 it can be seen that more than 90 % of the respondents believe in energy saving that can happen through utilizing it onsite.

Barrier for Energy Efficient equipment usage: More than 85% of the respondents believe that high prices of energy efficient products is a major deterring factor towards energy efficient equipment and they do not always save energy.

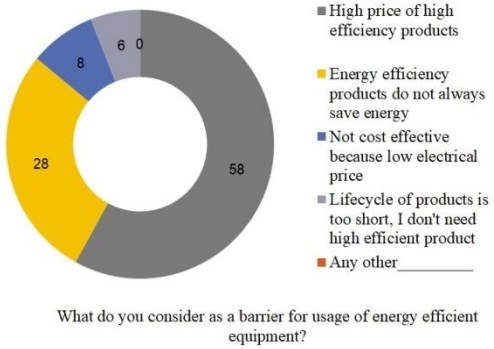

Figure 7: Percentile representation of respondents understanding for barrier of energy efficient equipment onsite

VIII. CONCLUSION & RECOMMENDATION

The potential to energy efficient construction site in residential sector definitely achievable since approach and understanding towards energy efficiency is in the right direction. The motivational forces such as subsidies and understanding of the potential cost savings could further help. Outreach programs by Policy makers, certification agencies could trigger the clearance of these road blocks.

High prices of energy efficient equipment is always going to be compared to the price of energy which has a vast

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difference and nothing can be done about it. If the market trends change with technological innovations making the energy efficient equipment more-cheaper, could make the possibility scenario to tackle this problem.

Policy makers, government agencies, certification agencies can take this data further to incorporate more attention towards the energy conservation in construction process by creating motivational drivers.

FURTHER RESEARCH

The understanding and approaches of sustainability onsite construction brings forward lot of aspects that can be further taken into construction. As far as onsite energy consumption is considered it can be further researched to quantification and with energy monitoring certain thumb rules can be achieved that can further on how much energy will be needed for any project in the initial stage itself so that the stakeholders can take prior decisions and steps to potentially make energy efficient premises or even plan for onsite renewable energy generation as per the need.

ACKNOWLEDGEMENT

I would like to express my deep and sincere gratitude towards my guide Prof. Laxmi Salgia for guiding me through this research. And I would like to express my sincrere gratefulness towards Prof. Aparna Pangati, Prof BhagyashreeApte& Prof. BhagyashreeKadiwal for inspiring and pushing me throughout this research process.

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Human Comfort in Green Rated Office Buildings

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ABSTRACT: Green rated office buildings are supposed to provide comfort to its occupants and have minimum impact on the environment, both indoor and outdoor. Perceived comfort is a major factor that affects occupant's performance in an office environment which seems to be neglected in green rating systems. This research presents findings of study conducted to understand occupant's perception of thermal comfort in IGBC rated office building in Pune city. It measured the parameters affecting thermal comfort and analyzed occupant's response through surveys and interviews. The results suggest that green building rating criteria are insufficient to fully capture comfort needs of the occupants and need holistic understanding of occupant's perception.

Keywords: Occupant Comfort, Thermal Comfort, Perception, Green Rated Office, Survey Questionnaires, Interviews

1. INTRODUCTION:

Human comfort in buildings can be defined as – "That condition of mind that expresses satisfaction with the thermal environment and is assessed by subjective evaluation" (ASHRAE, 2010). Parameters of comfort include; personal factors, health and wellbeing, thermal comfort, indoor air quality, visual comfort, noise nuisance, ergonomics, and so on. "Similarly, occupant behavior is a driving factor of energy use in office buildings, which depends on the comfort criteria of personal choice. The fact that employees are the biggest expense in an office operation, it has compelled organizations to improve health, well-being, and productivity via optimization of workplace environments: day lighting, natural ventilation, natural view, open space, places of respite, and other comforts" (Fei Xue, 2016). More over the employees are often neglected with respect to their working environment conditions and thus it becomes more important to assess their comfort in order to maintain their productivity. In many of the offices which work on single shift basis the employees need to be concentrated in one space for almost 1/3rd of their daily time thus requiring proper amount of comfort. Generally Post Occupancy Evaluation (POE) uses objective measures of thermal comfort focusing on physical parameters and ignore how employees perceive the comfort conditions and their satisfaction. Thus, it becomes necessary to understand the comfort conditions of the employees as in an Indian, the country consists diverse climatic regions that provide varied thermal conditions.

2. CORRELATIVE STUDY OF HUMAN COMFORT PARAMETERS:

The rating of green rated buildings takes into considerations all the required factors for energy savings, resource conservation and human comfort. However, there is still a concern regarding the end user comfort in these buildings as most of the focus in Pre certification and Post Occupancy is given on energy and resources only. Many of the green rated offices do go for POE but, lack the analysis of end user comfort as it is perceived by them. IEQ (Indoor Environmental Quality) can negatively affect occupants' physical health (e.g., asthma exacerbation and respiratory allergies) through poor air quality, extreme temperatures, excess humidity, and insufficient ventilation and psychological health (e.g., depression and stress) through inadequate lighting, acoustics, and ergonomic design if not properly maintained even in a green rated building. (Amanjeet Singh M. S., 2010).

