

conference proceedings

**National Conference**  
on  
**Built Environment and  
Beyond 2.0:**  
Theory, Practice and Pedagogy

Peer-Reviewed  
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MKSSS's Dr. Bhanuben Nanavati College of Architecture for Women, Pune  
(Affiliated to Savitribai Phule University)



BNCA



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## About the Institution



MKSSS's Dr. Bhanuben Nanavati College of Architecture for Women, was established in 1994 with the visionary leadership of Mr. Avinash Wardekar and Principal Dr Anurag Kashyap; with a futuristic approach and idealism towards architectural education with a quality in imparting education and empowering girls with newest skill set to make their mark on the globe. Being “Women Only” institute is BNCA's asset and defines its distinctiveness.

BNCA believes in teaching and learning beyond the curriculum. Environment, Ecology, Climate-change, and Culture are the aspects that it focuses on, all being shaped largely by architectural practices. The institutional core values focus on education for emancipation, accepting multiplicity of cultural expressions, intellectual humility.

The activities such as the projects under United Nations Academic Impact Program, activities of numerous Students' Clubs dedicated to Ecology (Vanaja) and Traditional Indian Knowledge (Once upon a time in India), MOU's with organizations like MEDA (Maharashtra Energy Development Agency), and INTACH (Indian National Trust for Art and Cultural Heritage), and participation in competitions like Solar Decathlon are all with a conscious aim of nurturing environmental and cultural empathy in the students.

# Preface

Built Environment often refers to the orchestrated setting of structures, landscapes, cultures that serves as a backdrop for human activity. From the sprawling metropolises to the quaint villages, the built environment tells the story of human progress, ingenuity, and our ever-changing relationship with the natural world.

Over the years there has been a significant transformation in creation of the built environment and associated meanings with it. In present times, it encompasses of the social and cultural circuits, phenomena of perceptions and imaginations, economic, political drivers and not just limiting to the ensemble of infrastructure and services. The present definition confirms to the paradigm shift in the understanding of the built environment, its working and forces shaping it. Along with the physiological; impacts by the psychological, historical, sociological aspects can be witnessed in the built environment and its reformation. The exploration through multi-dimensional lens becomes imperative to truly understand the setting and context in which humans inhabit while deciding its future. Architecture, as a discipline, offers opportunities to study and investigate this multifaceted nature through the tangible and intangible forces. Inquiries along this spectrum promise to help humans understand the environments they inhabit in a profound manner through its past, present and future.

The story of the built environment is one of continuous evolution. As our understanding of the world around us changes, so too do the ways in which we shape it. Fostering research, innovation and investigation of this multi-dimensional nature, can ensure its efficacy by not limiting it to just a functional space.

The National Conference organized by BNCA titled “Built Environment and Beyond 2.0: Theory and Practice” aimed at addressing this multidisciplinary nature of the architecture and allied disciplines. The conference invited papers from academicians, professionals, students and research scholars and encourages them to explore this multifaceted nature of the built environment under the following themes:

1. *Architecture and Planning*
2. *Landscape and Ecology*
3. *Art and Humanities*
4. *Environment*
5. *Culture and Heritage Conservation*
6. *Emerging Technology and Services*

## Principal's Note



### **Dr. Anurag Kashyap | Principal | BNCA**

BNCA (Dr. Bhanuben Nanavati College of Architecture for Women), MKSSS (Maharshi Karve Stree Shikshan Samstha) runs one of the most significant Ph.D centers in India, affiliated to the state university: SPPU (Savitribai Phule Pune University). To enhance the research component further, in the context of the NEP 2020 (National Education Policy, India), BRH (BNCA Research Hub) was established at BNCA in the year 2021 to create an interdisciplinary and collaborative platform. This platform envisioned to facilitate and encourage research interactions, innovations and interconnections amongst aspiring and established researchers from institutions, practice and industry.

National Conference was one such activity initiated by BRH. The collaborative research platform organized its first Conference titled “Built Environment and Beyond: Theory and Practice” in the year 2022. The second National Conference was seen as the successor to the earlier to continue exploring aspects of the Built Environment covering its multidisciplinary nature and the paradigm shifts. One of the important activities of BRH is an annual research conference. The aim of starting the annual conference is to cultivate and nurture the culture of research in the field of architecture and allied disciplines and to encourage students, academicians, and practitioners to write and present their research. BRH conference with its commitment to facilitating research, has set up a systematic and rigorous process of peer-review and at the same time encouraging research through mentoring by domain experts invited at BRH, BNCA.

This conference brought together knowledge partners, educational institutions and experts to initiate discussions about aspects of built environment through theory, pedagogy and practice. Keynote speakers Shri. Hitesh Vaidya (Ex-Director, NIUA) highlighted about the “Practice, Governance and Policies” whereas, Ar. Sumita Singha (OBE, RIBA) initiated the discussion about the “Role of Women in Architecture”; both highly relevant to the architectural domain. The Conference Proceedings is a compilation of blind peer reviewed papers selected by the reviewers and jury, representing various aspects of built environment under various themes. This book also represents efforts and initiatives by the Conference Advisory Panel, Conference Convener and Co-conveners while making this endeavour a success.

I am thankful to all mentors, reviewers and experts for their valuable inputs and guidance that made this scientific and academic endeavour; a success.

## About the Conference and BRH



**Dr. Swati Sahasrabudhe | Professor | Head, BRH | BNCA**

The first national conference of BNCA Research Hub (BRH) was held on October 18-19, 2022, on a virtual platform. The theme of the conference was 'Built Environment and Beyond: Theory and Practice'.

The second national conference of BNCA Research Hub (BRH) was held on November 2-3, 2023, on a virtual platform. The theme of the conference was 'Built Environment and Beyond 2.0: Theory, Practice and Pedagogy'. This year, the theme involved pedagogy as one of its significant sub-themes and deliberated upon the same in the conference.

Based on the feedback received from the first conference, some valuable enhancement was done in the process of the same with value added benefits of some papers getting selected for peer-reviewed research journal. The intent of the conference was to create an opportunity for the young and budding researchers (students of graduate and post graduate programs, faculty and professionals) in architecture and allied disciplines to write and present their research papers. To practice the rigor of the research activity, a call for abstract, a call for paper and a blind peer review process was followed for selection and finalizing of the content of the final papers. The manuscripts were received and reviewed by the expert reviewers based on the sub-themes of the conference. Comments and suggestions by panellists of the theme sessions during the conference were incorporated in the final papers. The whole process was carried out systematically pre and post conference with plagiarism checking, peer reviewing and finally publishing the papers in the book in the form of proceedings of the conference. The conference was very well received and participated by students, faculty, professionals across India.

## Convenor and Co-Conveners' Note



Dr. Avanti Bambavale  
Assistant Professor | BNCA



Ar. Siddhi Joshi  
Assistant Professor | BNCA



Ar. Mandar Athavale  
Assistant Professor | BNCA

The built environment today is not limited to just individual buildings but also encapsulates the surroundings, urban patterns and morphology, social and political circuits, services and innovations in technology. The multidisciplinary nature of the built environment has brought a shift in the way we perceive architecture and environment around. With the paradigm shift there have been transformations in architectural practice, theory and pedagogy. This shift has presented various lenses and tools to explore the tangible and intangible aspects of built-unbuilt environment.

The National Conference organized by BNCA titled “Built Environment and Beyond 2.0: Theory and Practice” aimed at addressing this multidisciplinary nature of the architecture and allied disciplines. The conference invited papers from academicians, professionals, students and research scholars and encouraged them to explore this multifaceted nature of the built environment. The conference was conducted in an online mode for a possibility to bring together diverse group of researchers, experts and practitioners. Papers were invited under the themes of Architecture and Planning, Landscape and Ecology, Art and Humanities, Environment, Culture and Heritage Conservation, Emerging Technology and Services.

The conference received an overwhelming response and the presentations were followed by discussions and comments from the Session Chair and invited experts. The discussions provided valuable insights on various aspects of the built environment. A double-blind review process was adopted to select the final papers, out of which a few were also selected for publication in NICMAR’s Journal titled “NICMAR Journal of Construction Management”. The other papers that adhered to the conference publication guidelines and within the given plagiarism of 15% were selected for publication in the Conference Proceedings.

Few of the ideas presented at the Conference had potential to propel significant advancements in the field of built environment, while some research findings started the dialogue about exploration and integration of multidisciplinary approach. Research related to Urban Planning and Design highlighted theoretical integration with practice and potential to explore perspectives related with city’s planning and management and received the highest number of papers. Overall, the presentations covered a diverse range of topics from all the domains related to the Built Environment. We are confident that platform’s like have the potential to ensure dialogues with the experts, open up discussions about ideas, innovations and promote exchange of knowledge. We are delighted to present a compilation of research highlighting various aspects of the Built Environment as a part of the Conference Proceedings.

## Acknowledgements

We are grateful to Dr. Anurag Kashyap (Principal, BNCA) for his constant support and creating environment that fosters growth of individuals and institution. We would like to thank the Conference Advisory team: Dr. Sharvey Dhongde, Dr. Swati Sahasrabudhe and Dr. Aarti Verma, for their guidance and judicious review of the proceedings. We also would like to thank Dr. Swati Sahasrabudhe for her constant support in conduction of the conference. We are grateful to Dr. Vasudha Gokhale for her guidance in structuring of the conference.

The Conference has adopted a peer-review process, and we thank our paper reviewers for their positive critiques that helped researchers to improve the quality of papers. We sincerely thank all the Session Chairs for their reviews and insights over presented papers. We would like to express our sincere gratitude to the keynote speakers: Shri. Hitesh Vaidya (Ex-Director, NIUA, India) and Ar. Sumita Singha (OBE, RIBA) for accepting our invitation and sharing their insights on compelling topics in architecture.

This Conference would not have been successful without authors who shared their research through the manuscripts. We congratulate them and wish them best with their research journey.

Along with these, we also wish to thank:

### **Conference Team:**

Dr. Avanti Bambavale (Conference Convener)  
Ar. Siddhi Joshi (Conference Co-Convener)  
Ar. Mandar Athavale (Conference Co-Convener)  
Dr. Swati Sahasrabudhe (Head, BNCA Research Hub)  
Dr. Amita Pradhan (Publication support)  
Mr. Umesh Chavan (BLMS support)  
Mrs. Harshada Gadgil (Admin support)  
Ar. Pooja Ghorpade (Technical assistance)  
Ar. Ketaki Kadam (Technical assistance)  
BNCA Information Technology (IT) team, Accounts and Administration staff

### **With Sincere Gratitude to:**

Dr. Sharvey Dhongde (Advisory Panel)  
Dr. Swati Sahasrabudhe (Advisory Panel)  
Dr. Aarti Verma (Advisory Panel)  
Dr. Chetan Sahasrabudhe (Academic Support)  
Dr. Vasudha Gokhale (Ph.D. Centre)  
Dr. Meera Shirolkar (Ph.D. Centre)  
Dr. Amruta Garud (Academic Support)  
Ar. Mahesh Bangad (Connecting with the dignitaries)  
Ar. Piyush Girgaonkar (Connecting with the dignitaries)

....

Dr. Avanti Bambavale  
Ar. Siddhi Joshi  
Ar. Mandar Athavale



## Keynote Speakers

### Day 01



**Shri. Hitesh Vaidya | Ex-Director | NIUA**

Mr. Hitesh Vaidya is the Ex-Director of the National Institute of Urban Affairs. He has over 20 years of experience in the field of urban management, urban governance and capacity building. He has been involved in providing technical assistance and capacity building support to several urban local bodies and instituting significant urban reforms at local level. He brings on board strong demonstrative experience of improving institutional capacities including developing strategies to support in delivering the program results. He has been associated in areas of urban development, urban governance and urban Infrastructure management with UN, World Bank, U.S. Agency for International Development (USAID) assignments. Poverty Alleviation has been an integral component in all his assignments. Prior to joining NIUA, he was the Country Representative of UN-Habitat in India. He was intensely involved in supporting an eco-system to design and roll-out urban programs including localizing Sustainable Development Goals. His strength lies in developing institutional arrangements and project implementation strategies through facilitating effective liaison and coordination with various stakeholders. Mr. Vaidya holds a Master's degree in Business Development and Post-Graduate Diploma in Urban Development & Planning and specialization in Urban Management from Institute of Housing and Urban Development Studies (IHS), Rotterdam, Netherlands.

## Keynote Speakers

### Day 02



**Sumita Singha | OBE | RIBA**

Sumita Singha is an architect, teacher, and writer with awards including UIA: UNESCO, Women In Business and Atkins Inspire awards. Sumita received an OBE for services to architecture in 2021. Sumita founded Architects For Change, the Equality forum at RIBA, and is past Chair of Women In Architecture. Sumita has served on RIBA committees for decades. Currently, she is a nationally elected RIBA Councillor and the Board Trustee for Education. Sumita served as a non-executive Director in the NHS for nine years. Sumita is a trustee of Architects Benevolent Society, Waltham Abbey Royal Gunpowder Mills and Commonwealth Association of Architects; and founding director of Charushila, an environmental design charity. She has also taught sustainable design for over 25 years and is an external examiner at several universities in the UK and abroad. Sumita is the author of many books and publications on architecture and sustainable design, including on women in architecture.

## Conference Session Chair



Dr. Vaishali Anagal  
Professor | BNCA



Dr. Mamatha Raj  
Director | BMS COA



Dr. Sudnya Mahimkar  
Director | BMS COA



Dr. Dhruv Chandwania  
Professor | BNCA



Dr. Aarti Verma  
Professor | BNCA



Dr. Atul Singhla  
Dean | LPU, Punjab



Dr. Sharvey Dhongde  
Professor | BNCA



Dr. Ujjwala Palsule  
Principal | MMCA



Dr. Vaishali Latkar  
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## Conference Session Chair



Dr. Rutuja Deshmukh  
Professor | SSPU



Dr. Shubhada Kamplapurkar  
Professor | BNCA



Ar. Sathya Prakash Varanashi  
Founder | Sathya Consultants



Dr. Parag Narkhede  
HOD | BKPS



Dr. Shubhangi Shirole  
Principal | MMIED



Dr. Swati Sahasrabudhe  
Professor | BNCA



Dr. Shishir R. Raval  
Professor | MS University



Dr. Sujata Karve  
Professor | BNCA



Ar. Vinit Mirkar  
Principal | IES COA

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The National Conference 2023: Built Environment and Beyond 2.0: Theory, Practice and Pedagogy organised by Dr. Bhanuben Nanavati College of Architecture and BRH received 44 papers out of which 6 manuscripts were selected for publication in the NICMAR Journal of Construction and Management.

We wish to acknowledge the authors for their contribution and congratulate them for publication in the NICMAR's Journal.

*Following papers were selected for NICMAR's Journal:*

**1. Spatial Assessment using Redevelopment Potential Index: An Urban Studies Studio Experiment**

Ar. Nilima Dhamal and Dr. Amruta Garud

**2. Water-edge public spaces & the city: analytical framework for studying coastal edge public spaces**

Ar. Urvashi Purohit and Ar. Jwalant Dave

**3. Understanding Material & Fabrication Constraint as a Pallet for Digital Design of a Non-Standard Glulam Pavilion**

Ar. Sayali Rahinj

**4. Reuse of Strength-Tested Concrete Cubes for Cost-Effective Construction Solutions**

Ar. Rupali Mahajan, Dr. Sujata Mehta and Ar. Aarti Shah

**5. Examining the value of traditional Blue Green networks and its potential for augmenting the existing grey infrastructure in historic cities: A case of Burhanpur**

Ar. Jinisha Lodaya

**6. Impact of tourism development on the spatial landscape: Case of Spiti valley region, Himachal Pradesh, India**

Ar. Neeti Trivedi and Ar. Rushikesh Deshmukh



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# 01

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## **TRACK 1: ARCHITECTURE AND PLANNING**

BNCA Conference Proceedings 2023



# Public Spaces and Street Vendors in Mumbai A Theoretical Understanding of Urban Reciprocity

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## **Abstract:**

*Street vending is not only one of the most prominent, observable and prevalent forms of the informality in urban areas; it is also one of the most resilient forms of the informal urban economy. It contributes towards the generation of economic activity at the neighborhood scale and also adds value to urban living by providing a necessary convenience of more direct access to numerous commodities and services for a far wider demographic spectrum than addressed by most formal means of distribution. This research focuses on the city of Mumbai, the financial capital of India, and attempts to identify the specific relationships that street vending activities develop with the public spaces within which they are conducted and the impacts it has on these spaces. It also investigates the influence that the physical form and spatial characteristics of the public space have on the type of vending activity and the manner in which it is conducted. The research examines the existing policies and legislation that govern street vending in India, as well as the specific scenarios that exist as the ground reality for street vending activities. It also relies on available scholarly literature and established theoretical concepts to develop a methodology to study these specific scenarios and identify the nature of the intrinsic interdependence between urban public spaces and street vending activities. A matrix of evaluation is derived from this methodology and applied to various areas of the city where street vending is prevalent to obtain and analyze tangible and measurable data. The findings reveal identifiable patterns of street vending associated with specific typologies of public spaces and these are organized into distinct categories. The research concludes with specific recommendations for developing a regulatory tool kit that addresses the needs and concerns of street vending activities in the context of the particular public spaces that host them while also ensuring that other activities of a public nature that are conducted in the same public spaces are not impacted adversely.*

**Keywords:** *street vending; urban informal economy; public spaces; social inclusion; regulatory controls*

## **1. Introduction:**

Informal economic activities are having a market value but do not directly contribute to the tax revenue of a city/state/nation, since they are not recorded. The International Labor Organization estimated (in early 2021) that about 60% of the global work force and about 80% of global enterprises were, at least partially, part of the informal sector of the global economy. The Indian economy has been classified as an *Emerging Market and Developing Economy* by the IMF in their *World Economic Outlook Database* published in October 2022, and ranked as the fifth largest economy on the global scale in the same database. At the same time, India ranks significantly lower on GDP per capita share (due to its large population and the increasing disparity in wealth distribution across the population).

### **1.1 Informal economies of Urban Street Vendors:**

Informal economic activities in Indian cities manifest in myriad forms, with one of the most visible and vital forms that is evident across cities being that of the *Street Vending*. Street vendors form an integral component of the urban economy making it dynamic and flexible by hawking their goods and services to potential customers, in public spaces that are well frequented by people and see extremely high footfall, thus literally bringing the market to their customers rather than having the customers come to the market. Street vending proliferates directly at the locality level and thus helps create a robust mechanism of urban growth and resilience, while adding vibrancy and social energy to public spaces that are not only inherently active due to high footfall, have a high degree of accessibility (physical, financial, temporal and universal), have greater safety, but are also more inclusive and diverse in terms of usage and more recognizable within the larger context of the city itself.

### **1.2 Problem Statement:**

Street vending contributes substantially to the social and economic vitality of urban public space and is instrumental in defining the spatial character of the public realm by shaping the lived reality of public spaces. While this demonstrates the inherent plurality and social inclusivity of public spaces it also highlights the central role that regulatory frameworks need to play in ensuring equitable access to these spaces and upholding the public right to inhabit and occupy them, as theorized by Edward W. Soja in his book “Seeking Spatial Justice”.

### **1.3 Area of Concern:**

Street vending is observed to be intrinsically entwined with the spatial character of public spaces and often endows them with their unique identities, thus necessitating it to be systematically integrated into these spaces. This can be achieved through a robust and dynamic legislative framework that governs not only the social and functional/economic dimensions of the activity but extends beyond to regulate the morphological/physical dimension of the activity. This would effectively integrate the vending activity with the physical realm within which it is conducted, thus imparting flexibility and plurality of use.

### **1.4 Aim of Research:**

The research aims to establish the relationship between the informal socioeconomic activity of street vending and the legislative and regulatory framework necessitated by it to favourably optimize the use of urban public spaces as socially plural and multifunctional realms of the city.