Most of the green rating systems follow various sustainability criteria's such as of resource conservation, energy conservation, material conservation and indoor environmental quality for which they state certain parameters to be fulfilled. These criteria's are to be fulfilled by the buildings for gaining their green certifications. Similarly the case study of an office building in Pune that was being considered also had these above mentioned criteria's fulfilled from which the IEQ criteria for thermal comfort were only considered for the research. The case study consisted of LEED India new construction green building rating certification. The parameters that were mentioned in the rating system regarding IEQ criteria's were studied in detail from the LEED India certification booklet provided to the building. Also, the human comfort conditions to be assessed were studied in detail from another building rating system of 'Well Building Standards'. These

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two above mentioned Green rating standards thus provided the base for assessing the research aim. However, from the below mentioned *Fig. 1* there is no parameter in the green building rating system that analyses the individual thermal comfort mentioned in well building standards. There is a lack of appreciation provided to the user thermal comfort in the green rated building.

COMPARISON BETWEEN WELL BUILDING AND OTHER GREEN BUILDING STANDARDS

WELL BUILDING STANDARDS

CRITERIAS (Affecting User health (psychological) and productivity)	FACTORS (That need to be studied)					
						Green building standards / WELL building standards
Light	Visual lighting design	Solar glare	low grade workstation design	Colour quality	Right to light	Daylighting levels (simulation)
Comfort (Thermal, Ergonomics, Luminous)	Physical and Visual working space design (as per standards)	Individual thermal comfort	Adaptable spaces	Spatial familiarity	Health, wellness and awareness	Olfactory comfort
Acoustic	Exterior noise intrusion	Internally generated noise	Sound masking	Sound reducing surfaces	Sound barriers	
Air	Smoking	Ventilation effectiveness	VOC Reduction	Cleaning protocol	Moisture management	Operable Windows

Fig. 1 (Comparison between WELL BUILDING and GREEN BUILDING standards used)

2.2 Previous Methodology for measuring perceived thermal comfort and process for analyzing the perception of the users -

The methodology for collection of the data in human comfort studies consists of 2 processes of subjective data collection through Survey Questionnaires, Interviews and Observations while objective data collection through measurements of the factors affecting human comfort in the building. (Spengler, 2015). However just by using one of the above subjective methods to assess comfort the results that will be generated won't be appropriate and trustworthy. Hence there needs to be collaborative methods used to get data for the study by considering both survey questionnaires and interviews. Similarly the measurements of the architectural parameters affecting comfort factors need to be done to correlate it with the subjective data. The perceived comfort of the users can be analyzed through various techniques which are mentioned in the research papers that are studied such as frequency analysis, scaling, t-test, z-test, chi-square test etc. (Amanjeet Singh M. S., 2010). However, all these techniques can't be used in all forms of researches as they require specific sample size and response parameters. For this research the analysis tool used is of frequency analysis which is structured using the survey questionnaire responses.

3. METHODOLOGY:

3.1 Overview of Methodology –

The research is based on 3 major parts of study. These 3 major parts include:

Secondary data collection by reading through topic related research papers, articles, drafts or guidelines, study reports etc. which provide solid base for setting up primary on site data collection as well as for future analysis.

Primary data collection by carrying out Live case study and measuring physically the various Architectural IEQ parameters that affect human thermal comfort as well as gathering human perception data by asking people to fill in their views in survey questionnaire. Also, taking personal interviews of certain people form the sample selected.

Analyzing Secondary and Primary data collected by making a correlation in between them. The analysis thus helps to find out the overall perception of the end users with respect to their thermal comfort conditions.

3.2 Methodology Framework –

The Framework consisted of objectives that were to be studied during the research for which various comfort factors were listed down from different literatures. These objectives formed a part of the 3 major study parts mentioned in *section 3.1*. Following are the different objectives and their relative comfort factors derived from literature study –

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1) Objective – To study why human comfort is important in office buildings.
Factors relative – Workspace productivity, psychological Impacts.
2) Objective – To understand how and what factors affect human comfort in green rated office buildings.
Factors relative – Air quality, temperature, humidity, ventilation, lighting, acoustics, ergonomic design.
3) Objective – To shortlist and measure the parameters that are considered for this research study which affect human comfort in an office building.
Factors relative – <u>All factors</u> : Air quality, temperature, humidity, ventilation, lighting, acoustics and ergonomic design.
<u>Factors considered for study</u>:
Thermal Conditions - Temperature, Humidity and Air changes.
4) Objectives – To analyze, which of above mentioned parameters affect the human comfort and in what way.
Factors relative – Human perceived comfort, data representation.

4. CASESTUDY AND ANALYSIS:

The Corporate office complex in Pune which was selected for study is IGBC Platinum rated green building that consists of a G+3 floor office building. All the floors consist of workspaces with different departments on each floor. The office building is centrally air conditioned with maintained temperatures on each floor and there is a main atrium joining every floor centrally. Thus, considering the requirement of the research for open workspace with capacity employees of more than 30 in number, first floor of the office was selected for the study. The office consisted of employees with diverse age groups. Also, the employees had a specific dress code to be worn during work provided by the office management of full sleeves formal shirt and a trousers. Some other details regarding the office are provided below:

- Timings: 9am to 5:30 pm.
- Lunch break: 12 pm to 2 pm (any 45 min. in between the mentioned hrs.).
- Tea break: Not formally in schedule, but employees usually prefer in between 3:30 pm to 4:30 pm.

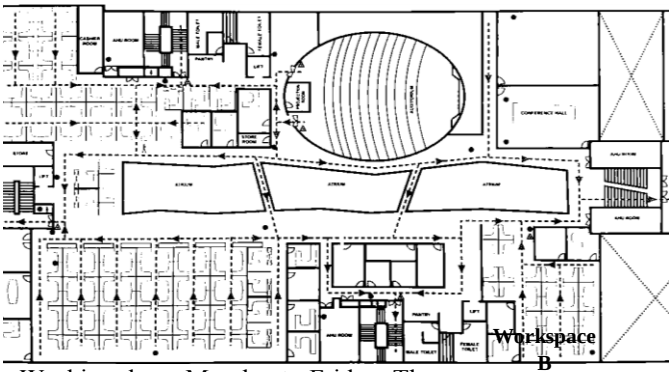

Fig. 2 (Office floor plan – 1st floor)

- Working days: Monday to Friday. The Case study consisted of 2 spaces that were studied on the same floor of the office building which were oriented in different directions. One was a larger workspace area with cubicles that faced the South while the other one was a smaller workspace that faced the North. However, the employees using the Workspace A and B were 70 and 36 respectively. Thus the workspace B had more population density as compared to the workspace A. The method of the study consisted taking readings of temperature for 3 times of the day i.e. Morning, Afternoon and Evening and conducting survey questionnaires and interviews of 20 and 3 ppl each respectively in both the workspaces. The questions were asked with respect to how the people perceived thermal conditioning within the office space throughout the day.

<u>Workspace A – Data and Analysis</u>

<u>Physical Measurements –Temperatures in °C</u>
Inside temp. – DBT ranges 25-26-25.5 and WBT ranges 20.5-22.5-22 from morning to evening.
Outside temp. – DBT ranges 26-27-25.5 and WBT ranges 23.5-25-19.5 from morning to evening.

<u>Survey Questionnaire – Perception data</u>

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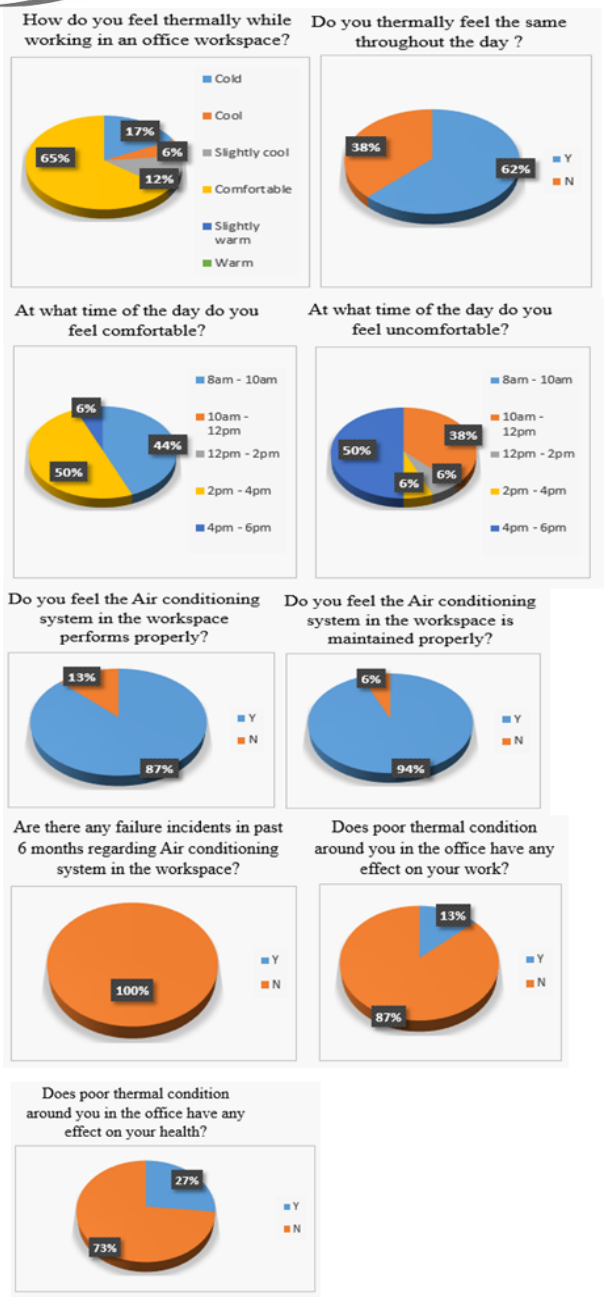

Fig. 3 (Survey responses)

Interviews – Personal perceptions from users

"Sudden cooling happens due to zonal air conditioning system as perceived by the user."

Workspace B - Data and Analysis

Physical Measurements –Temperatures in °C

Inside temp. – DBT ranges 25-26-25.5 and WBT ranges 23-23.5-22 from morning to evening.