## 1.5 Research Question(s):

*Main research question:*

- What is the nature of reciprocity in the relationship between street vending activities and public spaces in metropolitan cities such as Mumbai?

*Research sub-questions:*

- What are the identifiable characteristics of public spaces that act as enabling factors for conducting the activity of street vending within them?
- What are the scales of public space at which street vending activities thrive?
- How does the scale of the public space influence the types/variety/diversity and the
- Magnitude/concentration/volume of street vending activity conducted within it?

## 1.6 Research Objectives:

- To identify the reciprocity in the relationship between urban public spaces and street vending.
- To identify the scales of urban public space that supports this reciprocal influence.
- To determine the relationship of proportionality between the location and scale of the public space and the diversity and magnitude of street vending that occurs within it

## 1.7 Hypothesis:

Street vendors in cities such as Mumbai, provide an essential means of distributing a host of goods and services directly to end consumers, becoming a necessary convenience of access and significantly adding value to urban living.

Therefore, street vending needs to be acknowledged as an urban value added activity that has a legitimate right to the public spaces that it is conducted within for optimal access to the end consumers.

## 1.8 Significance of Study:

Street vending is not only one of the most visible forms of the informal economy in urban areas, but due to this visibility is also one of the most vulnerable forms of informal economic activity. The social perception of street vending is also significantly polarized with frequent and volatile fluctuations between protection and persecution, often existing in a fluid state of negotiated tolerance.

Moreover, while the past decade, particularly in the wake of the COVID19 pandemic and consequent lockdowns, has seen significant and positive transformation in the government's stance towards street vending by initiatives such as the provision of; legislative protection through the *Street Vendors (Protection of Livelihood and Regulation) Act, 2014*, financial inclusivity through schemes such as *Pradhan Mantri Street Vendors Atmanirbhar Nidhi Yojna* and social welfare through the *Support to Urban Street Vendors (SUSV) under the Deendayal Antyodaya Yojana National Urban Livelihoods Mission*; these measures remain largely on paper and the policy framework has not translated to benefits on ground for the street vendors. It is therefore imperative to understand the potential of utilizing these legislative initiatives to create an inclusive and progressive socioeconomic environment that positively affects the integration of this most prominent facet of the informal economy into the formal economy at the local, national and global levels.

### **1.9 Scope:**

This research focuses on studying the various manifestations of the activity of street vending and includes the diversity of locations, modes and products that are observed in urban street vending in India. Further, the research focuses on street vending from the lenses of sociology, economics and legislation to establish the degrees of reciprocity that exist between the activity and the space that it inhabits.

### **1.10 Limitations:**

This research is restricted to studying street vending activities within the jurisdictional boundaries of the Municipal Corporation of Greater Mumbai (MCGM) while taking references of global, national and local examples in order to ensure a focused and localized study of a diverse and global phenomenon. The research does not specifically view the political dimension independently and instead studies the political implications and influences on street vending through the sociological, economic and legislative dimensions.

## **2. Literature Review:**

The research reviews available scholarly academic literature on street vending as an urban activity as well as existing legislation and policy framework for street vending in India, while applying the lenses of sociology, economics and legislation to understand not only the role that street vending plays in cities, but also the ways in which it shapes urban life and urban public spaces where it is conducted. The literature has been categorized according to key themes that illustrate the underlying mechanisms through which street vending activities and public spaces influence each other, and organizes the inferences so as to develop a clear understanding of the of sociological, economic and legislative importance of street vending as an urban phenomenon.

### **2.1 Sociological Perspective:**

#### ***Understanding street vending, its types and distribution:***

The existence of street vending can be traced through the history of human civilization, across different cultures and countries, adding vitality to a city's public spaces and generates economic activity at the local scale of the neighbourhood. The situation of street vending as observed in India confirms that it is more prevalent in urban settlements, with Central Government data from 2017-18 showing about 90% of the workforce being employed in the informal sector and about 14% of this being street vendors. Street vending is an informal enterprise that can operate at significantly smaller scales requiring minimal financial investment, making it especially attractive to migrants and other urban poor who cannot afford other means of enterprise and usually lack adequate education to be absorbed into the formal economy.

The Street Vendors Act of 2014 uses spatial criteria and takes into consideration the distribution and concentration of street vendors in a public space. It identifies four typologies of vending zones as; *Public Spaces* (open spaces within the city that are accessible to the public and primarily serve the purpose of passive and active recreation); *Natural Markets* (neighbourhoods that have traditionally hosted formal markets, retail and commercial activities within the city and are identified as the city's commercial hubs); *Streets* (the axes within the city that provide movement and access to various modes of transportation within particular neighbourhoods); and *Railway Stations* (the primary transportation hubs within a city).

The National Policy on Urban Street Vendors, 2009, uses the status of mobility and adaptability of the street vending activity to identifies three typologies of vending based on the type of cart/stall/kiosk that is used by the street vendor. *Stationary* vendors, who have a fixed stall at a specific location; *Peripatetic* vendors, who tend to carry out the vending by moving from place to place and time to time with a moveable cart or stall; and

*Mobile* vendors, who move around across a place and constantly circulate as they vend from a mobile cart or bicycle mounted stall. A number of scholarly research papers also classify street vending activities in a similar manner, describing the stalls variously as “kiosks, heavy stalls, heavy mobile stalls, pushcarts or stalls on wheels, etc.” or as “fixed, semi-fixed and mobile or itinerant vendors”

These methods of classification demonstrate that while street vending appears to be a largely uniform and homogeneous phenomenon, in practice it is a complex activity comprising an extremely broad spectrum of legal, albeit, informal trade activities, manifesting in a diversity of forms and modes. Street vending is therefore perceived to be a pervasive and resilient activity that without adequate regulation permeates into most of the available public spaces and proliferates a form of urban informality at the most local scale in the city. This perpetuates a negative perception of street vending resulting in public attitude towards street vendors fluctuating constantly between *protection* and *persecution*.

### ***Perceived social ramifications of street vending:***

The opposition to street vending primarily appears to stem from its perceived illegality and unregulated nature of operations, and often manifests from four directions; first, as being detrimental to the value of a neighbourhood; second, as being a nuisance to the well-being of local residents and businesses; third, as being the primary cause of chaos on public roads, streets and opens spaces; and fourth, as being damaging to the environment due to the lack of accountability for managing the waste it generates. This is especially evident in neighbourhoods where a large number of stakeholders having specific but often conflicting interests, focus their attention on the street vending activities attributing to them any observed disorder, congestion, pollution and a general unsightliness. Such areas are predominantly the central business districts, neighbourhood level commercial centres or retail spines, transportation terminals and recreational spaces such as sports centres, entertainment centres and tourist attractions, and have been identified as “conflict zones” by Bromley (1978, 2000). It is interesting to note that these correspond directly with the four typologies of vending zones classified by the Street Vendors Act of 2014.

The support for street vending, on the other hand, appears to stem primarily from the perspective of humanitarian values and economics, usually manifesting from four directions; first, as a right of all citizens, especially the most marginalized and poor, to be able to practice an occupation involving the trade of legal goods and services as a livelihood; second; as a form of social welfare that brings together various stakeholders in a neighbourhood creating social and economic linkages between them; third, as an economic activity that contributes directly to the widest spectrum of the local demography while encouraging entrepreneurship within the neighbourhood communities and generating innovative ideas for new enterprises; and fourth, as a politically beneficial stance to endorse the idea of the right to livelihood for all citizens, and a political opportunity to win the favour of a significant urban constituency.

### ***Innovation, Adaptability and Resilience of Street Vending in urban areas:***

As observed earlier, street vending is one of the most innovative, adaptable, and resilient forms of the informal urban economy being a vital component of the larger urban ecology as one of the most efficient mechanisms to distribute essential products and services to the widest spectrum of the urban demography including citizens who may lack access to formal channels of distribution. Street vendors’ associations, having large numbers of members often exercise some degree of negotiation with local authorities and other government bodies. These associations may also leverage a greater degree of access to formal financing for their individual members.

Additionally, local non-governmental organizations concerned with the general welfare of the city and its population, especially the most vulnerable sections, also provide much needed professional support. Street vendors also tend to be fiercely territorial of their pitches and often have conflicts among themselves over the right to conduct their trade at a particular place. Such issues are less prominent in the case of street vendors

who have established themselves over a number of years and are generally recognized as much for their location than for their wares.

In certain cases, formal retail and commercial establishments develop a mutually beneficial relationship with street vendors allowing specific vendors to operate in front of the formal establishments. This helps in attracting more footfall for both and provides customers of either with value addition from the other. Garment shops often allow tailors to set up outside their premises allowing them access to infrastructure such as power and water, in order to provide their customers with the value added service of alterations which they may themselves not offer.

## **2.2 Economic Perspective:**

### ***Reasons for the emergence of street vending in urban public spaces:***

The factors that lead to the emergence of street vending in public spaces tend to be primarily economic in nature, and may arise from a variety of situations such as, migration to urban areas to escape poverty, loss of employment in a formal sector of the economy, lack of alternative employment in public or private sector enterprises and the attraction of starting up a business, albeit informal, with minimal financial inputs and risks.

### ***Perceived economic ramifications of street vending:***

Street vending is sometimes perceived to be an unfair competition to formal retail and commercial establishments since it operates without the overheads of rent for space, staff and access charges for infrastructure services such as power, water, sewerage and waste disposal. Moreover, since street vendors rarely provide any guarantees to back their wares, this is also seen to be an unfair advantage favouring street vending.

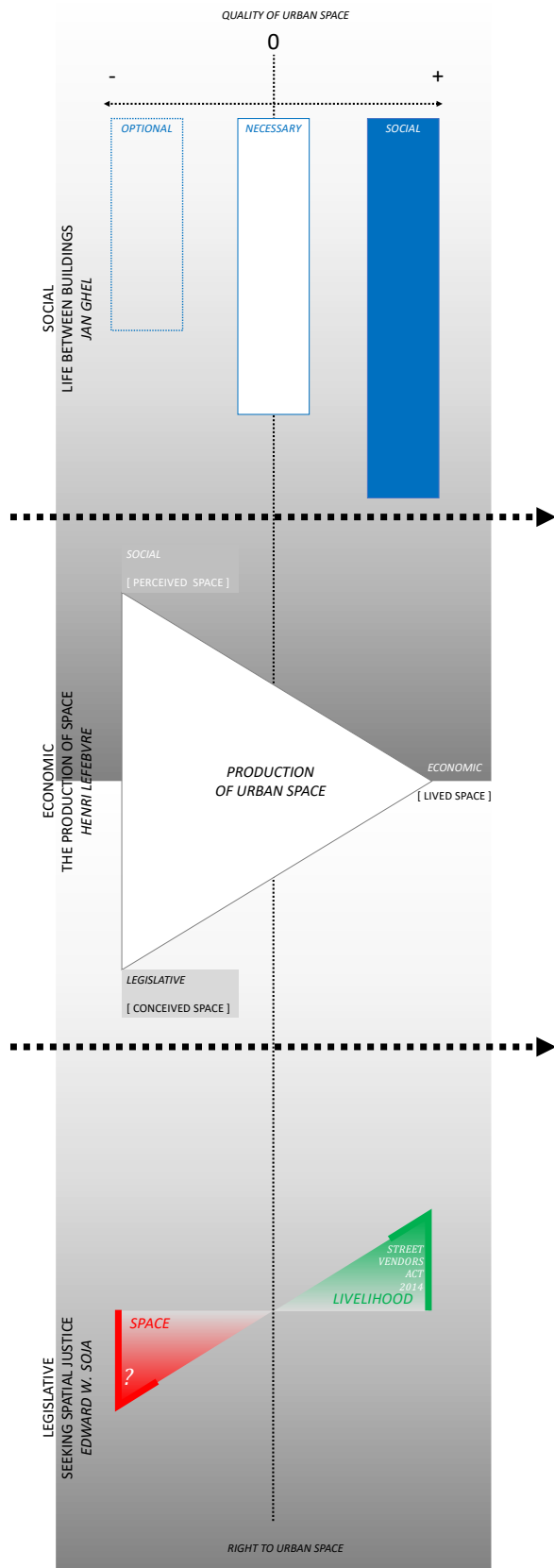
This leads to stigmatization and stereotyping of street vendors as sellers of substandard products and services, affecting them negatively and excluding them further from the formal economy. Financial exclusion also occurs due to the lack of regulated and government backed welfare schemes that provide vital services such as credit, insurance and microfinance.

The link between access to such financial services and economic growth through formalization and financial inclusion is an observed and established fact. Further, research has also established a clear link between the availability of microfinance through Micro Finance Institutions (private sector financing entities) and the reduction of poverty.



### 2.3 Legislative Perspective:

#### *Necessity for legislation of street vending activities:*



In India, the Street Vendors (Protection of Livelihoods and Regulation of Street Vending) Act, 2014, provides the legislative support required to protect the rights of street vendors to conduct street vending as their livelihood activity and is a first step towards the gradual integration of street vending into the formal economy. It also provides the framework required to develop specific regulations and controls for street vending within the administrative jurisdiction of cities and places the onus on urban local bodies (local or municipal authorities) to develop and implement such regulations. The complexities of developing regulations that address an extremely broad range of scenarios and involve multiple stakeholders with diverse and often conflicting interests, have constrained urban local bodies from developing and implementing such regulations. A deeper understanding of street vending activities and their relationship with urban public spaces, while fundamental to the development of any comprehensive regulations, is severely lacking.

This makes it a concern of urgent importance, both to address the livelihood needs of street vendors, and to address the larger planning needs of the city, such as developing integrated and inclusive design strategies that promote the inclusive and balanced growth of the city by enhancing the quality of the public spaces, leading to a more supportive and inclusive urban economy that protects the rights of all citizens, especially the street vendors who have so far been neglected and excluded from integration into the formal economy.

#### *Challenges in regulating street vending activities:*

The Street Vendors Act, 2014 mandates every urban local body to form a Town Vending Committee, but only a few cities have succeeded in this. Most, including the Municipal Corporation of Greater Mumbai, have even struggled with conducting accurate census surveys or documenting the existing situation of street vending in the city.

Figure 1: Production of urban space (Source: Author)

**Complexities in drafting appropriate regulatory framework:**

The process of drafting an appropriate regulatory framework for street vending in urban public spaces, that addresses the diverse interests of all stakeholders, and also ensures the minimization of the impact of any one stakeholder activity on others is a complex task, and requires a broad study of the diversity of expression in street vending, its intrinsic relationship to the public spaces and its impacts on other public activities.

Parameters Derived from Conceptual Framework						
Key Concepts	Attributes/ Characteristics	Tangible/ Quantitative	Intangible/ Qualitative	Street Vending	Variables	Indicators
<b>QUALITY OF OUTDOOR SPACE AFFECTS DEGREE OF OUTDOOR ACTIVITY</b> Life Between Buildings Jan Gehl	Necessary Activities	Minimum dependence on External Influences, such as : Time, Place and People Planned, <i>ROUTINE</i>	✓	✗	Daily shopping: Groceries such as: (Vegetables, Fruits, Dairy, Eggs, Fish, Meat, etc.)	Vicinity to point of source (home/work/etc.)  Number of vendors/ Frequency of visiting Time spent in shopping  
	Optional Activities	Moderate dependence on External Influences, such as: Time, Place and People Planned, <i>VOLUNTARY</i>	✗	✓	Occasional Shopping: Clothing items, mobile accessories, etc.	Identity of vending area from type of product sold there  Time of day of visiting?  
	Social Activities	Maximum dependence on External Influences, such as: Time, Place and People Spontaneous, <i>RESULTANT</i>	✓	✓	Incidental Shopping: Tea, snacks, etc.	Familiarity of vending area and vendors  Number of contacts Duration of Contact during visits  
<b>CAPITALISM INTRINSICALLY DEPENDENT ON PRODUCTION OF URBAN SPACE AND HENCE GROWTH OF CITIES</b> The Production of Space Henri Lefebvre	Perceived Space Association of Abstract Values with Space	Power, Scarcity, Identity, Safety, Status, etc.	✗	✓	Sociological Perception of Street Vending: As a contributor to vitality and safety in public spaces. OR As a contributor to illegality and conflict in public spaces.	Cleanliness at vending area  Number of garbage bins available  
	Lived Space Use and Inhabitation of Space	Space as Capital, Monetary value	✓	✗	Economic Perception of Street Vending: As a contributor to the generation of economic activity at the informal level. OR As a competitor to the organization of economic activity at the formal level	Volume of sales at vending area  Number of Customers/ Footfall  
	Conceived Space Quantification and Definition of Space	Measurement, Dimensions, Boundaries	✓	✓	Legislative Perception of Street Vending: As a means of livelihood that has legal protection OR As a public nuisance that is an illegal occupant of public space	Congestion, Crowding at vending area  Number of stalls per square unit length Size of stalls  
<b>THE SPATIALITY OF JUSTICE AFFECTS SOCIETY AND SOCIAL LIFE AS MUCH AS THE SOCIAL PROCESSES SHAPE THE SPATIALITY OF SOCIETY</b> Seeking Spatial Justice Edward W. Soja	Freedom as predominantly economic notion that does not affect geography	Legislative production of urban growth	✓	✗	Right to Livelihood without the right to public space for conducting livelihood activity of street vending	Legality of vending  Status of notification of vending area  
	Justice as a concept more effective in addressing the social cleavages of class, race(cast) and gender	Social production of urban growth	✗	✓	Projection of social discrimination of class, cast and gender onto vending zones and street markets as poorer spaces of the city	People's perception of safety within vending area  Limitations on access based on gender, class, etc.  
	Collective right to urban space most effectively addressed at regional scales	Economic production of urban growth	✓	✓	Right to space embedded within the physical dimensions of public spaces instead of limiting access to only defined vending zones	Factors enabling vending activities  Availability of infrastructure for vending activities (power, water, sewerage, waste disposal, etc.)  

IDENTIFICATION OF VARIABLES AND INDICATORS FOR STUDYING VENDING ACTIVITIES

Figure 2: Identification of variables and indicators for studying vending activities (Source: Author)

## 2.4 Conceptual Framework:

The principles proposed by Jan Gehl in *Life Between Buildings: Using Public Space* (originally published in Danish in 1971 by Arkitektens Forlag, first translated to English and published in 1987 by Van Nostrand Reinhold, New York) are applied to street vending in order to understand its role in encouraging Social Activities that happen within public spaces. The research categorizes street vending into *Necessary Shopping Activities* (e.g. shopping groceries and food items, usually performed daily) and *Optional Shopping Activities* (e.g. shopping clothes and accessories, usually performed weekly or monthly) and investigates their influence on increasing *Social Activities* that happen within any public space. These activities are measured using the three metrics of *Density, Diversity and Duration* of street vending since these three indicators are directly proportional to the number of opportunities of social interaction that happen while conducting the necessary or optional shopping activities.

By applying Henri Lefebvre's *Production of Space* theory to the study of urban street vendors, the research distinguishes the use of urban public space by the street vendors for vending activities into three distinct yet intertwined methods that correspond with the three categories of space defined by the theory. These are elaborated as:

### ***The Perceived Space:***

This is the way humans associate abstract values to space. It involves the association of concepts such as power, sanctity, etc.

SOCIOLOGICAL perception of space is explored through this category.

### ***The Conceived Space:***

This is the way humans quantify and define space. It employs processes such as measuring and surveying space, drawing boundaries to define it, allocating uses to it, etc.

LEGISLATIVE perception of space is explored through this category.

### ***The Lived Space:***

This is the way humans actually use and live within the space. It brings together the conceived and perceived aspects and is often the way that humans utilize space as capital, to create monetary value from the space, etc. Economic perception of space explored through this category. The research also applies the concept of "Spatial Justice" as proposed by Edward W. Soja in his book *Seeking Spatial Justice* (University of Minnesota Press, 2010; reprinted 2013). The research methodology is principally structured around understanding urban public space used for street vending through the three key aspects concerning the activity of street vending, i.e. the legislative perspective, the social perspective and the economic perspective.