Outside temp. – DBT ranges 26-27-25.5 and WBT ranges 23.5-25-19.5 from morning to evening.

Survey Questionnaire – Perception data

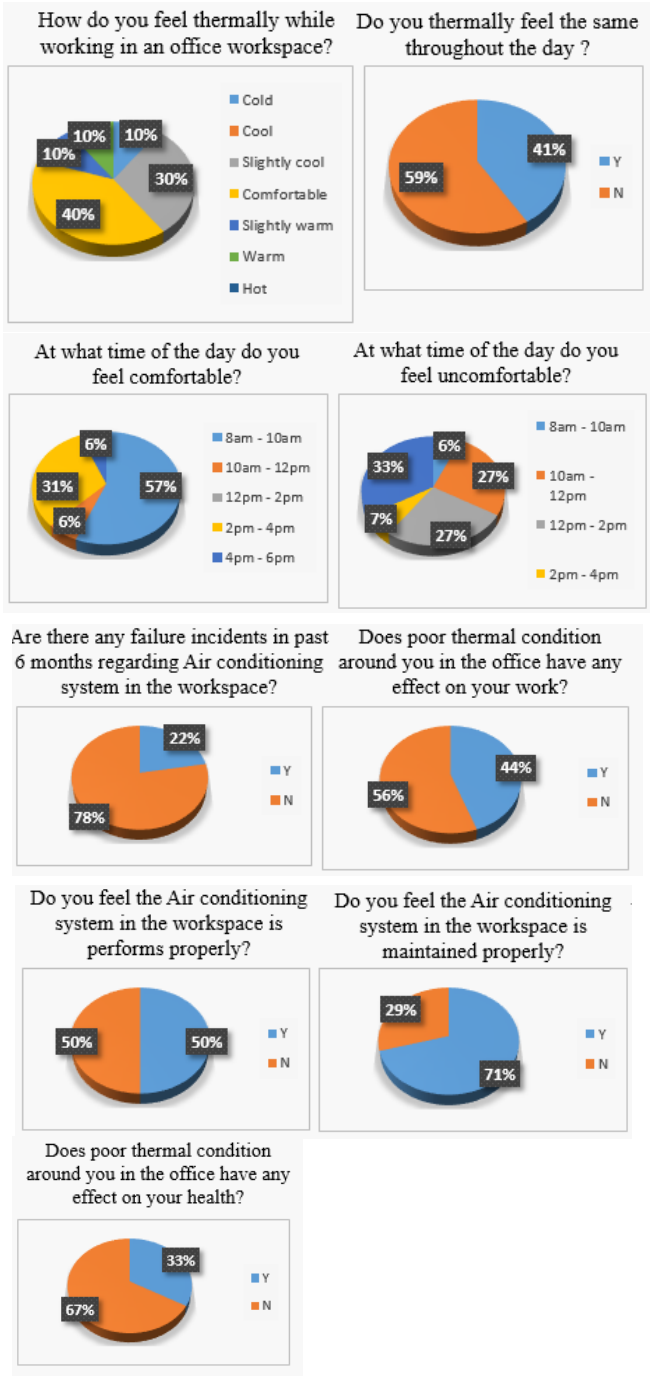

Fig. 4 (Survey responses)

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Interviews – Personal perceptions from users

"Air conditioning system are not maintained properly as well as there is no proper temperature adjustment."

5. RESULTS AND INFERENCES:

Inferences from the survey and interviews –

Workspace B

1) In this case the perception of the employees towards thermal comfort was changing due to improper conditioning of overall space.
2) The thermal comfort majorly depended on how the individual employee perceived it, however most of the employees were not content with the ventilation supply as well as maintenance.

Workspace A

1) In this case the employees had lesser troubles as compared to Workspace B, However there was discomfort as perceived by the employees regarding the zonal cooling from the A.C. system which fluctuated from time to time.
2) Also, employees sitting near to the glazing felt more heat during summers as compared to those sitting to the inside.

Correlation between green rating criteria's followed and human perception results through study –

Factors	Workspace A Perception	Workspace B Perception	Fulfilled Criteria's	Green Rating Criteria's
Thermal Comfort	NOT PROPER	NOT PROPER	Y	Controllability of systems
	N	N	N	Thermal Comfort Design
	N (NOT CONSISTENT)	N (NOT CONSISTENT)	N	Thermal Comfort , Verification

Table 1 (Correlation between green rating criterias and human perception)

6. CONCLUSION:

The Research study and its results suggest that there is a lack of appreciation provided towards the thermal comfort of the users in the building. The users perception tells us that there is a lack of correlation between the designing and the managing of the internal ventilation system (i.e. Air Conditioning). The green rating criteria's do not fulfill the comfort parameters required as shown in *Table 4*. As a result we can state that human thermal comfort in green rated office buildings is neglected in the considered case.

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Study of Existing High Rise Buildings Shadows on the Basis of their Geometry

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Abstract: High rise buildings are a symbol of modern life, wealth to the city and also introduces modernity. However, they are known for their shape and form. In high rise buildings, casting of shadows plays an important role as they tend to cover their neighboring buildings firstly because of their humongous height but also with their concrete mass.To attain these purposes, comparison of existing high-rise buildings will be analyzed to consider shadow pattern from different forms i.e. triangle, square, oval, rectangle and circle and at different heights. In conclusion, the results will be summed up for the best appropriate geometry for high rise buildings on the basis of shadow length and area underneath shadow.

Keywords: High rise buildings, shadow pattern,neighboring, geometry.

I. Introduction

The high-rise building, more than any other building type, has the capacity to capture the public imagination, its sheer scale, visual prominence, and symbolic potential have rendered it a speculative enterprise, economically, technologically and architecturally. The skyscraper is representation of cities around the world. From New York to Kuala Lumpur, London to Hong Kong and Singapore to Sao Paolo, high-rise buildings define the image of metropolis. The high-rise buildingshave been called a “social condenser” and a “vertical machine” and yet it has traditionally been seen as a building type outside the mainstream of architectural culture.

Despite its close relationship to development forces the multistory buildinghas created as provocative and unique range of architectural approaches to its design. Perhaps because of those very ties, it serves as a barometer of contemporary culture.Multistory buildings can also stimulate issues like wind flow, view, sunshine and air pollution. High-rise building can get a sun solar easily especially the upper floors because of its height. What about the impacts of the building on the surroundings area, making shadow and avoiding getting sun solar directly from the sun are the appear points that many researchers concede about it. The effects of this shadow and shading are change in different climate and block the sun with change the access, sun light and solar sun.

As clear that this shading goes back to a number of factors as:

- Differences in height of buildings (sky line)
- Tall buildings direction and location according to surrounding neighborhoods (with sun path and time)
- Mass and form (geometry)
- Urban space between the buildings (distance)

High rise buildings, although they are mostly well-known symbolic figures of metropolises, have been criticized since their first development. Primarily, opponents to tall building construction cite their huge mass as contrary to human nature; with their excessive energy consumption; the extra pressure they cause on city infrastructure; and the exacerbation of already difficult issues such as traffic and parking. Further, opponents object to their unnatural indoor conditions that adversely affect occupant health, and their role in the lowering of the economic viability of surrounding land by blocking the light, air, and view (Bronin, 2009).

The effects of shading by one building upon another can be either positive or negative depending upon the site-specific circumstances of the properties involved. A potential benefit of shading for adjacent structures may be a cooling effect gained during warm weather. Negative consequences of shading include the loss of natural light for passive or active solar energy applications or the loss of warming influences during cool weather. Factors influencing the relative impact of shadow effects are site-specific and include differences in terrain elevation

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between involved properties, the height and bulk of structures, the time of year, the duration of shading in a day, and the sensitivity of adjacent land uses to loss of sunlight.

Tall buildings block the sun of their surrounding environment and change their 'solar access', properties. Reduction at sun light is an important issue for energy efficiency, vegetation, and daylight properties of indoors. With the growing interest in sustainability, the use of sunlight has begun to play a major role in building design and green architectural strategy. This paper highlights the different form of high-rise buildings that can cast different type of shadows and also analyze the best suitable shape forless amount of shadow cast on surrounding buildings. Shadows look different, and even take on different shapes, when cast from different perspectives.

II. Methodology and Results

Famoushigh-rise buildings from different cities with different shape and form has been selected for the analysis of shadowlength and shadow zone.These buildings are:

a) Flatiron Building,NewYork
b) Agbar Tower, Barcelona
c) Picasso Tower, Madrid
d) 30 St Mary Axe (Thegherkin), London
e) Jin Mao Tower, Shanghai

LOCATION - NEWYORK	LAT - 40° 71' N , LONG – 74° 00' W			
	JUNE SOLSTICE		DECEMBER SOLSTICE	
TIME	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
9 A.M	90°	37°	139°	14°
12 NOON	140°	68°	181°	25°
4 P.M	259°	49°	239°	6°

Table 2: Sun Chart of Flatiron, New York

Each structure is selected on the basis of their form, footprint, shape and elevation. Table 1 describes the details about the location of the building, latitude, longitude, numbers of floors, building height, footprint shape, built year and their architects. All the cities chosen falls above Tropic of Cancer.

Sun Chart provides azimuth and altitude angles of sun which is manually derived from sun path diagram depending on their location and latitude of the structure. The sun chart gives seasonal-and-hourly positional changes of the sun as the Earth rotates.

June and December months are considered for every location due to the summer and winter solstice (Shadows cast by structures vary in length and direction throughout the day and from season to season. Shadow lengths increase during the "low sun" or winter season and are longest on December 21-22, the winter solstice. The winter solstice, therefore, represents the worst-case shadow condition and the potential for loss of access to sunlight that a project could cause is greatest. Shadow lengths are shortest on June 21-22, the summer solstice.).Of the total amount of the sun's energy available during a daylight period, approximately 85% of it reaches the earth between 9:00 a.m. and 3:00 p.m. Shadow length will be calculated for 9am, 12 noon and 4pm to understand the best suitable shape and form for high rise building. Similarly, for other cities the sun chart has been made which will be used to study shadow pattern depending on their shape and form.