The above three theories are applied in unison to derive a cohesive framework within which the interactions between street vending activities and the public spaces that host these activities are studied to understand the intrinsic spatial relationships between them. This framework is further utilized to determine a comprehensive set of parameters and define the observable and measurable indicators of these parameters, in order to systematically study specific districts which, support the various modes of street vending observed in the city.

The research is informed by the literature review as well as the existing legislative framework for street vending in India, to identify the four typologies of public spaces within a city where street vending activities are predominantly observed; *Public Open Spaces, Natural Markets, Streets, and Railway Stations*.

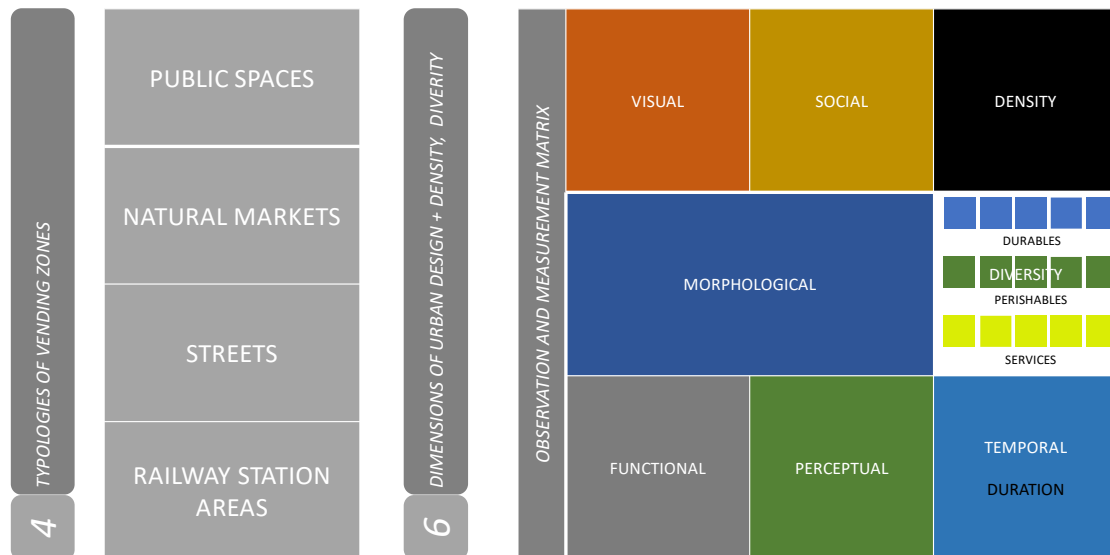


Figure 3: Typologies of vending zones (Source: Author)

The research also utilizes the six dimensions of urban design as defined by Matthew Carmona in the book *Public Places - Urban Spaces* (Routledge, 2003, 2012) to create a matrix of study within which the indicators derived through the conceptual framework are placed and the matrix is applied to specific examples of each of the four identified typologies of street vending zones within the city.

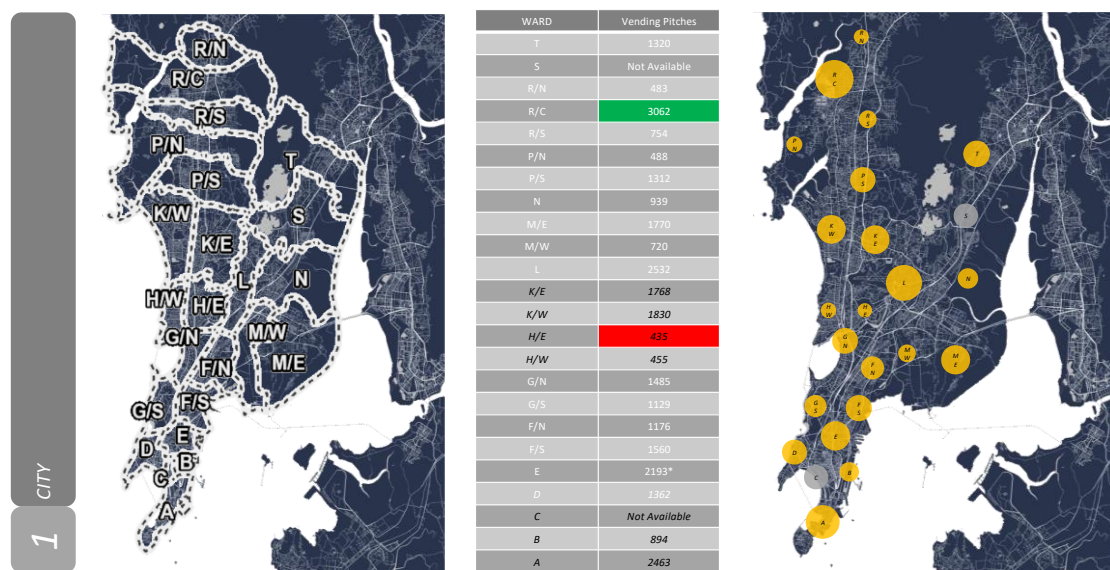


Figure 4: Vending pitches in wards (Source: MCGM Hawking Pitches Database)

The Municipal Corporation of Greater Mumbai’s database of identified vending pitches in Mumbai is utilized to select the specific examples of the four vending zone typologies. The H-West and K-West administrative wards are selected for the study due to; the geographical adjacency of both wards; the contrast in the geographical size and population density of both wards; the diversity of development (residential, commercial, mixed use, social amenities and recreation) within both wards; the presence of well-developed network of transport within both wards and good degree of connectivity with the rest of the city through these networks; and most importantly the presence of all four typologies in relative proximity to each other in both wards.

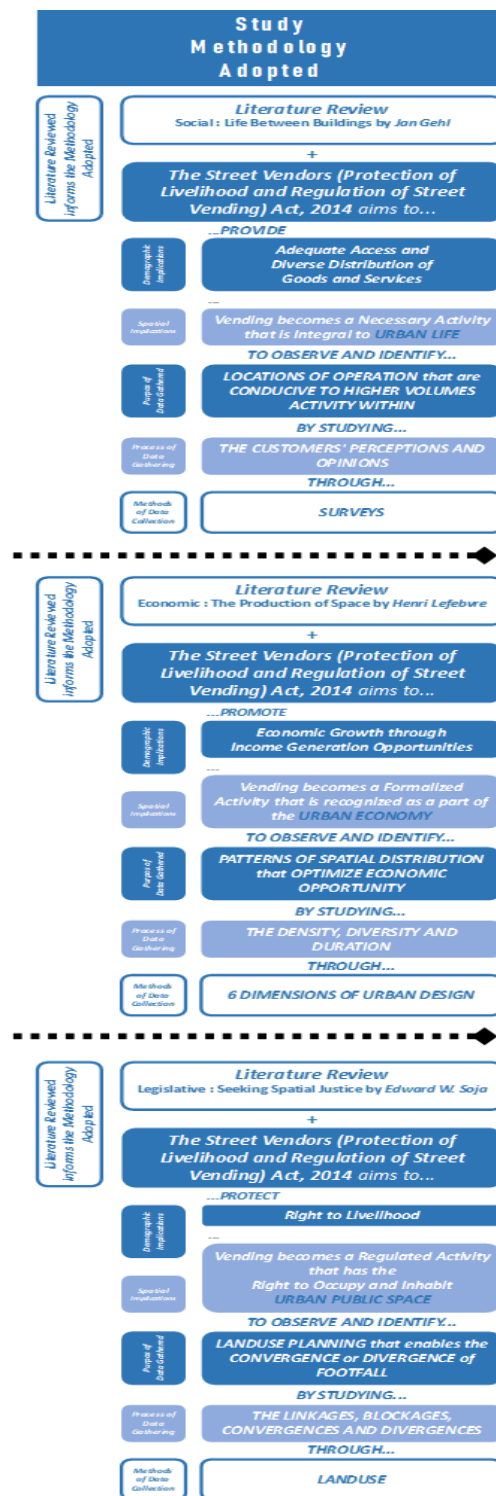


Figure 5: Methodology of study (Source: Author)

### 3. Methodology of Study:

The research also adopts a distinct methodology from each of the three theoretical backgrounds of the conceptual framework in conjunction with the legislative framework of “The Street Vendors (Protection of Livelihoods and Regulation of Street Vending) Act 2014, to address the three distinct lenses (sociological, economic and legislative) used to study the phenomenon of street vending.

In each case, the demographic and spatial implications of street vending when perceived through that particular lens are identified and utilized to define the specific purpose and type of data to be collected, as well as the process and methods to be used for collecting this data.

***Sociological Perspective:***

By using the theoretical background proposed by Jan Gehl in *Life between Buildings*, the research identifies *adequate access and diverse distribution of goods and services* as the demographic implication and views the role of street vending as *a necessary activity for urban life* as the spatial implication. The purpose of the data here is to provide observable information about the *locations that are conducive to supporting high volumes of street vending activities*, with the process of data collection being the *study of customers' perceptions* and the method of data collection being *surveys*.

***Economic Perspective:***

By using the theoretical background proposed by Henri Lefebvre in *The Production of Space*, the research identifies *economic growth through income generation opportunities* as the demographic implication and views the role of *street vending as a formalized activity for the urban economy* as the spatial implication. The purpose of the data here is to provide observable information about the *patterns of spatial distribution of street vending activities that optimize economic opportunity*, with the process of data collection being the *study of density, diversity and duration of street vending activities* and the method of data collection being *through a study of the six dimensions of urban design*.

***Legislative Perspective:***

By using the theoretical background proposed by Edward W. Soja in *Seeking Spatial Justice*, the research identifies *the right to livelihood* as the demographic implication and views the role of *regulations in endowing street vending activities the right to occupy public space* as the spatial implication. The purpose of the data here is to provide observable information about *land use planning that enables the attraction and flow of footfall*, with the process of data collection being the *study of linkages, blockages, convergences and divergences of street vending activities as a direct result of land use planning* and the method of data collection being *through a study of the presence of land use magnets and transportation routes of the footfall*.

**3.1 Land Use:**

***Land Use Magnets:***

In a typical urban scenario, land uses such as *Commercial, Transportation and Social Amenities*, act as *magnets* and attract large volumes of *footfall* to the interconnecting street networks.

***Footfall Linkages:***

These *magnets* have their own influence areas, and play a crucial role in determining the volume and direction of the flow of *footfall*. They form important *linkages* for vending

**Impact on Street Vending:**

The streets carrying the *footfall* around these *magnets* become ideal spaces to support Street Vending, and directly influence the Density, Diversity and Duration of Vending Activities.

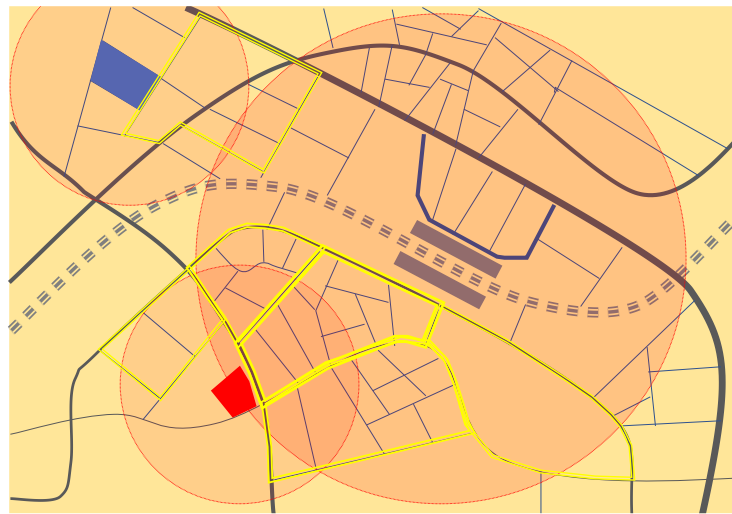


Figure 6: Transportation hub, social amenities, commercial premises, public spaces with potentially high footfall (Source: Author)

Diagram showing the extents and overlaps in influence zones of different land use magnets, and public spaces most likely to host high footfall due to these land use magnets

**3.2 Six Dimensions of Urban Design:**

MORPHOLOGICAL	VISUAL	FUNCTIONAL	SOCIAL	TEMPORAL	PERCEPTUAL
PHYSICAL CHARACTERISTICS OF VENDING LOCATIONS	METHODS ADOPTED FOR OPTIMIZING VISIBILITY	PHYSICAL DIMENSIONS OF VENDORS' CARTS/STALLS	PERCENTAGES OF TYPES OF INTERACTION ENABLED	PATTERNS OF OPERATION OVER DIFFERENT SPANS OF TIME	SENSORY PERCEPTION OF STREET VENDING ACTIVITIES WITHIN PUBLIC SPACES
Height of Compound Walls	A) FOREGROUND FEATURES :	Footprint, height, shape and size	1. Necessary (items of daily necessity)	Period / Segment of day for operations :	Distinctive calls to advertise wares
Width of Footpath / Sidewalk	Carts/Kiosks form and design	Area required for vendors to operate :	Lead to daily encounters and develops sociability	Morning, Afternoon, Evening, Night	Distinctive smells of wares especially food
Height of Railings / Barricades	Product displays, arrangement of wares / goods	Access to wares / goods, equipment (sitting / standing)	2. Optional (items bought periodically)	Operational hours during that period :	Sense of touch due to compact arrangements in restricted spaces
Width of Parking lane, Carriage Way, Divider	Signage used to add visibility to cart / stall	Area required for customers to circulate :	Lead to chance encounters and develops familiarity	Number of Hours per Day	Distinctive tastes of food items
Height and Spread of Street lights	B) BACKGROUND FEATURES :	Access to stall, products, vendor (standing / moving)	3. Social (shopping as a social activity)	Variation in Volume of Vending Activity (customers / hour)	IMAGIBILITY OF PUBLIC SPACES THAT HOST STREET VENDING
Distance between Trees and size of canopy	Condition of Compound Walls	Area required for storage, equipment, etc.	Lead to intended opportunities for socializing	Maximum Footfall hours	Perception of street vending contributing to the public space:
Availability of other Street Furniture	Character of Building Facades	Area required for waste disposal, etc.	4. Public Perception of vending activities	Average Footfall hours	Towards more sociability and interactions
Availability of Public Toilets and Waste Collection	Interaction with formal Shops : 1. Inclusion 2. Exclusion	Distance / Extent of circulation (territory) for Mobile Vendors	a. Congestion of surroundings OR b. Convenience of service	Historical presence of Vending Activities at the location	Towards value addition to urban life by providing convenience and diversity of access to goods and services
Availability of physical Infrastructure			5. Value addition to urban life		Towards more congestion and chaos



Figure 7: Six dimensions of urban design (Source: Author)

**Physical Characteristics of Vending Locations:**

The characteristics of public spaces / streets such as compound walls, footpaths, railings, etc.

**Foreground - Background:**

The components that make the foreground of the stall juxtaposed against the components of public space that provide the background

**Area Required:**

Length, Width and Height dimensions required for stall to function

**Congestion or Convenience:**

The time span during which vending activities are operational

**Time and Duration:**

The time span during which vending activities are operational

**Regulations:**

The regulatory frameworks that shape the public spaces

**3.3 Length of Frontage of Plots:**

**Situation A:**

Long frontage plots, larger distances between entry / exit points. This presents fewer opportunities for people to pause to interact while walking along the street, resulting in fewer opportunities for vendors to attract customers.

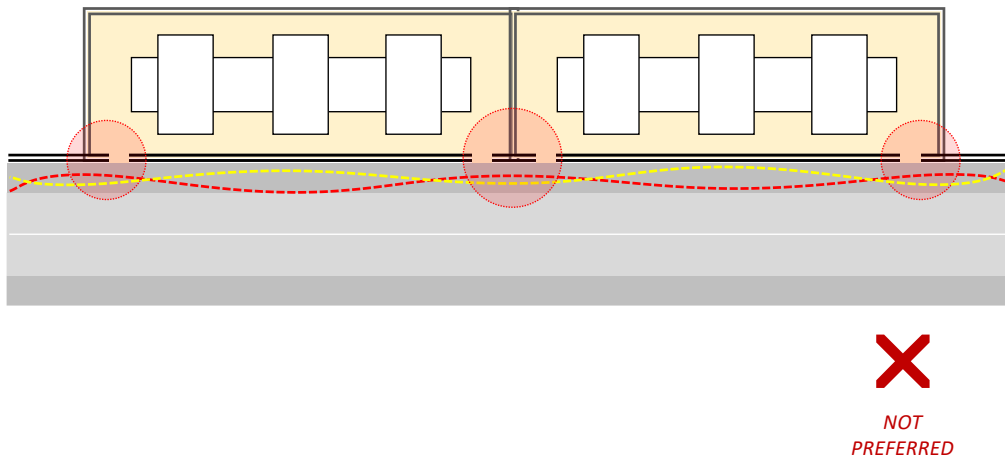


Figure 8: Large frontage plots and larger distances between entry/exit points (Source: Author)

**Situation B:**

Short frontage plots, short distance between entry / exit points. This presents more opportunities for people to pause to interact while walking along the street, resulting in more opportunities for vendors to attract customers.



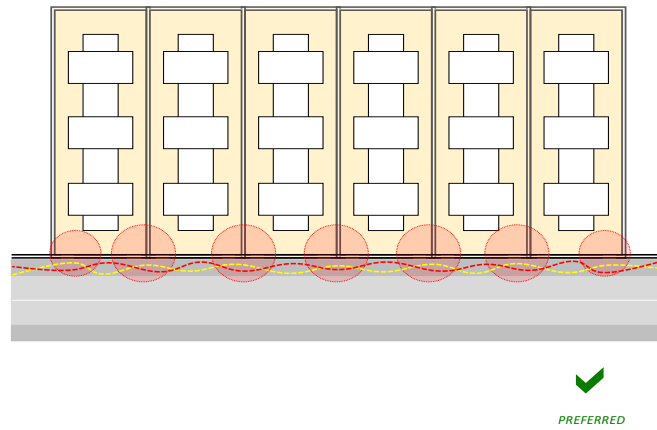


Figure 9: Short frontage plots and shorter distance between entry/exit points (Source: Author)

In *Life between Buildings*, Jan Ghel highlights the inverse relationship between length of frontage of plots and number of opportunities for social interaction observed along that frontage.

### 3.4 Surveys of Customers:

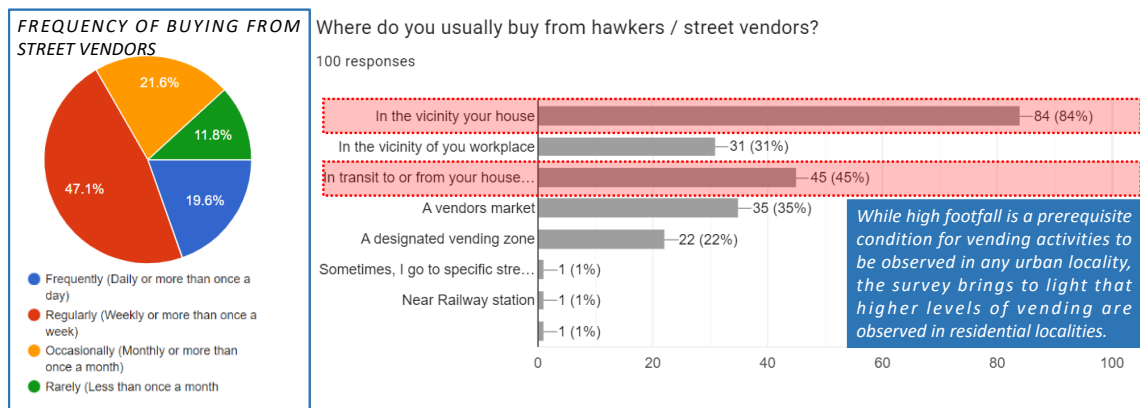


Figure 10: Frequency of buying from street vendors (Source: Author)

While high footfall is a prerequisite condition for vending activities to be observed in any urban locality, the survey brings to light that higher levels of vending are observed in residential localities.