LOCATION - BARCELONA	LAT - 41° 38' N, LONG – 2° 17' E			
	JUNE SOLSTICE		DECEMBER SOLSTICE	
TIME	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
9 A.M	82°	27°	128°	6°
12 NOON	118°	60°	167°	24°
4 P.M	245°	60°	223°	11°

Table 3: Sun Chart of Agbar Tower, Barcelona

LOCATION - MADRID	LAT - 40° 41' N, LONG – 3° 70' W			
	JUNE SOLSTICE		DECEMBER SOLSTICE	
TIME	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
9 A.M	78°	22°	124°	3°
12 NOON	110°	56°	161°	23°
4 P.M	239°	62°	219°	15°

Table 4: Sun Chart of Picasso Tower, Madrid

LOCATION - LONDON	LAT - 51° 50' N, LONG – 0° 12' W			
	JUNE SOLSTICE		DECEMBER SOLSTICE	
TIME	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
9 A.M	97°	36°	139°	5°
12 NOON	151°	59°	180°	15°
4 P.M	247°	45°	232°	-1°

Table 5: Sun Chart of Gherkin, London

LOCATION - SHANGHAI	LAT - 31° 23' N, LONG – 121° 47' E			
	JUNE SOLSTICE		DECEMBER SOLSTICE	
TIME	Azimuth(Az)	Altitude(Al)	Azimuth(Az)	Altitude(Al)
9 A.M	90°	50°	137°	21°
12 NOON	186°	82°	182°	35°
4 P.M	277°	35°	235°	9°

Table 6: Sun Chart of Jin Mao Tower, Shanghai

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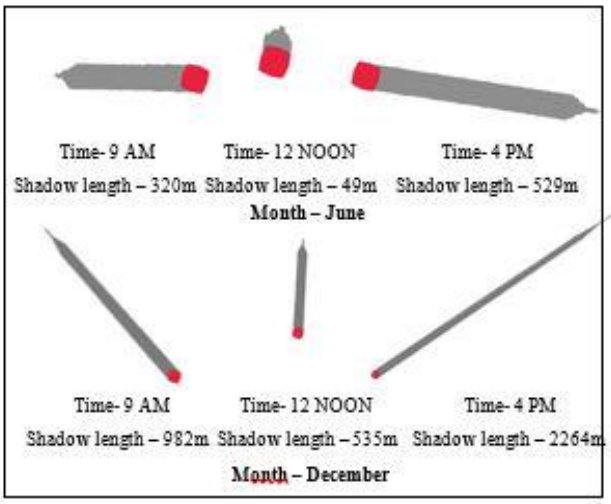

Figure 5: Shadow length of Jin Mao Tower, Shanghai

Shadows are cast to the west by objects during the morning hours when the sun is coming up on thehorizon in the east. During late morning and early afternoon the shadows of objects move northerly and by late afternoon they are cast easterly in response to the apparent movement of the sun across the sky from east to west. Shadows cast in winter are longer, and those at the winter solstice the longest.

To determine shading impacts of the existing structures, their shadow lengths were calculated and their patterns projected in plan view on site. Both winter and summer solstice shadow patterns were examined to document the full (high to low) range of shadow impacts by their shape. A 3D model was made in Sketchup 2018 for all five structures. Shadow settings were applied on 21st June and 21st December, specifically at 9 am, 12 noon and 4 pm.

The shade study graphics were completed through the following process:

1. 3D design model exported from Sketchup 2018 to AutoCAD 2016.

2. Model simplified to remove unnecessary elements (i.e., interior and underground features).

3. Initial base image of the model exported without shadows.

4. Shadow settings applied on the location of the Project site according to the specified dates and times.

5. Model and various shadow settings overlain onto the base orthophoto, to scale.

6. For clarity, enhanced contrast applied to shadows and proposed infrastructure using Photoshop.

7. Shadow zone calculated by overlapping shadow images from 8 am to 4 pm in Photoshop for every form.

HIGH RISE BUILDINGS	JUNE SOLSTICE	DECEMBER SOLSTICE
FLATIRON BUILDING	1:18	1:140
AGBAR TOWER	1:20	1:145
PICASSO TOWER	1:22	1:150
THEGHERKIN	1:14	1:180
JIN MAO TOWER	1:25	1:175

Each shape casting different shadow pattern on ground for their respective height and latitude. The shape of the structures to be designed in such a way that minimum shadow impact on ground level. By analysing the shadow pattern surrounding site function can be designed deliberately. The data in table 7 indicates that the building with the circle footprint (The Gherkin) has less ratio in June solstice but in winter solstice it has the maximum ratio as compared to other building form because of its shape and height. Similarly, for the square shape building(Jin Mao Tower) the ratio is slightly more than the rest of the structures due to the height, building footprint but December solstice ratio is less than the circle shape building. So that leads to the inference for better shape for high rise could be a **square shape building**.