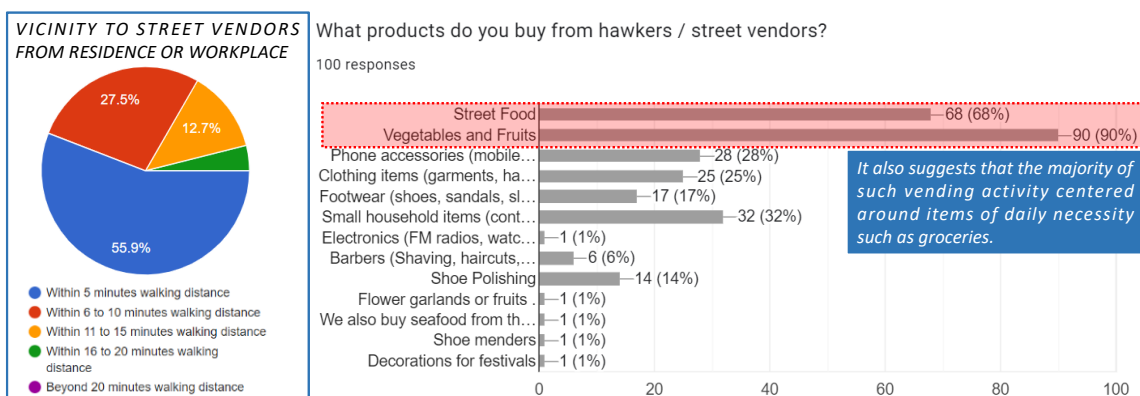


Figure 11: Vicinity to street vendors from residence or workplace (Source: Author)

It also suggests that the majority of such vending activity centred on items of daily necessity such as groceries.

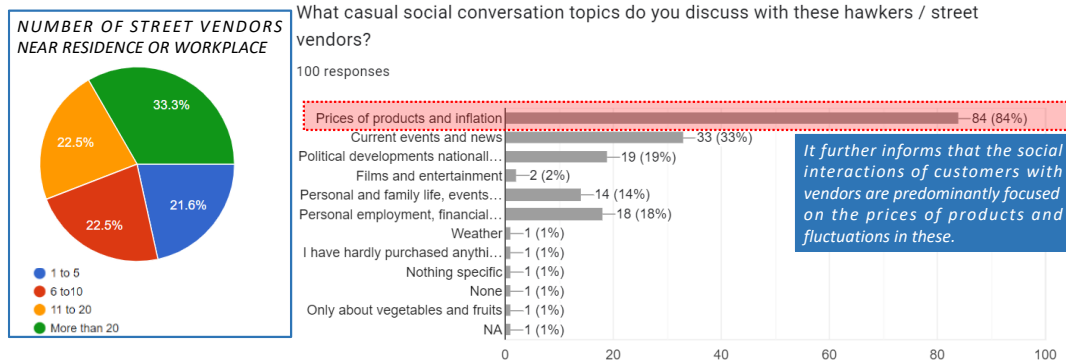


Figure 12: Number of street vendors near residence or workplace (Source: Author)

It further informs that the social interactions of customers with vendors are predominantly focused on the prices of products and fluctuations in these.

### Sections of Vending Streets:

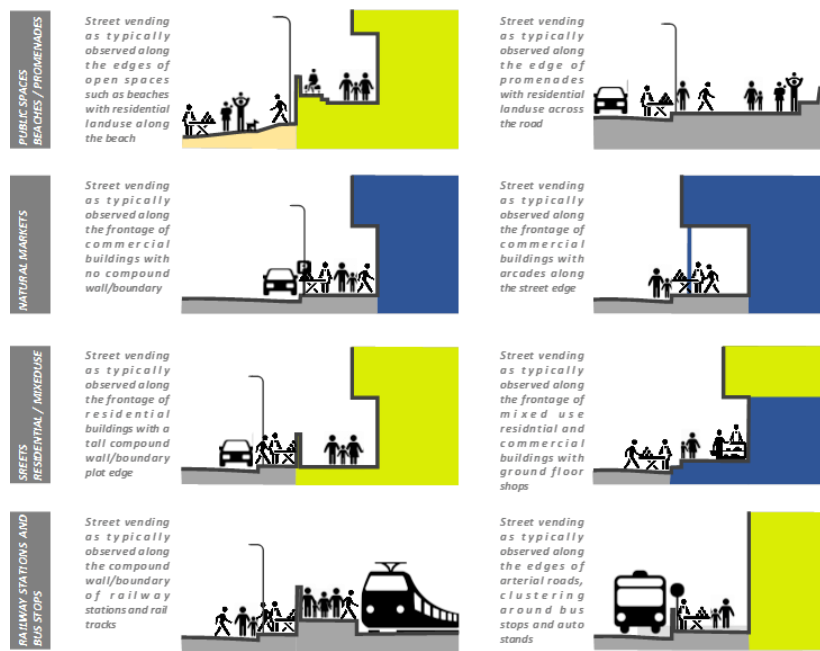


Figure 13: Sections of vending streets (Source: Author)

In *Seeking Spatial Justice*, Edward W. Soja argues that in urban areas all inhabitants of the city should have the right to not only access public space, but should also to shape this space equitably.

**Distribution of Street Vending Activities:**

	TYPOLOGY OF VENDING ZONES	DENSITY	DIVERSITY	M	P	F	DURATION
SPARSE	PUBLIC SPACES SILVER BEACH JUHU CHOWPATY JUHU BEACH CARTER ROAD	AVERAGE DENSITY OF VENDORS FOR A STRETCH OF 500m IS OBSERVED TO BE BETWEEN 5 TO 10 (<10)	QUICK SNACKS	✓			06:00 HRS TO 10:00 HRS  16:00 HRS TO 22:00 HRS  22:00 HRS TO 02:00 HRS
			PACKAGED DRINKING WATER	✓			
			SMALL TOYS	✓			
			INSTANT PHOTOGRAPH SELLERS	✓			
			TEA/COFFEE (MOBILE)	✓			
	NATURAL MARKETS JP ROAD, ANDHERI WEST R G GADKARI MARG, IRLA JUHU ROAD, SANTACRUZ WEST LINKING ROAD, BANDRA WEST	AVERAGE DENSITY OF VENDORS FOR A STRETCH OF 500m IS OBSERVED TO BE BETWEEN 10 TO 20 (<20)	QUICK SNACKS		✓		08:00 HRS TO 10:00 HRS  12:00 HRS TO 15:00 HRS  16:00 HRS TO 19:00 HRS
			FAST FOOD		✓	✓	
			PACKAGED DRINKING WATER			✓	
			TEA/COFFEE			✓	
			ELECTRONICS AND MOBILE ACCESSORIES		✓		
			STATIONERY		✓		
			COBBLERS			✓	
	STREETS VEERA DESAI ROAD, ANDHERI WEST  SAMARTH RAMDAS MARG, JVPD  TAGORE ROAD, SANTACRUZ WEST  HILL ROAD, BANDRA WEST	AVERAGE DENSITY OF VENDORS FOR A STRETCH OF 500m IS OBSERVED TO BE BETWEEN 20 TO 30 (<30)	QUICK SNACKS		✓		09:00 HRS TO 21:00 HRS  16:00 HRS TO 20:00 HRS
			FAST FOOD			✓	
			PACKAGED DRINKING WATER			✓	
TEA/COFFEE				✓	✓		
ELECTRONICS AND MOBILE ACCESSORIES				✓			
TOYS (SMALL AND LARGE)				✓			
STATIONERY				✓			
GARMENTS, SHOES, BAGS AND BELTS					✓		
RAILWAY STATIONS ANDHERI STATION WEST  VILE PARLE STATION WEST  SANTACRUZ STATION WEST  BANDRA STATION WEST	AVERAGE DENSITY OF VENDORS FOR A STRETCH OF 500m IS OBSERVED TO BE BETWEEN 30 TO 50 (<50)	QUICK SNACKS		✓		08:00 HRS TO 12:00 HRS  10:00 HRS TO 22:00 HRS  16:00 HRS TO 20:00 HRS	
		FAST FOOD			✓		
		PACKAGED DRINKING WATER			✓		
		TEA/COFFEE		✓	✓		
		GREEN GROCERIES		✓			
		ELECTRONICS AND MOBILE ACCESSORIES		✓			
		TOYS (SMALL AND LARGE)		✓			
		STATIONERY			✓		
		GARMENTS, SHOES, BAGS AND BELTS			✓		
		BARBERS			✓		
		COBBLERS		✓			
		TAILORS		✓			
DENSE	AVERAGE DENSITY OF VENDORS FOR A STRETCH OF 500m IS OBSERVED TO BE BETWEEN 50 TO 100 (>50)	APPLIANCE REPAIRMEN			✓	06:00 HRS TO 18:00 HRS	
		KITCHEN UTENSILS AND CUTLERY			✓		
					✓		

Figure 14: Distribution of street vending activities (Source: Author)

**3.5 Inferences:**

**Convergent and Divergent Zones of Street Vending Identified:**

The research studies parameters such as the volume, direction of movement and diversity of footfall, presence of land use magnets that attract footfall, and length of frontage of plots along streets through indicators such as the density, diversity and duration of street vending activities, and identifies two distinct categories of public spaces based on the type and mode of street vending conducted within them:

**Convergent Zones:** Where the predominant land uses bring footfall to these areas, *converging* it into the available public spaces

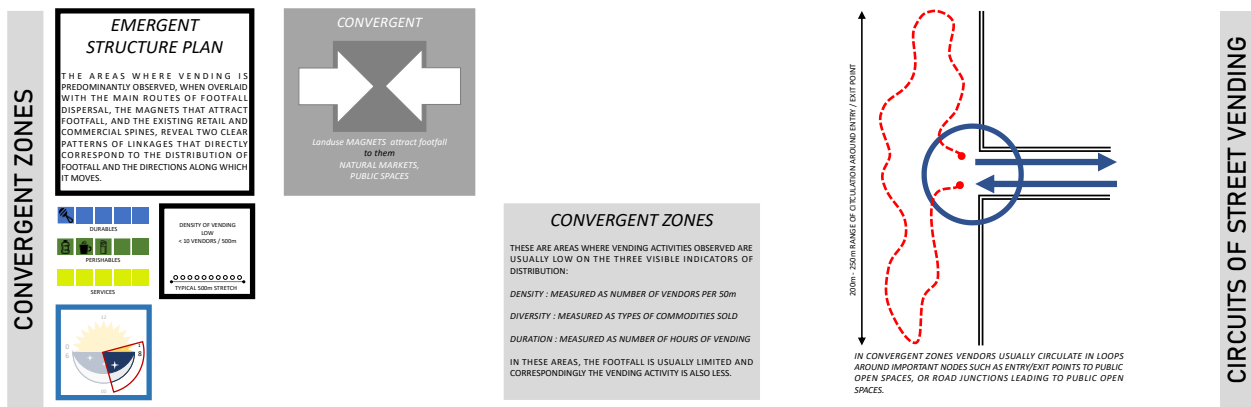


Figure 15: Convergent zones (Source: Author)

In such zones the dominant patterns of street vending are Circuits, where individual vendors have defined zones or territories of movement

Divergent Zones: Where the predominant land uses bring footfall *through* these areas, *diverging* it across the available public spaces

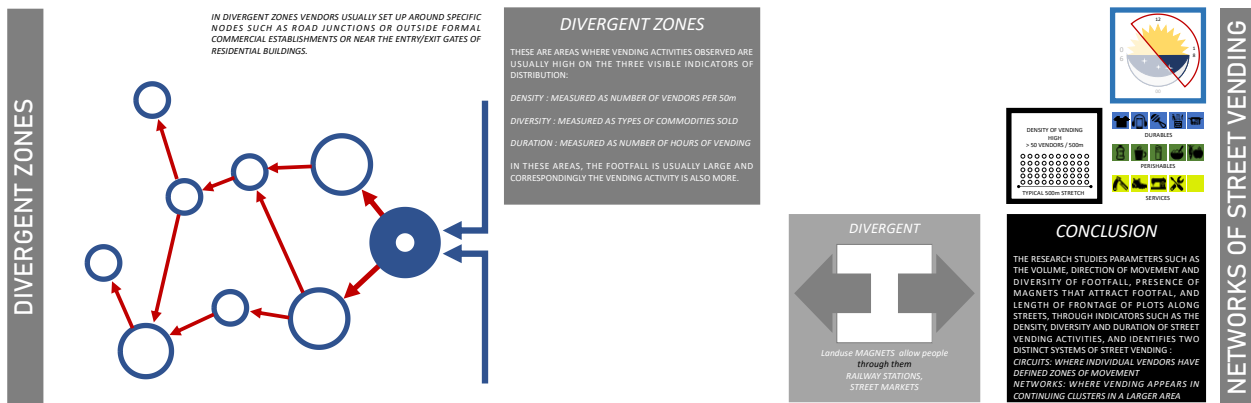


Figure 16: Divergent zones (Source: Author)

In such zones the dominant patterns of street vending are Networks, where street vending activities appear in continuing clusters spanning over a larger area. The research uses the predominant land uses and the direction and movement of footfall to or through a locality, to identify the direct relationship between the typologies of street vending activities and the type of land use that is predominant in that locality as illustrated by these two distinctly observable patterns.

Thus, *Circuits of Street Vending* that are usually observed in localities and neighbourhoods that are categorized as *Convergent Zones*, whereas *Networks of Street Vending* that are usually observed in localities and neighbourhoods that are categorized as *Divergent Zones*.

#### 4. Conclusions:

Street vendors show a great degree of innovation, adaptability and resilience to legislative hurdles and political fluctuations that they encounter frequently, as well as to the spatial constraints of the physical environment that they inhabit to conduct their livelihoods. This is evident in the myriad variations of displaying their wares suited to the available space and its characteristics. This research further demonstrates that beyond the morphology of a space, vending activity also significantly depends on numerous other factors that determine the category and distribution of street vending in that space.

While footfall remains the foremost among these, factors such as dominant land use and length of plot frontage also have substantial influence on the patterns of street vending activity supported within a space. The research thus identifies *Convergent and Divergent Zones* for vending and determines the predominant form of vending within each zone as being in *Circuits or Networks* respectively. The research suggests that in order to better address street vending in public spaces, the above framework can be applied to individually to different areas and based on the category and distribution of vending identified, a customized set of regulatory guidelines should be adopted for each area rather than applying a standard set of regulations across the entire city.

## 5. Recommendations:

The conclusions of the research provide a substantial degree of clarity on the approach that needs to be adopted to create regulatory frameworks and controls that suitably address the needs and concerns of urban street vending activities. Further, the research recommends that in order to ensure the smooth operation and integration of street vending activities into the public spaces within which they are conducted, while also ensuring that these do not impact the other public activities that are supported by these shared spaces, it is necessary to study the areas where vending is conducted and determine their typology as *convergent zones* or *divergent zones*, and identify the *circuits of vending* or the *networks of vending* respectively, that are formed as the street vending activities are conducted.

The regulatory framework and controls that suitably address the variety of activities contained within any particular public space, including street vending, need to be responsive to the pattern of street vending supported by that public space. This necessitates the application of a customized set of controls that are specific to not only the street vending activities being conducted in a particular public space, but also their patterns, and the spatial characteristics of that particular public space.

The research therefore proposes a *Regulatory Tool Kit* that has specific regulations that address these diverse characteristics of the public space and the street vending activities hosted within them. The intent of this regulatory tool kit is to make available a wide variety of control options that can be selected and customized to address the specific needs of a particular public space, locality, neighbourhood or geographical area based on its spatial needs.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Assessing the Changing Dynamics of Peri-Urban Areas in Metropolitan Cities

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## Abstract:

*Rapid Urbanization is leading to extensive population growth in metropolitan cities. The spillover effect of the increased population is reflected in the peripheral regions leading to peri-urbanization. These areas are facing serious problems in the planning of land use transformation affecting the peri-urban ecosystem. The paper is based on a systematic literature review of national case studies to gain insights into the key characteristics of peri-urban zones and identify the fundamental challenges for territorial management in metropolitan cities. It outlines the major problems related to governance, land use change and rent seeking interest groups to cope with the rapidly changing dynamics of peri-urban areas. It concludes with the discussion on multifaceted nature of the peri-urban areas and suggests participatory development strategy for metropolitan cities. The discussion culminates by suggesting to create a balance between center and periphery with a more democratic and sustainable approach, socio-economic opportunities, and citizen participation.*

**Keywords:** *peri-urbanization, land use transformation, governance, sustainability, citizen participation*

## 1. Introduction:

Urbanization refers to the ongoing phenomenon where a growing number of individuals are relocating to inhabit urban areas, including cities and towns. As urbanization continues to accelerate, it is often accompanied by a transformation of the landscape, as urban development expands into previously rural or natural areas. The transformation notably impacts peri-urban areas, which are situated on the outskirts of cities. The urbanization and peri-urban transformation process brings forth various social, environmental, and economic consequences. It is crucial to comprehend the challenges and opportunities it offers in order to strategize for sustainable development. In this paper, the key issues related to urbanization and peri-urban transformation are reviewed and their implications for planning and policy-making are discussed.

## 2. Methodology:

The literature review has concentrated on the urbanization process and the evolution of peri-urban areas. Publications detailing governance and land use change processes in peri-urban areas underwent systematic scrutiny. Titles and abstracts were initially screened, followed by a comprehensive evaluation of eligibility based on full-text examination. Publications were deemed eligible if they satisfied the three specified criteria:

- The publication's case(s) should be situated in a peri-urban area.
- Emphasis within the article should be placed on peri-urban governance.



- The article must detail land use change in peri-urban regions and its consequences, such as environmental effects or socioeconomic impacts.

The Scopus and Google Scholar databases were used for the search, given their exclusive inclusion of peer-reviewed publications, ensuring rigorous quality control for the evidence incorporated in this review. All searches encompassed review papers, journal articles, research reports, books published in English. Conference proceedings and grey literature were excluded, as they might entail ongoing or incomplete research.

PRISMA Statement tool is used for scrutinizing literature based on selection criteria's. (Moher et al., 2009). The available literature on "peri-urban transformation" in the field of urban planning, environmental sciences and social science were mapped. The time frame of two decades starting from year 2000- 2023 was selected.