A square shape high rise building might have less shadow zone and shadow length as compared to other forms. All the shadow is casted on the Northeast and Northwest side of the building. In December solstice, all the shadow pattern is of linear shape while in June solstice,

a. Flatiron Building and Picasso Tower has rectangular shape shadow pattern
b. Agbar Tower has flower shape shadow
c. The Gherkin has petal shape shadow
d. Jin Mao Tower has linear shadow pattern

IV. Conclusion

High rise buildings of their shadow can reach very far away from their location. All types of forms of buildings has an overshadowing effect on a geographical wide area. Structure are located on the northern hemisphere above Tropic of Cancer so, the affected zone lies on Northeast and Northwest in June solstice and summer solstice. The solar access of building is obstructed by all different forms resulting in serious reduction of solar energy. If more than two or three high rise buildings are close to each other than their shadow zone would be wider and stronger. According to the observation, square shape might be the best form for a high-rise building. Different forms of high-rise building demonstrate different shadow pattern for various latitudes which indicates that shape does matter and their shadow as well for surrounding areas. And also, orientation of the high-rise building affects the core building spaces. This study helps to design zoning of surrounding area for better quality of life.

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HIGH RISE BUILDINGS	FLATIRON BUILDING	AGBAR TOWER	PICASSO TOWER	30 ST MARY AXE (THEGHERKIN)	JIN MAO TOWER
LOCATION	New York, USA	Barcelona, Spain	Madrid, Spain	London, England	Shanghai, China
LATITUDE AND LONGITUDE	40° 71' N, 74° 00' W	41° 38' N, 2° 17' E	40° 41' N, 3° 70' W	51° 50' N, 0° 12' W	31° 23' N, 121° 47' E
FLOORS	21	38	45	41	88
HEIGHT	87 m	144 m	157 m	180 m	420 m
FOOTPRINT SHAPE					
BUILT IN YEAR	1901-1902	2001-2005	1982-1988	2001 - 2004	1994-1998
ARCHITECT	Daniel Hudson Burnham	B720 Arquitectos,jean Nouvel	Minoru Yamasaki	Norman Foster, Ove Arup & Partners, Ken Shuttlewort	Owings & Merrill Skidmoreadrian Smith