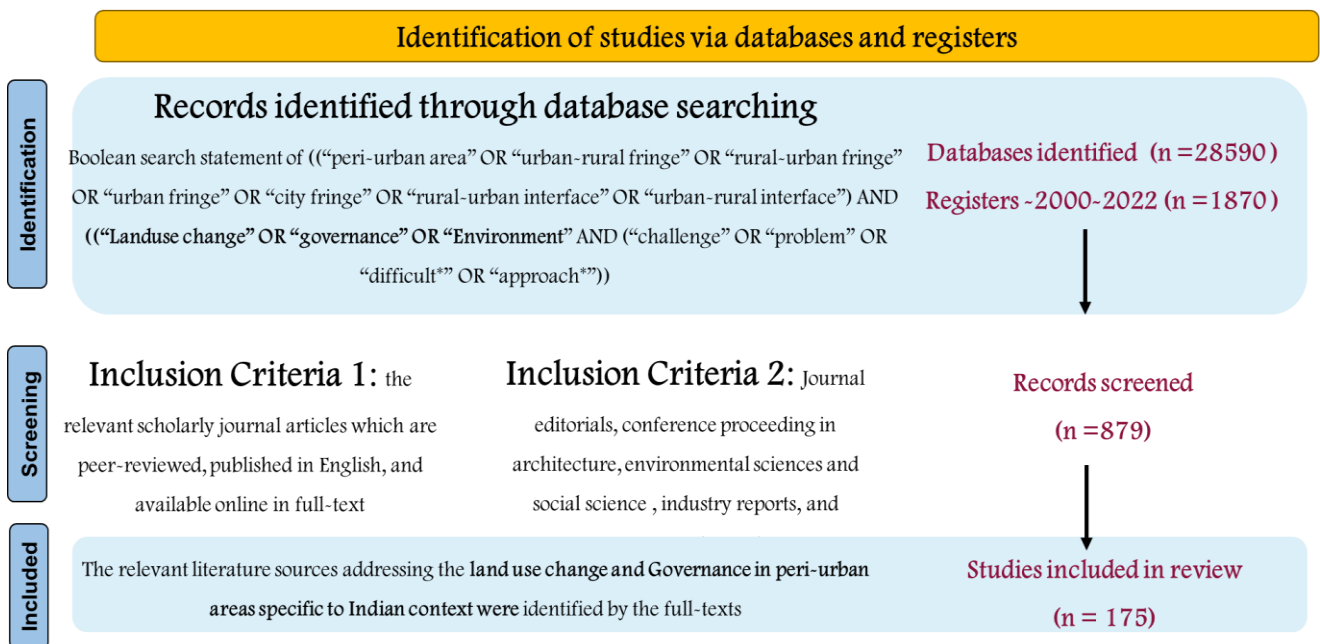


Figure 1: Combination of keywords used for the research in literature database (Source: Author)

Total of 175 articles were selected after assessing each article on the inclusion and exclusion criteria.

## 2.1 Results and Interpretations:

The results and interpretation are the crucks of all the 175 articles reviewed to interpret the changing dynamics of peri-urban areas in context of:

Land use change and its effect (110 No.)

Role of governance. (65 No.)

## 2.2 Peri-Urbanization and Land Use Change:

Urbanization is leading to increased demand for land and resources to satisfy the growing need of population. The cities are growing beyond the formal urban boundary and jurisdiction in an unplanned and haphazard manner (Maithani, 2020). This phenomenon is called urban sprawl and its manifestation is termed as peri-urbanization (Rosenzweig et al., 2018). These peripheral areas are undergoing transformation from primarily agricultural to more urban land uses. It consist of mixed rural and urban character making it increasingly complex and dynamic over time to manage (Cahya et al., 2018). Total of 95 papers out of 110 highlighted the concerns that Peri-urban region is undergoing destruction of natural habitats, increased pollution, and changes

in the local climate. In addition, these regions are also experiencing increased traffic and congestion, as well as the loss of open spaces and recreational areas (Matthew et al., 2022).

Out of 110 papers reviewed 85 No. of papers suggested the important change in peri-urban regions is the conversion of agricultural land to other uses. This is leading to decrease in the production of food and other crops, which is having negative economic consequences for farmers and others who depend on the land for their livelihoods. In addition, the loss of agricultural land is also leading to the loss of important ecosystem services, such as the ability to absorb carbon dioxide and provide habitats for wildlife. (Simon, 2008). Lisa Sharma (2016) looked at the relationship between land use change and social inequality in peri-urban areas in India. Total of 25 papers found that urbanization is leading to the displacement of poorer residents from the inner city to the outskirts of cities, where they often lived in informal settlements without access to basic services. Many papers found that these informal settlements were often vulnerable to flooding and other environmental hazards. Many metropolitan areas have a lack of coordinated planning and adequate funding for their surrounding municipalities, which leads to a phenomenon known as metropolitan fragmentation. This can exacerbate the poor living conditions experienced by people who have recently moved to these areas (Haroldo Da Gama Torres 2008). In general, however, land use changes have a significant impact on the environment, economy, and quality of life of people (Vejre, 2009).

Most of the literature has talked in context of land use change and its effect on environment followed by agrarian economy. Very few literatures have highlighted the issue of social inequality prevailing in such peri-urban areas which is the result of land use change. This area needs more attention from the research point of view.

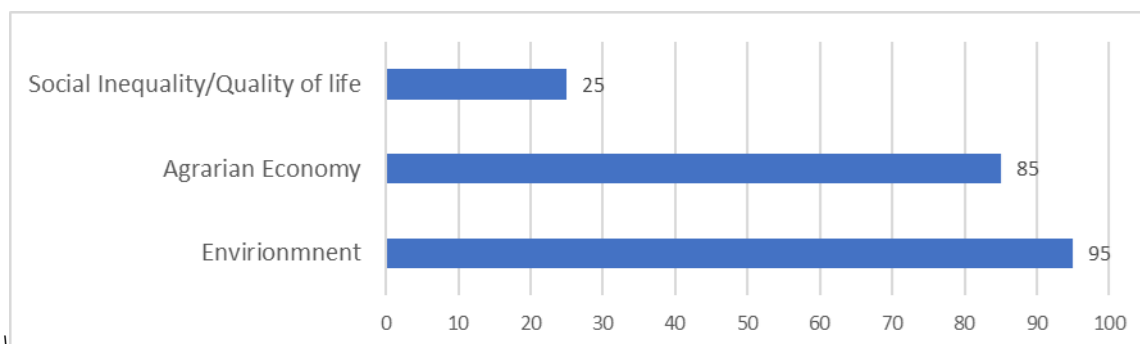


Figure 2: Concerns of land use change in the urban periphery (Source: Author)

Few papers also highlighted the positive side stating peri-urban regions often provide opportunities for urban expansion and the development of new homes and businesses. This can help to accommodate population growth and support economic development (Manasi & Raju, 2020). For example, the development of new buildings, roads, and other infrastructure can create jobs and generate economic activity. In addition, the growth of the population in peri-urban regions can also create new markets for goods and services and can provide new opportunities for businesses and entrepreneurs. However, it is important to ensure that the economic benefits of land use changes in peri-urban regions are balanced against the potential negative impacts on the environment and the community.

### 2.3 Actors in Peri-urban Land Transformation:

There are several different actors who play a unique role in peri-urban land transformation. Out of all the papers reviewed the key actors mentioned in peri-urban land transformation are Local governments and planning agencies, Developers, and landowners (Farmers), Community organizations, advocacy groups and Environmental organizations. The papers reveal that the evolution of land use in any given location is shaped by the collaborations and disputes among individual actors. In regions characterized by a blend of rural and

urban activities, such as peri-urban areas, these actors exert even more influence and are more abundant compared to other areas. Consequently, this heightened presence results in a greater occurrence of both alliances and conflicts. (Fazal, 2013).

Shahab Fazal, Nasrin Banu, Salma Sultana (2015) in their study reviles that the high demand for land in certain cities leads to informal urban development, in which land is treated as a commodity and short-term profits are prioritized by different actors involved. This form of development frequently breaches legal regulations established for urban settlements, giving rise to problems like congestion, encroachment on access routes, conflicts, and legal disputes in court. The system is susceptible to corruption, involving dishonest practices and intimidation being used to protect the interests of influential individuals. Notably, property dealers wield substantial influence in the conversion of land into residential, commercial, and industrial properties. Operating on both the supply and demand aspects of the land market, they frequently possess intricate local information regarding land ownership, legal status, and pricing. While some property dealers are from the indigenous community and have an advantage due to their familiarity with the local area and social structures, having greater financial and political power ( rent seeking interest) .The demand from industrialists, speculators, and city dwellers also contributes to the property dealers' earnings, as they charge commission on transactions. However, as the village becomes more urbanized and the real estate sector expands, the community may lose some coherence and control over the property business, leading to conflicts and criminal activity in the land market (Fazal et al., 2015).

The expansion of Surat into its surrounding regions has revealed a complex interplay of 'rent-seeking interest' groups seeking economic advantages. This expansion has given rise to conflicts that encompass spatial, economic, and environmental aspects, resulting in disparities within the newly extended areas. Moreover, it has illuminated the pivotal role of rent-seeking interests and political conflicts in shaping the city's expansion trajectory. Regulatory Failures have allowed expansion into ecologically fragile zones, while the utilization of existing industrial infrastructure, referred to as "second capability," has facilitated the growth of industrial areas in the outskirts (Sassen, 2006). Consequently, these developments have had adverse consequences on the quality of life in the peripheral regions of the expanded metropolitan area.

## **2.4 Governance in Peri-Urban Regions:**

Out of all the 65-papers reviewed for Governance in peri-urban regions, all the papers have highlighted the incompetency of governance and its functioning in peri- urban areas. Governance plays the major role in the context of urbanization and peri-urban transformation. These areas are often characterized by a lack of clear boundaries and a complex mix of urban, suburban, and rural land uses, and named as transitional areas (Aijaz, 2019).

The 74th Constitutional Amendment Act of 1992 acknowledges transitional areas undergoing a shift from rural to urban status. It confers upon them the civic designation of 'Nagar Panchayat,' establishing them as the lower level of the urban body for effective governance. While Tamil Nadu stands as the pioneer state in implementing this provision, regrettably, most Indian states have yet to adopt the concept of Nagar Panchayats.

One key challenge which was majorly discussed in reviewed papers of Indian case studies was that peri-urban regions has lack of coordination and cooperation among different levels of government, as well as between different public agencies and private sector actors, for example Bangalore . This can lead to conflicting policies and regulations and can create barriers to effective decision-making and planning. As the population of the city continues to grow and government institutions fail to meet their targets for land and housing supply, it seems likely that a significant portion of the sector will be privatized (Singh, 2020). Another challenge in peri-urban governance in India is the lack of robust and effective mechanisms for public participation and engagement. Many peri-urban residents are marginalized and lack access to information and decision-making processes, and this can lead to a lack of accountability and transparency in governance (Leif Petersen, 2019). In addition,

the lack of public participation and engagement can also make it difficult for governments to understand and respond to the needs and priorities of peri-urban residents.

In conclusion, jurisdictional ambiguity and bureaucratic fragmentation in certain areas can lead to a lack of regulation of land use and services, resulting in conflicts over resources and social issues as different groups (industrial, residential, etc.) compete for space on the landscape. Wealthier individuals may be able to mitigate these problems using technology and private service providers, while the poor may struggle to find secure and affordable long-term solutions. This can create a dangerous imbalance in the availability of resources and services to the underprivileged (Sharma-Wallace, 2016).

### **3. Discussion:**

An analysis of the literature indicates that the expansion of urban areas has led to a significant transformation in their character, giving rise to various challenges that impact both the populace and the environment. Peri-urban areas in India experience a higher prevalence of these issues compared to cities and towns. The root of these problems lies in the insufficient attention provided by administrative agencies to peri-urban areas, coupled with the absence of effective legal mechanisms for planning, management, and governance. The proliferation of built structures spanning both urban and rural territories further complicates matters, contributing to a governance deficit in peri-urban areas, which is exploited for various purposes. The inefficiency of rural and urban administrations in adapting to evolving conditions in peri-urban regions permits influential groups and individuals to engage in undesirable activities. The absence of established laws, rules, and mechanisms further complicates the ability of local and regional authorities to regulate such behaviours. With cities and urban conglomerates in India consistently drawing in people and investments, the pressure on peri-urban areas is anticipated to intensify. Given these trends, it is imperative for the national government to formulate a policy for the systematic spatial expansion of megacities to ensure the sustainable development of peri-urban areas. This national policy should address pertinent concerns, and individual state governments should formulate their own policies and regulations tailored to their distinct urbanization patterns. It is crucial to safeguard vulnerable groups and the environment, ensuring that government actions and individual activities do not cause harm, while also preserving social and cultural practices and economic activities.

Local governments overseeing peri-urban areas should possess a comprehensive guiding document, such as a local area plan, to facilitate future planning and development. This plan, backed by data, should offer clarity on various facets of the peri-urban area, encompassing land use, building construction, employment, energy, infrastructure, services, environment, and safety. To effectively fulfil these responsibilities, local governments must undergo preparation by national and state agencies, potentially engaging in partnerships with private and community organizations. Another viable approach involves the adoption of a regional development plan by both local and government agencies, which should also incorporate robust grievance redressal services for peri-urban residents. Emphasizing public participation and community-led development is crucial for context-driven progress in peri-urban regions.

Overall, the implications of urbanization and peri-urban transformation for planning and policy making are significant, and it is important for planners and policymakers to consider the complex and multifaceted nature of peri-urbanization in order to promote sustainable development.

## 4. Conclusion:

In the past, urbanization was not seen as a threat to the environment or development. However, the current trend of urbanization, including the expansion of cities into surrounding areas with range of complex and interrelated challenges, such as population growth, land use conflicts, and infrastructure deficiencies has become a major concern. Due to a lack of effective planning and management, coordination among stakeholders, and the inability to anticipate and plan for peri-urban growth, the region suffers from a lack of basic services such as water supply, electricity, and sanitation. This can negatively affect the environment and degrade the quality of life and built environment, ultimately threatening sustainable habitation. It is essential to address the negative impacts of this haphazard and unplanned process of peri-urbanization. Participatory planning can help ensure that peri-urban areas are developed in a way that is sustainable, equitable, and meets the needs of the people who live and work there. It can help identify these challenges and develop strategies to address them in an effective and coordinated manner.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Spatial Analysis of Ramkund Ghat: Relationship between Spatial Occupancy of Ghat and Vendor Activities

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## Abstract:

*The Ghats along the river in India are a vernacular landscape defined by cultural activities, contextual events, and performances that support public life. The study area of this research is the Ramkund Ghat, Nashik [Maharashtra]. One of the main activities that take place on Ramkund ghat, Nashik, among others, is vendor activity. The research is based on the premise that vendor activities amongst others are significant in rendering an image of riverfronts which is culturally significant. The aim of the research is to identify the factors that influence the space occupancy of vendors on Ramkund ghat as a result of various activities, their behaviour, and the physical setting. Non-participant observation, behaviour mapping, and photographic documentation were used to find the parameters which establish a relationship between vendor activities and their spatial pattern. This study focuses on understanding their spatial patterns and factors impacting their location and mobility decisions. Physical area, Circulation of Visitors, the activity of visitors, direction of movement, visitors' time, cultural activities, and weekly markets are some of the factors identified in this study that impact spatial pattern. Thus, instead of looking at vendors as a hindrance activity, this study intends to analyse their activity patterns to provide primary data for future redevelopment of the riverfront.*

**Keywords:** Ramkund ghat; vendor activities; behavioural mapping; spatial occupancy

## 1. Introduction:

Human settlement and its evolution can be traced back to river basin areas. The evolution of human settlements has been known to be in the proximity of rivers. In India, the *Ghats* represent one of the strongest forms of human settlement; an intact landscape that is sustaining the life of many over the period.

In India, the *ghats* are public commons, ritual spaces, and cremation sites. As such they represent an extraordinary cultural heritage in their history and as settings for continuing enactment of ancient traditions that sustain cultural memories, beliefs, and values. Public space along rivers is considered a sacred place where the life on *ghats* swirls around many activities. Public life on the *ghats* is sustained by multiple communities—of *ghatias* (ritual priests), *aghoris*, barbers, washermen, vendors, backpacker tourists, pilgrim groups, students, mourners, and many others. Religious, commercial, and recreational activities occur in close proximity, and various structures form spaces with multiple functions and meanings. Activities associated with life and death and worship are observed in this public space. Places are found, built, and appropriated, for worship, play, commerce, and community, making the landscape not just a view but also a situated event (Sinha, *The Making of Vernacular Urban Landscape*, 2020).

These spaces witness overlapping boundaries of social activities and spatial allotments. Various vendors occupying places on platforms, steps, and landings of *ghats* attract visitors mostly pilgrims which induces

discussions. These spaces display a strong relationship between vendors and pilgrims on a daily basis which induces a sense of place in this setting.

Considering the daily activities, cultural activities, and tourist activities, there are several other activities that take place on the *ghat*. Vendor activity amongst them is the most visible and important activity on the *ghat*. Vendor activities are a part of people's daily lives; therefore, they play a significant role in the *ghat's* spatial arrangement and occupancy. These vendor activities have an impact on the movement pattern of people, their activities, and on surrounding space. For example, vendors selling their wares along the steps, cause congestion, making it practically hard to navigate the tiny pathways leading to the river and causing stress in the area.



Figure 1: Basemap of Ramkund ghat (Source: Author)

*Ramkund Ghat* in Nasik is one of India's most important *ghats* with rich cultural, religious, and architectural value. It is also one of the four *ghats* in India that hosts the *Kumbh-mela*, a major Hindu pilgrimage and festival. The myth of *Prabhu Ramchandra* visiting and bathing in *Ramkund ghat*, which is located in the heart of the city, makes it an important destination for devotees. The water of *Ramkund* is considered to be pure and auspicious. Hence people from all over the country visit this *ghat* to perform the last rites. *Ramkund* is one of the *ghats* in India where vending activity is more prominent than others and these vending activities establish a relationship with some issues on the *ghat* such as reduced space occupancy, traffic and public congestion, and improper waste management. Hence analysing the spatiality of vendors' activity becomes significant since it induces multiple activity patterns with strong connections between people and spaces.

*Ramkund* has certain serious issues caused over time that need attention. High density in the surrounding areas induces traffic congestion. Due to the high vendor population, many illegal settlements are also seen on the *ghats*. Further, their irregular pattern of occupying the space causes chaos. All this has created an unclean and unhealthy environment on the *ghats*.

On the other hand, accepting vendors as an important segment contributing to economic development, their analysis is the need of the hour. The number of vendors is increasing exponentially and the current space is unable to accommodate them, further resulting in overcrowding and improper management of space. This study identifies vendor as an important activity and hence their spatial pattern and locational aspects are studied.



## 2. Literature Review:

Various studies have emphasized the position of *ghats* in our civilization and the current state of their existence. They have also focussed on their significance in the day-to-day lives of people residing near these *ghats*. Amita Sinha affirms that “*ghats are a liminal space between the holy river and sacred land where the eruption of the sacred in the profane creates meaningful pauses in everyday life*” (Sinha, 2017). Here while pilgrims engage in spiritual practices, tourists venture beyond their cultural frame of reference to experience spirituality hence creating a third space (Bhabha, 1994). Thus, between these two ideologies, daily life revolves around commerce, recreation, and craft-making, thus determining conditions of social life articulating the design of *ghats*. (Certeau, 1984).

Amita Sinha also asserts that “Places are found, built, and appropriated, for worship, play, commerce, and community, making the landscape not just a view but also a situated event” (Sinha, 2017). Though these rivers and ghats hold utmost importance and value, it is facing lots of issues. The problems faced by the rivers of India in terms of pollution, reduced flows, and obstructions from dams have received a great deal of attention. Within this general concern, the rivers and their tributaries have grabbed the lion’s share of the focus because they are important sacred rivers with distinct meanings and roles (Alley, 2019). These ghats are dealing with several problems such as pollution, waste management, traffic management, and improper vendor activities.

On the other hand, vendors have become the catalyst boosting the economic growth of India. The overall number of street vendors in India is estimated to be around 10 million, and they make up a significant portion of the population (Singh, 2022). Street vendors have been accused of causing nuisance to public amenities, creating traffic jams, and being anti-social elements. They are presumed to cluster around city centres and locations where a maximum cost benefit could be achieved with minimum cost. Some studies reveal the influences of various factors on the agglomeration of informal activities, such as class differences (Turner, 2012), the inflow of international capital (Bromley, 2009), the regeneration of historical streets, and administrative policies (Custinger, 2000). However, most of these studies target specific areas in the city, such as a street. Only a few of them are studied with spatial statistics and analyses (Zhang Yanji, 2017).

Although the *ghats* possess a vivid image, they are not legible in the sense they are confusing and disorienting, especially to a first-time visitor (Sinha, 2017). Various issues like poor space and public management, lack of quality environment of the *ghat*, overcrowding, unhygienic spaces, etc. are becoming bigger issues day by day. Many on the *ghat* view the vendors, who occupy the space the most actively, as the problems. Prior to making any snap judgments, it is crucial to comprehend the situation of the *ghat's* vendors as well. This was the premise to study the fundamental issue to study behaviour pattern of the vendors on the *ghat*.