Table 1: High Rise Buildings Data

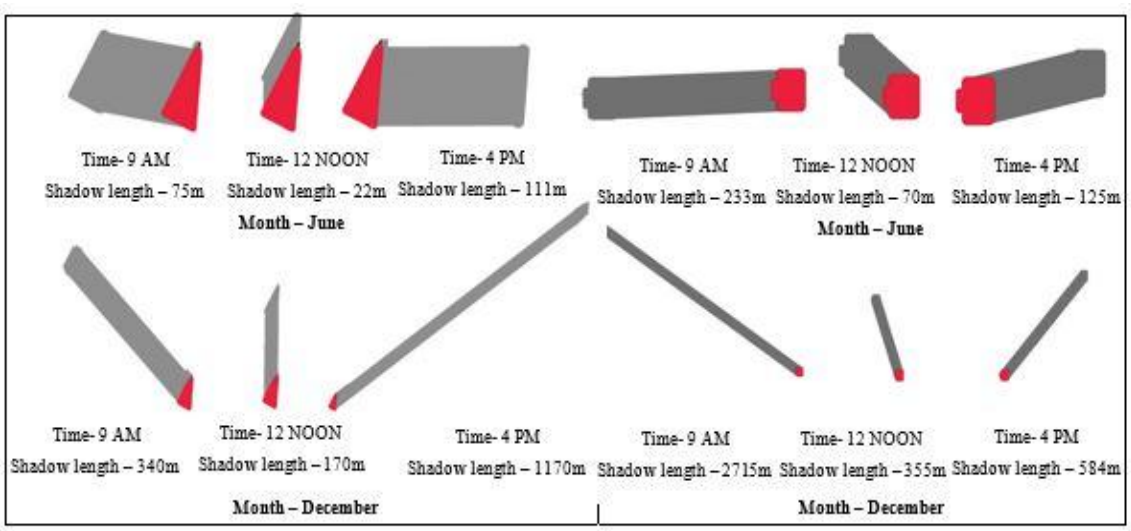

Figure 1: Shadow length of Flatiron Building, New York

Figure 3: Shadow length of Picasso Tower, Madrid

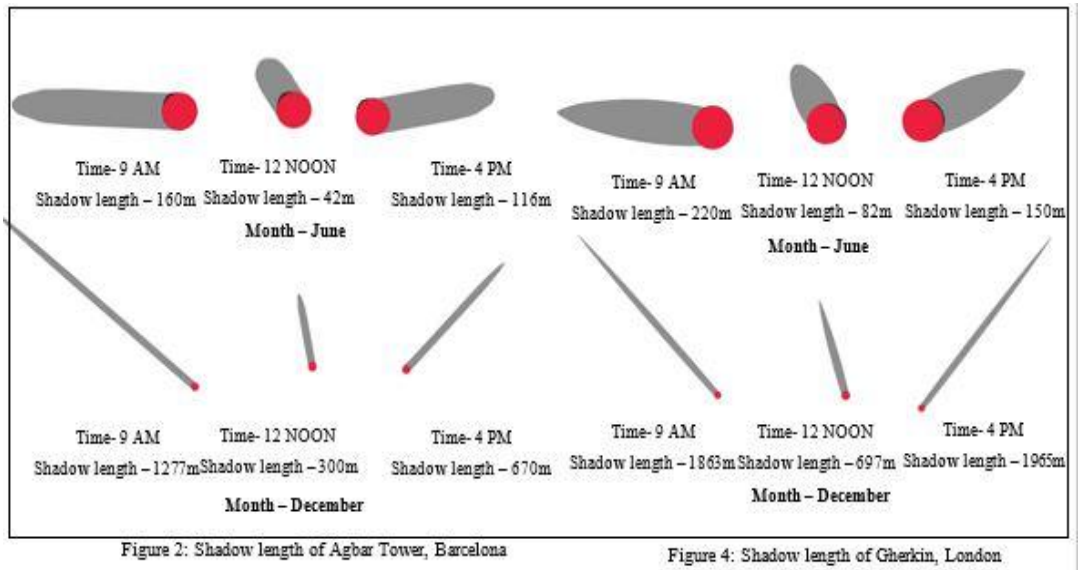

Figure 2: Shadow length of Agbar Tower, Barcelona

Figure 4: Shadow length of Gherkin, London

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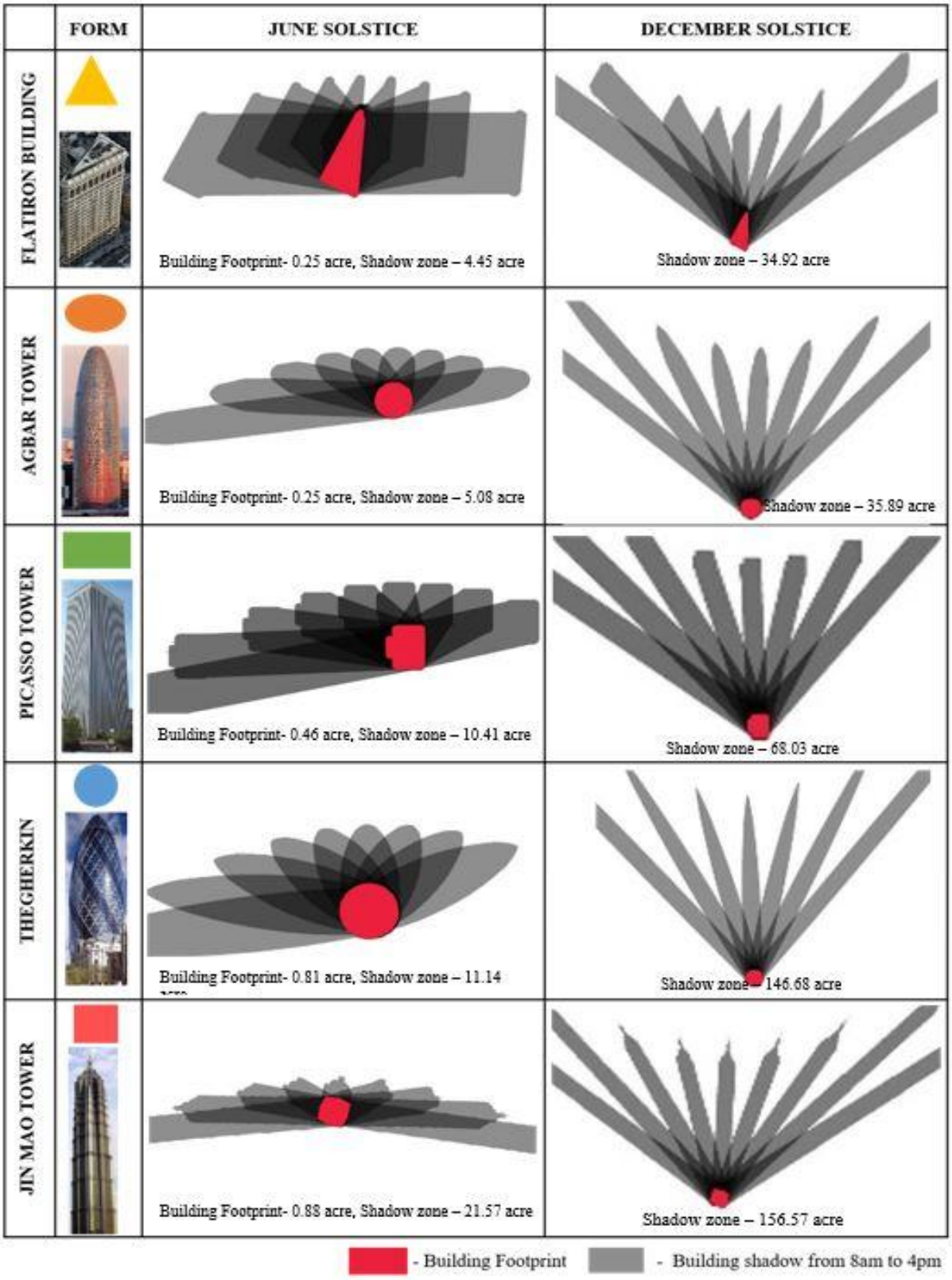

Chart 1: Shadow Pattern of all Five High rise buildings

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