## 3. Methodology:

The study was conducted on *Ramkund ghat* at Nashik on the banks of river *Godavari*. The study period chosen was non-festive so that the daily activities that render most of the qualities of the *ghats* can be studied. Base maps were prepared to map the spatial pattern. The behaviour mapping took place across three days, Sunday to Wednesday; Sunday was designated as a holiday, Monday and Tuesday as regular working days, and the research was done at two different times of the day. Mornings from 9:00 a.m. to 11:00 a.m., and evenings from 4:00 p.m. to 6:00 p.m. non-participant observation, behaviour mapping, photograph documentation, and informal interviews were used to collect data, which was then analysed. *Ramkund Ghat* is a public place in Nasik's urban core. According to the pilot study, it was observed that the population of vendors on the *ghat* is always in flux and changes with weekends and festive seasons. Vendors belonged to seven types depending on their sale products. They are:

1. Flower and *Prasad* vendors
2. Medicinal herbs seller

3. Vegetable vendors
4. Fruit vendors
5. Cloth Vendors
6. Hawkers
7. Others



Figure 2: Location of vendors (Source: Author)

The ‘Others’ category included Toy dealers, jewellery sellers, kitchen utensil sellers, local artifact sellers, bamboo basket vendors, and dry fruit sellers. The following picture shows the typical locations of these vendors. The pictures in the adjoining plate indicate the spatial location of vendors studied.

#### 4. Results and Findings:

During the pilot study, seven types of vendors listed above who are active and regular users of the *ghat* were identified. Despite their irregular pattern and conduct, their individual physical setting has been overserved every day in the same location. These vendors change their locations within the same extent of space. These locations have been investigated as a first stage in the research process. These locations are presented in the plate above.

##### *Location study of vendors:*

- Flowers and *Prasad* sellers – Steps and near temples
- Medical herbs sellers – Bridges and platform behind the steps
- Vegetable vendors-open spaces at the entrance of the *ghat* behind the platforms and street adjacent to the platform
- Cloth vendors-Bridge
- Kitchen utensils and others-streets nearby
- Hawkers-*Ghat* platforms and adjacent streets
- Fruit Sellers- Platform

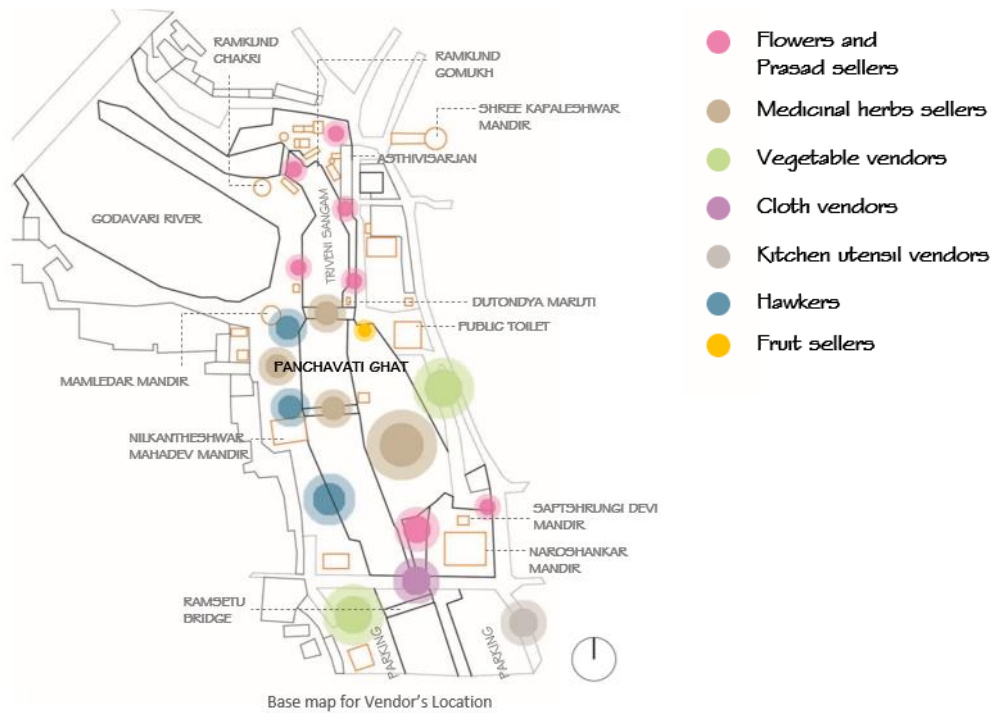


Figure 3: Basemap of location of vendors (Source: Author)

Ramkund ghat is occupied most of the time for “*Dashkriya vidhi*” which represents the last rites. Since these activities take place mostly in the morning, Flower and *Prasad* vendors are seen in the morning as they support this activity.

Their number is followed by Medicinal herb vendors who almost reside in this area. They stay close to public washrooms, water places, and food stalls. Since people need conviction to buy these products, these vendors sit at places where they access people easily and frequently? They have almost formed an illegal settlement on the *ghat*.

Vegetable vendors were the third busiest vendor category in the morning. There is a residential neighbourhood immediately along the *ghat* because it is located in the old core city. At the periphery of the *ghat*, there are old building typologies known as *Akhadas*, where people have lived for centuries. As a result, vegetable vendors have more opportunities to sell vegetables in that area. *Goda ghat* (another name for Ramkund ghat) is well-known for reasonably priced fresh vegetables. Vegetable vendors are seen in huge numbers during the weekly market on Wednesday when the ghat is flocking with the crowd. These vendors generally occupy the *ghat* entrance and exit, as well as along the street behind it.

Evenings on this ghat are busier for cloth vendors, fruit sellers, hawkers, and other vendors such as toy vendors, local jewellery sellers, cooking utensil sellers, local artifact sellers, bamboo basket sellers, and dry fruit sellers, among many others. Cloth vendors have a fixed location on *Ramsetu Bridge*. They take up nearly all of the bridge's available space. Apart from cloth merchants, there are only 3-4 additional vendors such as bamboo basket weavers, and jewellery sellers that have been observed on the bridge. Fruit vendors are only available in the evening. They are seen near the *Dutondya Maruti* (*Maruti Temple*), which is an important landmark on the *ghat*. Other occasional vendors, such as toy sellers, jewellery vendors, culinary utensil vendors, local artefact vendors, bamboo basket vendors, and dry fruit vendors, roam around the *ghat* area depending on the activities taking place on the *ghat*.

The following figures show the activity mapping of the vendors with their respective locations at the respective times of the day:



Figure 4: Activity mapping for Sunday (Source: Author)

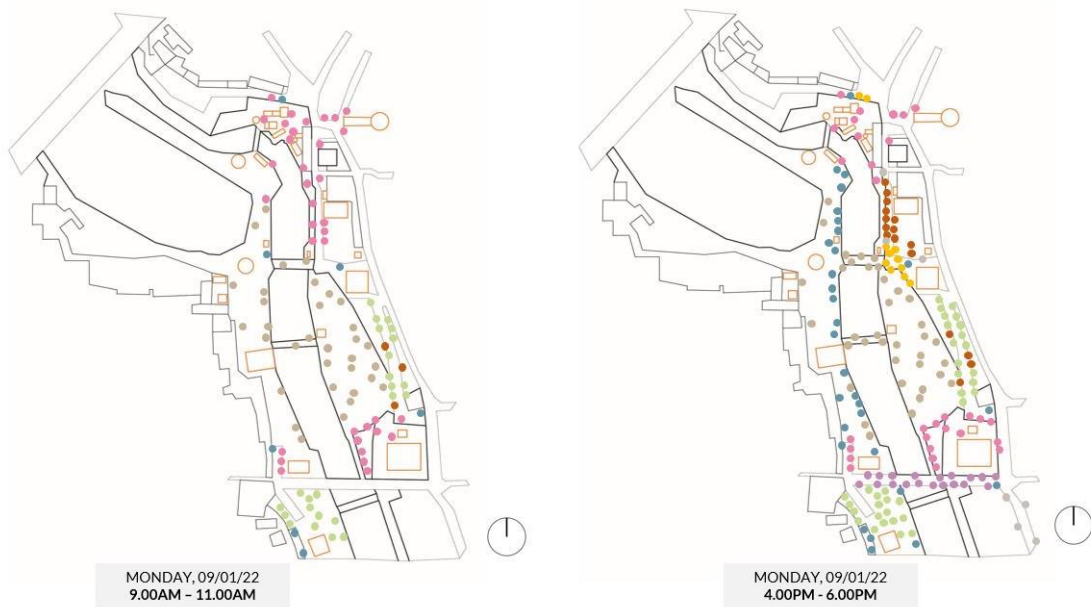


Figure 5: Activity mapping for Monday (Source: Author)

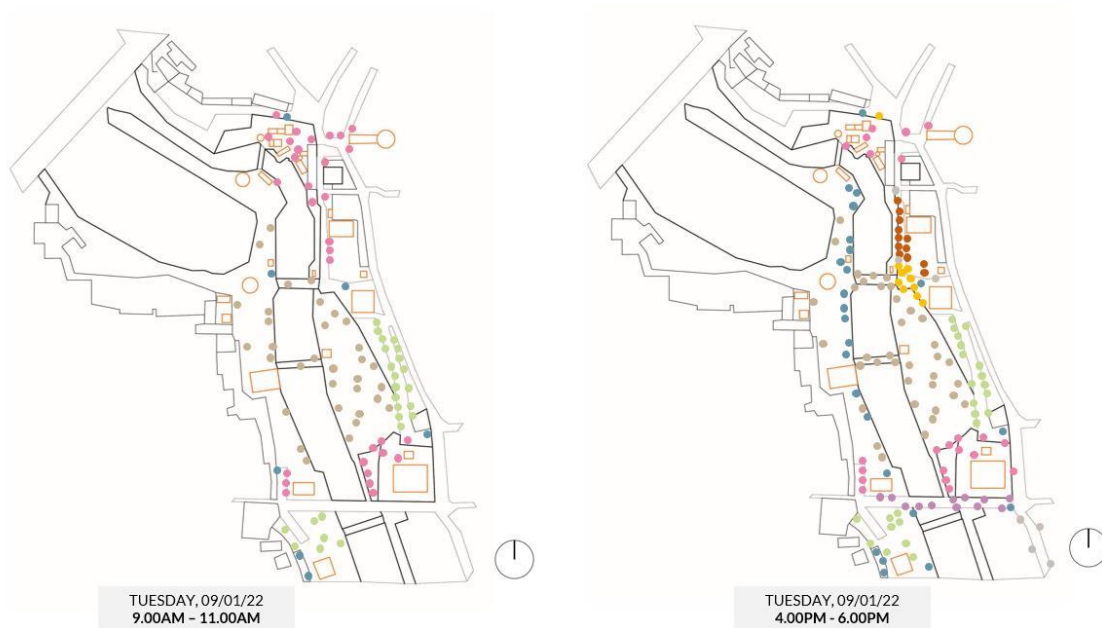


Figure 6: Activity mapping for Tuesday (Source: Author)

The below diagram shows a comparative analysis of the total vendors present on ghat during study days:

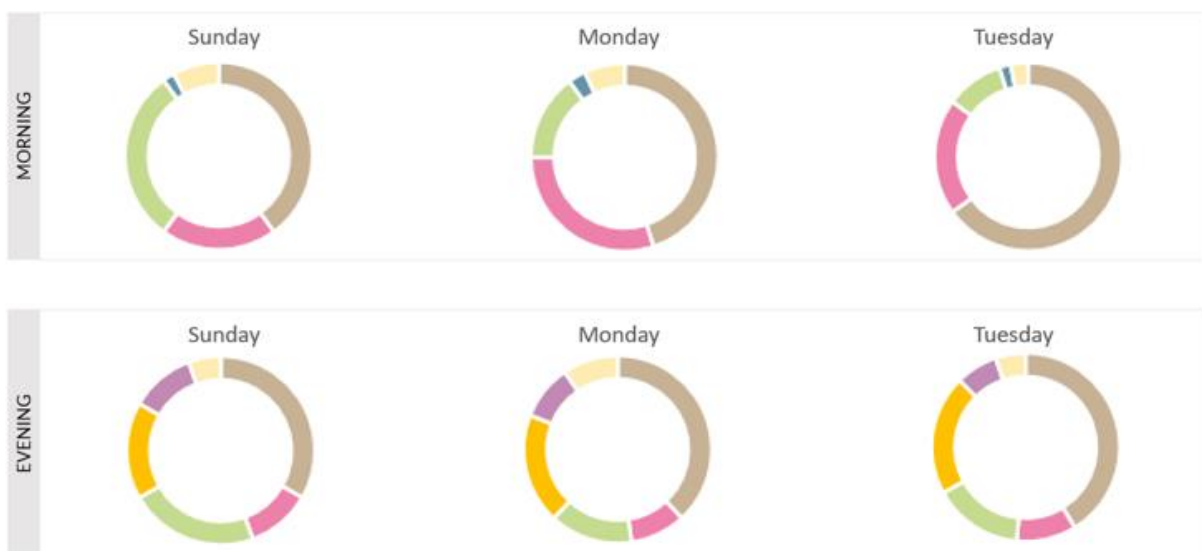
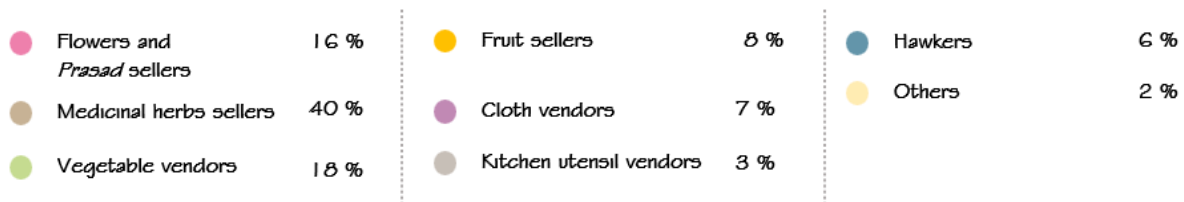


Figure 7: Comparative analysis of vendors in the morning and evening hours indicates that Vegetable vendors are present most of the time; followed by fruit sellers (Source: Author)

Table 1: Activity mapping according to the daily routine of vendors (Source: Author)

	Sunday		Monday		Tuesday	
	Morning	Evening	Morning	Evening	Morning	Evening
Flower and Prasad seller	A	M	A	M	M	M
Medicinal herb sellers	A	A	A	A	A	A
Vegetable vendors	A	A	A	M	M	M
Cloth vendors	M	A	I	A	I	A
Fruit vendors	I	A	I	A	I	A
Hawkers	M	A	M	A	I	A
Others	M	A	M	A	M	A

The table shows Active vendors marked as (A); Inactive vendors marked as (I) Moderately active vendors marked as (M). The vendors who are visible for most of the day on the *ghat* are said to be active (A). On the other hand, *ghat* vendors who are not visible for more than half of the day are inactive (I). Moderate (M) vendors are those whose population is deflecting according to the number and type of users on the *ghat*.

During the study specifically for these three days, some observations were noted with respect to the above data. They are as follows:

1. There are more Flower and Prasad vendors on the *ghat* on Sunday and Monday mornings as compared to other weekdays since people come from all across India to perform *Dashkriya Vidhi*. People also come to *Goda ghat* to worship, pray, and bathe in the holy water in which they immerse flowers as part of their worship. In the evenings, city people visit *Ramkund ghat* with their families for worship and leisure activities. Many people visit *Shiva* temples across the *ghat* on Monday, which is known as Lord *Shiva's* worshipping day. On *Goda ghat*, the most visited temples are *Kapaleshwar* temple and *Naromahadev* temple. Tuesday being a working day, the number of visitors drops as compared to weekends and Mondays. As a result, on this day, fewer Flower and Prasad vendors have been observed.
2. Medicinal herb sellers occupy permanent positions on the *ghat* hence their numbers are more or less consistent throughout the study and they are an illegally settled group of people on the *ghat*. Because they only live there, the number of medicinal herb dealers remains consistent throughout the study.
3. Vegetable Vendors, Flower, and Prasad vendors, have been seen in greater numbers on Sunday mornings. Along the *ghat*, there is a residential area. Locals and city dwellers love to buy vegetables from *Goda ghat*. From Sunday to Tuesday, the number gradually declines.
4. Cloth vendors have been seen on *Ramsetu* Bridge in the evening only. They have been sighted in extremely small numbers in the mornings, such as 1-2 on Monday and Tuesday. The numbers hardly grow to 3-4 on Sunday morning. In the morning, there are no fruit vendors. In the evenings of study days, they were sighted in greater numbers in the vicinity of the *Dutondya Maruti* landmark.
5. People come to the *ghat* area with their families in the evening, therefore hawkers selling food items are more active in the evening period. People sit and enjoy the view while eating their meal. Other vendors

such as toy sellers, jewellery vendors, culinary utensil vendors, local artifact vendors, bamboo basket vendors, and dry fruit vendors have noticed in more numbers in the evening.

## 5. Observations:

The following conclusions have been drawn after studying the activities, behavioural patterns, and physical setting of the vendors in order to go further toward finding the factors that affect the social occupancy of the *ghat*:

1. Despite the fact that the area of vendor activities was the same, the vendors changed their locations according to the activities taking place on the *ghat* in the same area.
2. Vendors who were present in the morning were not present in the evening. Only a few vendors may be able to sit there all day such as Flower and *Prasad* sellers, medicinal herb sellers, and vegetable vendors.
3. Medicinal herb vendors have no shelter or facilities. On the *ghat*, they have built an illegal settlement.
4. The mismanagement by authorities leads to an unhealthy *ghat* environment. They strew trash all over the place. Garbage and debris dumped on the *ghat* emits a horrible odour spreading throughout the area.
5. Vendors' chaotic physical arrangements generate traffic and public congestion on surrounding streets and on the *ghat* itself. They take up most of the *ghat's* space, which negatively impacts the *ghat's* spatial occupancy. Visitors are not using the space given or designated for specific activities because the space is either occupied by vendors or is littered and full of waste or garbage.
6. Despite the fact that *ghat* has religious and architectural significance, these activities and behavioural patterns detract from people's experience of visiting such a location. Because of the surroundings, many are hesitant to visit this location.

During research, the above concerns were seen and experienced. Vendors cannot be relocated from their current locations. *Ghat* engages in economic activities that benefit both the vendors and the local authority. That is why it is impossible to prevent vendor activity on the *ghat*. However, effective management is necessary when dealing with vendor problems. As a result, the goal of this research is to better understand the factors that influence these physical settings in order to better understand the relationship between vendor activities and *ghat* occupancy so that whenever future development happens the factors studied can be used while redeveloping so that it will not affect the vendor activities as well as other activities happening on *ghat* and the better space management can be worked out.

Table 2: Areas required for respective vendor activities (Source: Author)

Vendors	Area
Flower and <i>Prasad</i> seller	1.5sqm
Medicinal herb sellers	5sqm
Vegetable vendors	7.5sqm
Cloth vendors	12sqm
Fruit vendors	4.5sqm
Hawkers	15sqm

## 6. Discussion:

For this study, qualitative analysis was used. The elements that explain the reasons for this irregular pattern, as well as the vendor's physical settings, are discussed in the analysis. These parameters demonstrate the significant connection between *Ramkund ghat* and the activities of its vendors, which influences its spatial occupancy.

1. **Area** - Each vendor's Area requirements are different. Flower and *Prasad* vendors require the least amount of space, whereas hawkers and cloth vendors require more. This is the most important aspect in determining where the vendor activity will take place. Sellers of Flowers and *Prasad* demand less space, which is why they sit on stairs and platforms along the steps. As a result, the likelihood of public congestion decreases, and economic activity increases. Medicinal herb vendors, fruit vendors, and vegetable vendors all require more space to display their herbs, fruits, and vegetables, respectively. As a result, they require more space than flower dealers. As a result, these traders reside on the *ghat's* vast platforms. To display the various outfits, cloth dealers demand greater space than vegetable vendors. They also require some temporary storage. These cloth vendors have been sighted on *Ramsetu* bridge on *Ramkund ghat*. They've taken up the entire bridge
2. **Circulation of visitor** - A visitor's or buyer's movement has a significant impact on the vendor's activity. If their products have better visibility, they have a better chance of being bought. Hence Flower vendors and *Prasad* vendors occupy space on the steps on the way towards holy water. Medicinal vendors occupy space on the platform. Vegetable vendors occupy space on the entry and exits of the *ghat* since it is prominently visible to visitors. Fruit vendors sit near the intersection of the *ghat* platform and the bridge so that people passing by notice them. Cloth vendors sit on the *Ramsetu* Bridge, which connects two main streets. Despite the fact that the bridge is connected to major motor routes, it is entirely pedestrian and is covered with cloth merchants and other vendors, making it easily accessible to both locals and visitors. Others seats on the street along the *ghat* to grab the attention of the passersby.
3. **Activity of visitors** - The physical setting of vendors is also influenced by the visitor's purpose and activity. Sellers of flowers and *prasads* sit near the worshipping area. People utilize the *ghat* platform as a pause point when roaming on the *ghat*, so medicinal sellers and others sit there. Vegetable activities and other seats are placed near entry-exit points and along streets so that passers-by may readily see them and purchase them. Activities of visitors are mostly governed by their schedule on the *ghat* and vendor locations.
4. **Direction/view/focal point** - Near the *ghat* region, temples become focal centres. So, except for vegetable and cloth vendors, more other vendors sit near the temples. As previously stated, vegetable vendors sit near entry and departure locations, which forms the visitor circulation path's direction. On the bridge, there are cloth vendors. The bridge is the highest point in the area since it connects the *ghat* region and elevated streets.
5. **Visitor's time** - The physical location of the vendor is also determined by the buyer's time spent there. Purchasing flowers and *prasad* takes significantly less time than purchasing vegetables or clothes. The amount of time a buyer can spend on a purchase is determined by the item being purchased and the consumer's choices. With more options, deciding what to buy takes longer. As a result, purchasers will spend more time there, requiring more space. As a result, garment and vegetable vendors require large platforms near the *ghat* region.
6. **Cultural activities** - *Goda ghat* has numerous *Shiva* and *Devi* temples. Festivals like *Mahashivratri*, *Dussehra*, *Ganeshotsav*, *Gokulashtmi*, *Kumbh-mela*, etc. attract masses from all over the country and from abroad. This variety of other cultural activities that have an impact on the activities of the vendors. Cultural activities attract a larger number of people, resulting in additional opportunities for vendors. As a result, their physical setting varies in response to the density of visitors. Vendor sitting patterns are occasionally impacted by buyers/visitors however most sellers adjust their locations and physical settings in response to visitor density and cultural activities.
7. **Weekly market day** - Wednesday is a market day on *Godavari ghat*. In the evening, it has a greater density of vegetable and grain vendors. Locals and people from nearby villages prefer to purchase fresh vegetables and grains from this market. Because the number of visitors and the number of vendor activities are directly proportional, the *ghat* area becomes increasingly crowded. There are concerns with waste disposal, parking, and other visitors being unable to move around freely in that area. As a result, the market day of the week has a significant impact on spatial occupancy on Wednesday.



The factors above discuss the decision-making points for the vendors. These factors are responsible for the vendor activities and demonstrate the relationship between their behaviour pattern and mobility decisions.

## 7. Conclusion:

Many Hindus consider the river to be sacred and holy, and many conduct annual pilgrimage to Nashik Millions of people visit the *Ramkund 'tirth'* because of its significance, making it a powerful centre of religious activity, culture, and history. With such high importance, *Ramkund ghat* is one of the *ghats* where vendor activities occur simultaneously with other activities quite prominently. While there is a lot of opportunity for such activities, there are also a lot of issues that arise as a result of such unplanned, irregular vendor activities, making the *ghat* area unhealthy and ruining the image of the space as well as its spatial occupancy. The population is constantly increasing and so is the need and activities, but the space which actually provides a place to perform these activities has not evolved substantially.

Particularly in India, where public spaces like *ghats* have long served as gathering places for people of all backgrounds, it negatively impacts the *ghat's* utilization of space and causes a multitude of problems. Understanding these smaller issues could lay the groundwork for larger developments that will improve people's perception of these *ghats*.

Vendors significantly affect the economic structure of such public spaces. Though this is a crucial factor, there are other factors that influence the vendor's physical setting and behaviour. Physical area, Circulation of Visitors, the activity of visitors, the direction of movement, visitor's time, cultural activities, and weekly markets are some of the factors identified from this study that impact spatial patterns. Rather than chasing concerns and problems, this study tries to understand the situation of the main component of the space concerned in a specific area.

Closure of vendor activities is neither possible, nor advisable. However, proper administration of such operations may be possible. This study analyses primary data to better understand the physical settings of vendors and the elements that influence how they conduct their operations along the *ghat*. As a result, it's possible to identify more effective solutions while redeveloping such a vital public space in the future.

This paper discusses the factors affecting the spatial occupancy of the *Ramkund ghat* due to vendor activities. Associational values with *ghats* on Indian riverfronts vary with locations. More such studies can be carried out allied to this topic to better understand the actual situation in this *ghat* area. A study focusing on the economic impact of this activity can also provide better addition to this research. This study was held in one week for three days. Such studies could also be conducted longitudinally and during peak hours and peak seasons, which might give another perspective to the research objective.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Spatial Dimension of Pune City's Healthcare Infrastructure

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## Abstract:

*Pune is rapidly becoming popular for medical tourism and it has tremendous potential due to high end surgery options. Current population of the city is 3.99 million according to world population review. Though the current infrastructure of the city seems sufficient for its population, issues concerning accessibility were highlighted during the Covid pandemic. In planning field, URDPFI guidelines are used by the planners for estimating infrastructural demand. In most of the cities in India availability of beds is achieved but the accessibility aspect is not focused. Our research question, "What is the current state of healthcare infrastructure in each ward of Pune City?", encompasses availability of and accessibility to health care infrastructure. To obtain data on healthcare facilities in Pune City, we reached out to various sources, including the Pune Municipal Corporation (PMC) Ward Offices. We organized the compiled data into categories according to URDPFI guidelines. We then geocoded the data using QGIS software and plotted them on a map of Pune City. Lastly, we did Service area analysis for area served by various types of hospitals. During analysis it is found that the healthcare infrastructure is much dense in the wards covering central region of Pune City as compared to the wards covering peripheral regions. This research provides a comprehensive list of healthcare facilities in each ward of Pune City, with detailed information on the number of beds and the overall condition of the healthcare infrastructure in each ward. It can be used by healthcare providers to identify areas where there are gaps in healthcare services or by policymakers to allocate resources more efficiently and this also helps in planning for the establishment of new healthcare facilities.*

**Keywords:** *healthcare infrastructure; availability and accessibility; PMC; GIS; service area analysis*

## 1. Introduction:

Health is one of the safety needs for humans (Maslow, 1943) and also recognized as a Sustainable Development Goal worldwide. Accessibility to healthcare is an important aspect leading to a healthy population in any country. During COVID-19 pandemic, we realized that there is need of good healthcare system which can take care of the population's health needs not only in day-to-day life but also in such pandemic situations. People even with healthy lifestyle status weren't able to access required healthcare facilities due to lack of availability of beds. Many people lost their lives due to poor access to healthcare facilities with urban and rural areas making no difference. Hence, it is important not only to estimate healthcare infrastructure demand but also ensure the accessibility aspect through urban planning interventions. Recent research shows compact cities or a 15-minute city offers a good framework for sustainable development (Allam et al., 2022). Under 15 minutes city concept, accessibility to the various urban functions like healthcare, education, entertainment are ensured through non-motorised transit network that is walking and cycling to enhance the urban liveability (Moreno et al., 2021). The five dimensions of healthcare system are- Availability, Accessibility, Affordability,

Acceptability and Accommodation out of which Availability and Accessibility are spatial aspects and Affordability, Acceptance, Accommodation are non-spatial aspects (Penchansky and Thomas, 1981). This study will be considering only the spatial aspects of healthcare i.e. Availability and Accessibility.

The study uses Geographic Information System (GIS) to spatially measure both of these aspects by performing Service Area Analysis. The motive of this study was to identify areas where City’s healthcare infrastructure is leaving gaps and understand lacunas in the City’s healthcare system to further ideate on its improvement.

## 2. Background of study area:

In this study, area under Pune Municipal Corporation (PMC) is considered. Pune City has become a major industrial metropolis attracting hefty number of migrants from different parts of the country. As the population is rising, city’s current healthcare infrastructure is seen to be falling insufficient to serve the total population. Among city’s complete healthcare infrastructure, Primary Healthcare comes in contact with people before other. Therefore, the idea is that at least Primary Healthcare should be easily accessible to the total population. Pune is an administrative City divided into 15 wards and the ward wise population distribution is shown in MAP 1. The city’s population is estimated to be 3,124,458 according to census 2011 with population density of 603 people per square kilometre. However, the Pune Municipal Corporation data shows city population as 35, 56,824. For the calculation purposes, population by the PMC is considered. In this study, we refer ward wise population numbers collected from PMC ward offices

## 3. Data and Method:

The study used secondary source data. The data related to healthcare centres and quantitative data regarding ward wise population has been collected from the Ward Offices of 15 wards of PMC. Healthcare outlines from URDPFI guidelines are considered. The healthcare infrastructure inventory was further classified based on types of hospitals based on the URDPFI guidelines where the number of beds is the determinant. The norms given by the URDPFI guidelines for healthcare classification are listed in Table 1. The healthcare infrastructure was then marked using the Global positioning system (GPS) on Google Earth where their location was verified with Google Maps data. A base map consisting of road network, ward boundaries and Pune Municipal Limit was prepared in QGIS where geocoded healthcare infrastructure layer was superimposed. Below,

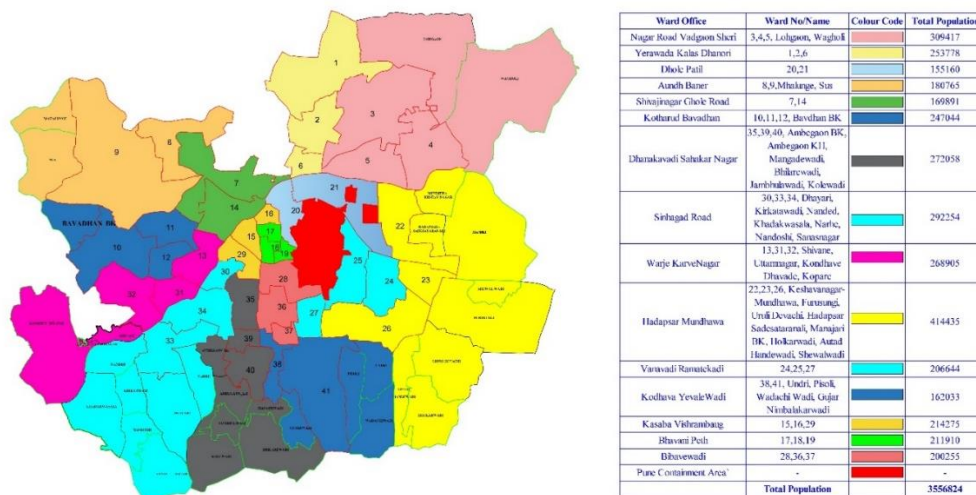


Figure 1: PMC ward offices as per the new 34 village boundaries (Source: Author)

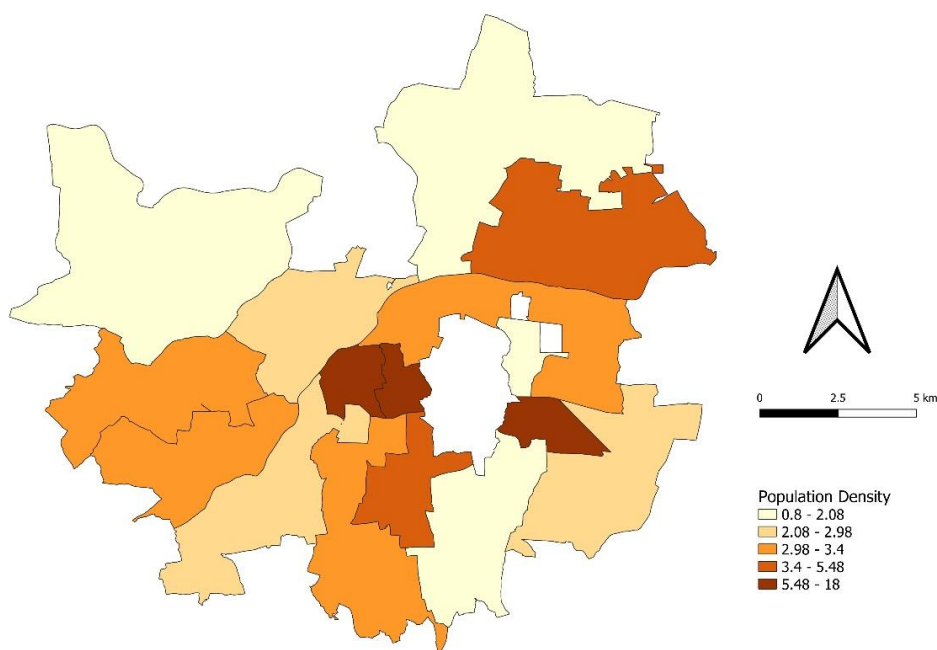


Figure 2: Ward wise population density of Pune (Source: Author)

Table 1: Type of hospitals according to URDFPI guidelines (Source: Author)

Type of Hospital	No. of Beds
Dispensary	< 25
Nursing Home, child welfare and maternity centre	25-30
Intermediate Hospital (Category B)	80
Intermediate Hospital (Category A)	200
Multi-speciality Hospital	200
Speciality Hospital	200
General Hospital	500

Table 2: Distance assumptions taken for accessibility aspect (Source: Author)

Type of Hospital	Distance (m.)
Dispensary	500
Nursing Home, child welfare and maternity centre	2500
Intermediate Hospitals (Category A and B)	2500
Speciality and Multi-speciality Hospitals	5000
General Hospital	7000

Further, using the Service Area Analysis tool in QGIS spatial analysis of study area has been performed for area served by each type of hospital. The steps conducted for this-

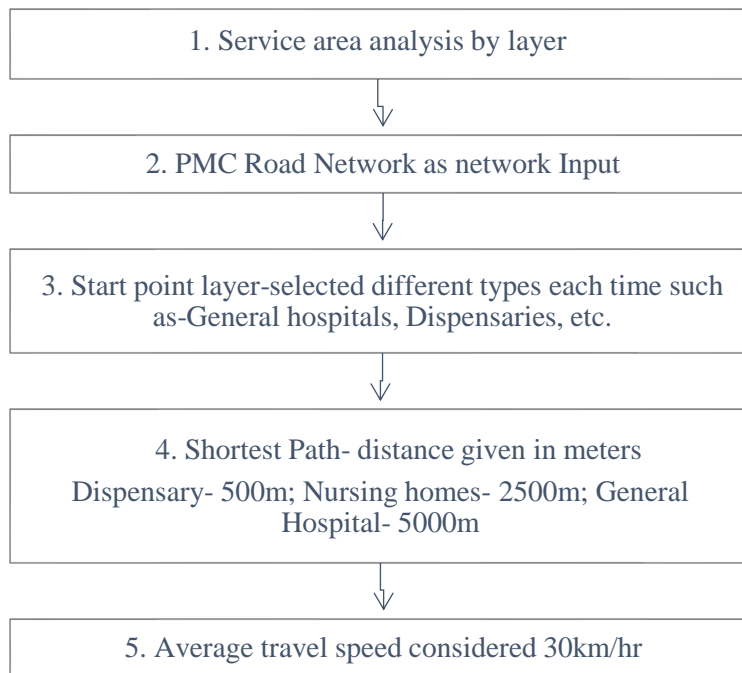


Figure 3: Methodology (Source: Author)

#### 4. Results and Discussion:

Below, figure 4 shows the locations of healthcare centres within the PMC limit classified into types as per URDPFI guidelines. It is observed that the healthcare centres are dense in central region of PMC limit.

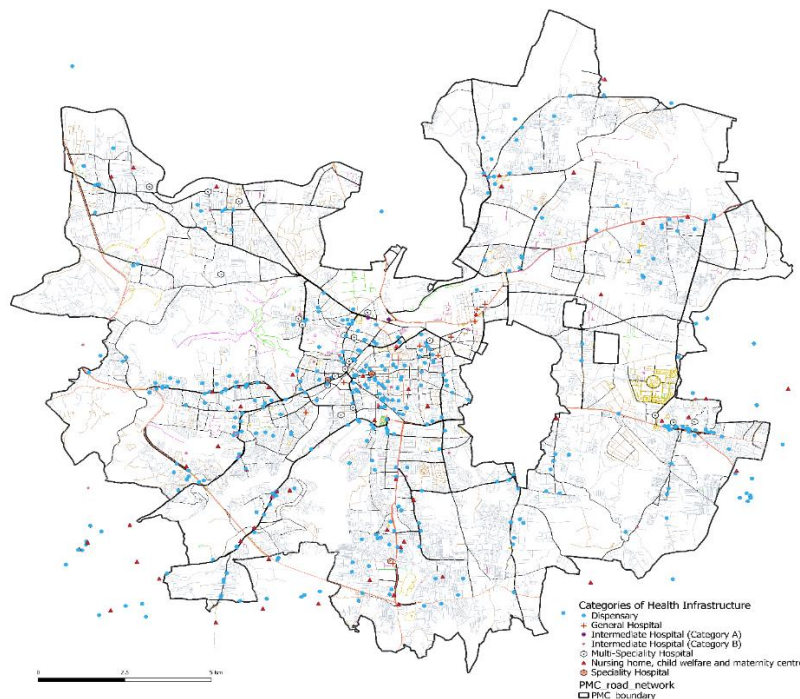


Figure 4: Locations of healthcare centres within the PMC limit (Source: Author)

Area under PMC is considered 34045 Hectares and population of 15 wards totalled to be 35, 56,824 as per the data provided by PMC. From which, population density can be calculated as 104 people/Ha.

Table 3: Healthcare infrastructure wise population served (Source: Author)

Type of Hospital	Distance considered in m.	Calculated Served area (in m.)	Calculated Served area (in ha.)	Population Served (people)	Percentage of population served (%)
Dispensary	500	59241652	5924	618922	17%
Nursing homes	2500	153671273	15367	1605468	45%
Intermediate Hospitals	2500	91651022	9165	957517	27%
General Hospitals	5000	100187707	10019	1046703	29%
Speciality Hospitals	7500	211557446	21156	2210229	62%

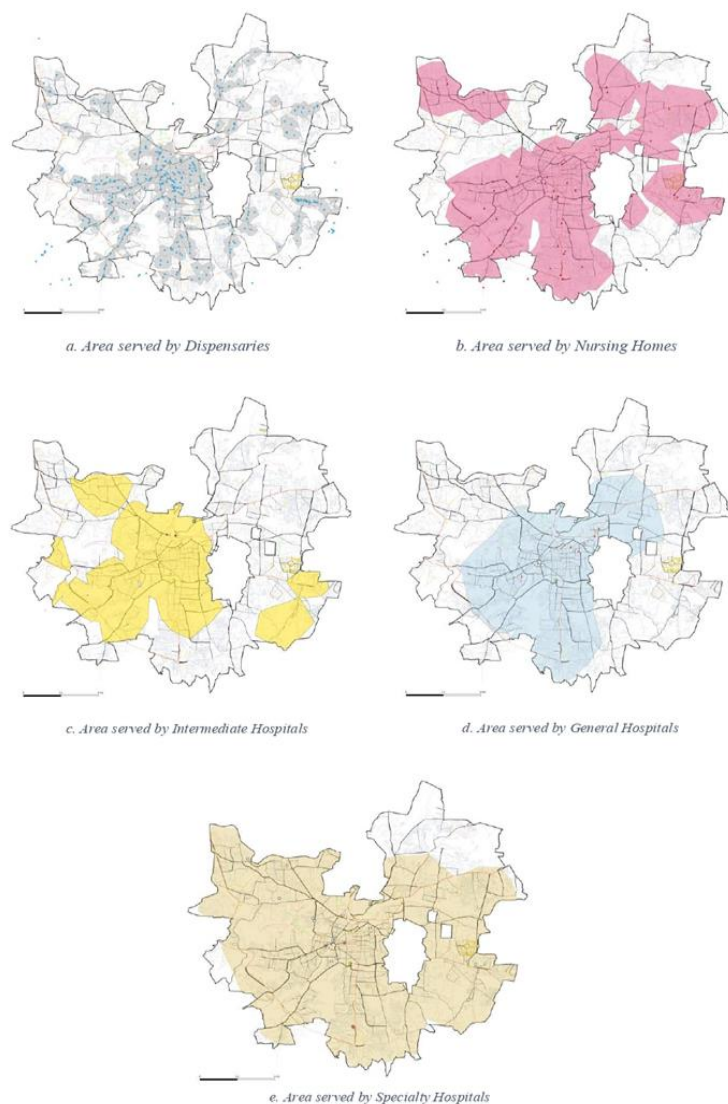


Figure 5: Map showing area served by types of hospitals (Source: Author)

From the analysis, it can be concluded as the healthcare services are dense in the core city and sparse around the periphery to match the population density. But due to it, the accessibility aspect in the peri-urban areas is

hampered as people need to travel more to access the healthcare centres. The calculations in Table 1 shows that the percentage of population served by healthcare centres is falling insufficient.

Dispensaries can be considered as primary healthcare which comes in contact with the population first. In service analysis, it is seen as there are few pockets which are completely deprived of dispensaries. The northern part of Nagar Road Vadgoan Sheri Ward is lacking in accessibility to all types of hospitals as there can be seen only 2 dispensaries. Also, western part of Aundh-Baner Ward and Kothrud-Bavdhan Ward are deprived of dispensaries but covered by Specialty Hospitals.

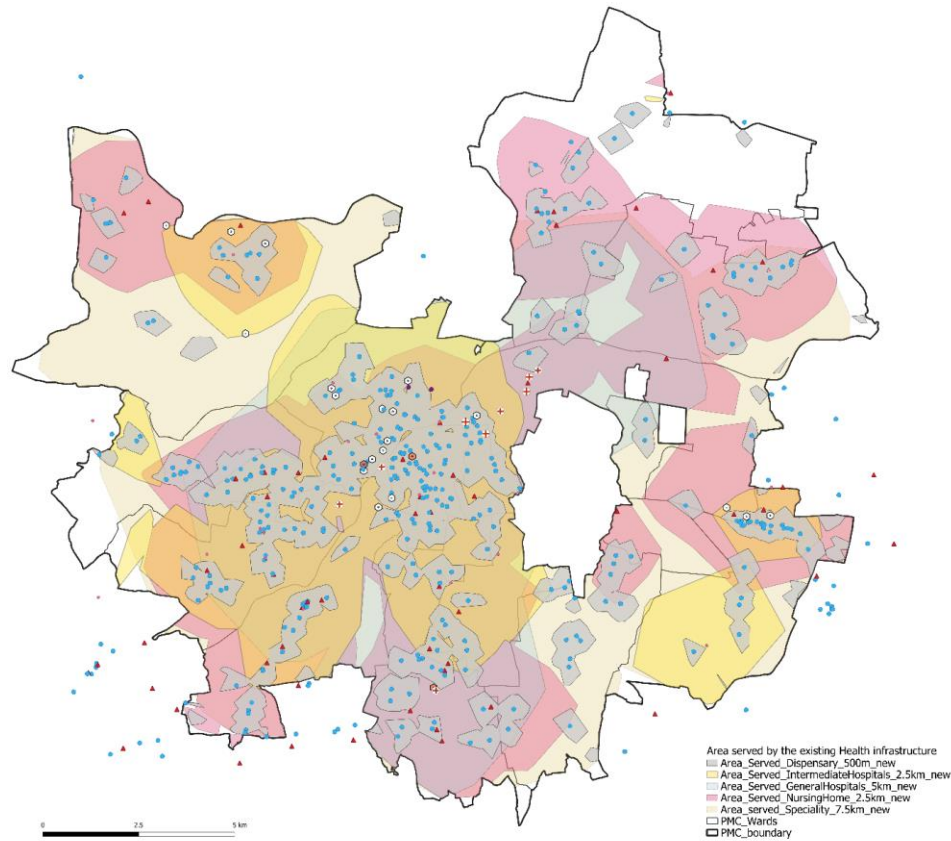


Figure 6: Existing healthcare infrastructure and area served by them in the PMC limit (Source: Author)

## 5. Availability and Accessibility as aspects:

Availability is considered as quantity of healthcare facility required for the population which is represented by Number of Beds whereas, accessibility is considered as catchment area served by a particular healthcare centre.

There are loads of literature available on Access to Healthcare. Healthcare accessibility is an individual's access and ability to obtain essential health services such as prevention, diagnosis, treatment and management of diseases, illnesses and disorders that can impact their health. (Chowdhury and Ravi, 2022). Among the three Principles of Equity, one is- Equal access to healthcare for those in equal need of healthcare (Oliver and Mossialos, 2004). Equal access can be considered as every individual getting equal access rather than the healthcare services spatially spread equal throughout the city. This means that the healthcare services must be distributed according to the population density per ward rather than geographically over the city. Map 1 shows us that the population density is higher in core city and decreases towards the periphery.



## 6. Conclusions:

In this study, it has been observed that the City's overall healthcare infrastructure is falling insufficient for the current population and is in immediate need of improvement as currently, healthcare isn't available on accessible distance. Due to this imbalance in accessibility, people living far from healthcare services are facing barriers to access essential medical services. People need to travel long distance for their medical needs which also leads to one of the City's major issues- load on road infrastructure. Lack of timely access to healthcare services can also lead to deaths, especially when the patient requires immediate medical attention such as heart attacks, severe accidents, etc.

Also, a good healthcare infrastructure is the most important requirement of post-pandemic era. City planners need to consider access distance while allocating new infrastructure. Planners should analyse the demographics, population density to prioritize areas with immediate attention. For this, accessing and identifying gaps is the very first step.

## Acknowledgement:

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## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Understanding the Spatial Requirements of Girl Child User in Urban Parks

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## Abstract:

*Rapid Urbanization is leading to extensive population growth in metropolitan cities. The spillover effect of the increased population is reflected in the peripheral regions leading to peri-urbanization. These areas are facing serious problems in the planning of land use transformation affecting the peri-urban ecosystem. The paper is based on a systematic literature review of national case studies to gain insights into the key characteristics of peri-urban zones and identify the fundamental challenges for territorial management in metropolitan cities. It outlines the major problems related to governance, land use change and rent seeking interest groups to cope with the rapidly changing dynamics of peri-urban areas. It concludes with the discussion on multifaceted nature of the peri-urban areas and suggests participatory development strategy for metropolitan cities. The discussion culminates by suggesting to create a balance between center and periphery with a more democratic and sustainable approach, socio-economic opportunities, and citizen participation.*

**Keywords:** *Girl-child-centric design, urban design, urban parks, girl- child-friendly spaces, outdoor safety concerns.*

## 1. Introduction:

The 1970's and 1980's consisted of large families with many children, as they lived in small house or big houses, they had to share bedrooms. Many children preferred playing outside the house in angans (front-courtyards) or pat-angan (backyard) of the house. Relatively, during this era, more boys played outside as compared to girls, because girls were assigned with majorly domestic chores. Another important difference as observed via conversations was, boys could do any kind of play like-running in the muddy waters, climbing over a fence, bicycling in a mud, get wet etc. They would still be considered even after their clothes were torn or unclean, but girls were expected to not do the same, be prim and proper and play with decency. (Ward, 1978)

The involvement and physical presence of parents in outdoor spaces was not significant back then. Kids were often seen playing and roaming around on their own rather with their parents. As the times changed, during 1990's and 2000's parents accompanying their children to the public parks, gardens, streets and other outdoor general open spaces has increased multiple folds. The most common reason for accompanying them is that they do not feel a sense of safety/ security in public outdoor spaces. Thus, as a result adults are often seen controlling and restricting the experience of child using the public space. Often enough a parent is seen running around or instructing the child for activities. Also, an increase in indoor activities is observed as parents prefer children coming home and doing group activities at large (Krogh, 2009).

According to the (UNICEF 2021), migration from small villages to towns/ cities has increased. The overall percentage of children in age group (5-13 years) is more than 40 % today. It is the major % of population comprising the city today, thus catering to their requirement becomes the utmost priority (Sipe, 2006). The current world population indicates that by the year 2030 majority of population would be dominated by children. India is home to 472 million children under (0-18 years), which makes 39% of the country's total population. With majority children population residing in cities/ towns, it is important to note that children in urban settings face a complex challenge with regard to their development and the fulfilment of their rights. Today, in an urbanization India, urban setting has phenomenal impact on the growth and development of children.

## **2. Girl child and the aspect of city planning:**

Our Indian mythology comprises of numerous examples which indicate that women and children were highly revered and special welfare policies were structured around their well-being during the era of rulers of varied dynasties. During the British era due to great philosophers and social workers like Pandita Ramabai Mehari, Girija Shankar and Taraibai Modak, special attention was given legally to the upliftment of women and child. Concepts like Balwadi and anganwadis were established as centers for redressal of the affected. Thus, it can be said that the culture of reinstating kids and women in the city was established way ahead of the UN conventions and policies. Worldwide we have widespread approaches and programs for the women upliftment. According to the crime assessment in the last decade, the alarming rate at which crimes are taking place is a matter of concern. The most affected sector today is the girl child in the age group of (4-16 years). According to National crime records bureau there has been sharp increase of 16.2% (increase of crime against girls) in 2020. Offences under POSCO show the 675 were below the age of 6, 3297 were in the age group 6 to 12 and between 12 to 16 years. Out of which only 317 were boys. (Pandit, 2020) (National commission for women, 2021)

We cannot negate the advantages of living in city. Urban planning creates better opportunities and place for children. Jane Jacobs and Kevin Lynch's theories give a detailed impact of how planning has positive impact on children. Public parks offer easily accessible resources for physical activity at little to no cost. Analysing the demographic characteristics and levels of physical activity among park visitors can provide valuable insights for tailoring park promotions and programming. This information can be utilized to devise interventions aimed at encouraging physical activity and minimizing sedentary behaviour within the park setting. However, even till today no proper assessment of the perspective of girl child with respect to urban planning or space planning has been done. Child friendly initiatives focus on children as a group. But considering the issues faced by girl child on daily basis, an assessment of space suitability for girls is a must today. How a girl child visualises a space differs drastically from how a male child perceives the same. With concerns ranging from safety, accessibility, multi-purpose use of same space, play segregations many more such issues need to be addressed with respect to girl child user, so that space can be made safe for them.

## **3. Factors affecting health and well-being of a girl child:**

According to Piaget, "kids develop their intelligences through series of experiences in stages. They think differently from adults. Their learning happens through cognitive development which is based upon processes and mental simulation through stage operations". (Marwaha, 2017). As mental health, psychological wellbeing, physical well-being, stress levels are few factors to be studied with children as prime focus, equally important is well-being of girl child within the realms of spaces used. Few point for consideration being: How does a girl child perceive a space used by mixed age group. Why does she feel safe/ unsafe while using the same? What spaces encourage her to use it to the fullest. Which areas amongst the visible areas does she prefer and why? Which areas do the girls prefer to avoid in Urban parks and why? How does the perceivable space interact when its dedicated to a particular age group of children? These few questions of well-being and health

related to girls needs to be studied in depth. Thus through this paper, a conscious study of neighbourhood parks, a specific learning and understanding can be developed along thematic lines. With the help of indicators from the urban space analysis, data collection a comprehensive study of what type of spaces do the girls prefer, why do they prefer, what do they not prefer, can be studied. It can in turn help develop more gender centric approach towards the urban scape.

#### **4. Methodology:**

For understanding of the subject in detail, a study of various disciplines like psychology, socio- economical aspect, wellbeing theory, socio- cultural aspect, history of evolution of spaces with respect to specific urban parks within the residential areas in Pune was done. The analysis of living domains of study, such as- green space (urban parks), dedicated play spaces, surrounding areas within the premises, non- designed spaces within the physical premises of the urban parks was studied through observations interviews, discussions with parents and children- both girls and boys. The study also discusses about the current use of space, its impact on overall aspect, thus suggesting better interventions. These studies can form a basis for space allocations, space design, better design of urban parks for girls.

The study examined and analyzed 2 urban parks in combination with other recreational settings for the purpose of this study. Pandit Bhimsen Joshi Udyan in Kothrud and Shivsena Pramukh Balasaheb Thakrey udyan in Dhanukar colony, Karve-road was studied in depth. A variety of park-based physical activity behaviors (e.g., sports, walking, vigorous exercise, and playgrounds) were also examined. Studies of urban parks that supported both formal and informal activities were included, but parks designed for formal activities only were disregarded. Park-based physical activity was measured using the System for Observing Play and Recreation in Communities (SOPARC) (14). Developed for open environments such as parks and playgrounds, SOPARC. (McKenzie, 2006)

Observed activity was coded as sedentary, walking or vigorous. Physical activity patterns, park characteristics, and their interdependence or interrelationship were observed and researched. Accordingly, 6 characteristics were studied:

1. Effect of the designed/ undesigned/ play spaces and their behavioral observations,
2. Spatial relationships with spaces and associations.
3. Space requirements of varied age groups based on their play patterns and observations
4. Features and aesthetics (amenities and facilities, attractiveness)
5. Access (proximity)
6. Safety

#### **5. Identifying the gender differences and need for girl-child centric approach for better spatial design of parks:**

It's a well-established fact that outdoor and indoor activities have an impact on our behavioural patterns. Kids are influenced by the surrounding they dwell in. Emotional connect gets developed in this process, with the space they use. This in turn helps bond with nature, sustainable behaviour and overall health development starts taking place without special efforts. (Elizabeth Nisbet, 2008) Environmental psychology examines the relationship between the environment and human behaviour and vice versa. These patterns thus indicate the dependant and the independent variables for the research and the focus on design based policy generation for the same. Today the use of urban parks by a girl child is primarily dictated various factors, some of which are listed below by:

## Understanding the Spatial Requirements...

1. Accompanying adult- the caretaker/ parent/ sibling who accompanies her to the park is very crucial. How much time they have to spare is directly proportional to how much time the girl child would be able to spend in the urban park.
2. Time of the day: Which time of the day is the park being visited is another factor for consideration. If its during day time, the parent accompanying is comfortable. If its during evenings/ late evenings, then questions about visibility, access to the park, crowd etc. become additional factors.
3. Distance: Whether some adult accompanies the girl child completely depends on how far or near is the park. If it's far, she is always accompanied by an adult. If its nearby, regulations like -how much time is assigned for play plays an important role here.

### 5.1 Research insights:

The age group were categorized as infants, toddlers, school age, pre-teens and teens as per the standards of child psychology and behavioural studies. Based on several discussions with child-psychologist, parents, counsellors and children, certain specific observations in space perception amongst boys and girls are made. Based on personal interviews, walk along interviews, interaction with parents, kids playing in the park, discussions with accompanying adults, certain observations were made as follows: Girls and boys exhibit varying levels of physical activity, demonstrating distinct habits and behaviours when utilizing available activity spaces.

*Table 1: Differences in perception of space between boys and girls (Source: Author)*

Age	Behavioural pattern observation- for girls	Behavioural pattern observation- for boys
1. Infants/ pre- schoolers	Girls have stable gaze and recognise faces. They have milestones achieved faster- such as hand coordination, talking, controlling emotions.	Boys spend more time attentively staring towards light. Boys are harder to calm down, which makes them easily aggressive.
	<i>Sense of touch/ smell/ colour/ texture/ sound is explored as this is sensory phase for both genders. Parents tend to carry children during this phase so focus attention to objects/ spaces is achieved through guided approach.</i>	
2. Toddlers	Girls have regulatory emotions; they understand spatial relationships which help them understand spaces and associations better.	Boys develop these qualities rather slowly. They tend to copy the sounds like gun shots etc.- basically physical play takes precedence.
	<i>Easily associate with spaces/ play equipment, prefer spaces more colourful, varied.</i>	<i>Prefer more open spaces/ more of free play and guided play spaces</i>
3. School age	Girls tend to play in smaller groups, prefer intimate conversations; they develop relationships while playing support games.	Boys prefer playing in large groups for competitive games, structured games.
	<i>Prefer quite spaces with varied textures/ materials/ flowers/ patterns- keen observer of aesthetics as well.</i>	<i>Multi purposes spaces are preferred as more of physical/ fast paced games are involved.</i>
4. Pre- teens and Teens	Girls tend to perceive stress more with respect to relationships, surroundings in general. They tend to develop motor skill earlier than boys.	Whereas boys tend to distract themselves more with activity if they are stressed.

<p><i>Prefer quite spaces/ as the focus is more on interaction and discussions rather than play.</i></p>	<p><i>Prefer sports based activities like football, cycling, basketball, running- basically group based activities but also prefer quite spaces for conversations and gathering.</i></p>
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**5.2 Impacts of accompanying adults/ parents on the usage of space by the child in urban parks:**

Pune, in last decade has drastically transformed for betterment for young adults and families. In recent years, new limits have been incorporated within the district of Pune. People are seen making more efforts in visiting nature- they visit hillock, gardens, open spaces etc. as a relief. To understand how Pune responds to changes in/ or need of child friendly space planning, a study of 4 different neighbourhood urban parks was done.

In India, children are always accompanied by an adult when they use outdoor spaces. Who accompanies the child is extremely important because the time spent in the park is directly proportional to the adult who accompanies them for the same. After several observations made by this study, it can be concluded that, the child is deeply influenced, governed and directed by his/ her parent on how far he/ she can go within the park, which spaces to avoid, what to play, where to play etc. Thus, when a study is to be made regarding the same, analysis of the same is extremely important. The analysis of how many adults/ caregivers accompany the kids is also important as mentioned above; the pie chart below indicates the same. For the same purpose a generalised observation was made in 4 different neighbourhood parks. The children studied for the purpose are as follows: Children in age group 0-3 years, 3-6 years, 6-9 years, 9-12 years

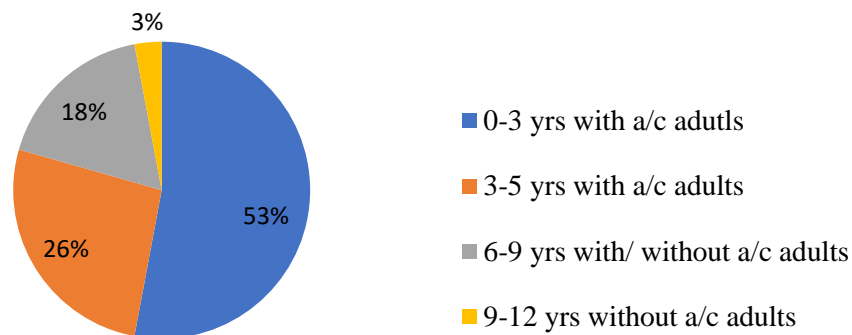


Figure 1: Percentage of age groups with/ without a/c adult (Source: Author)

**5.3 Understanding concerns/ issues and forming connections through spatial design interventions:**

Based on above understanding of psychological, psycho-social and behavioural theories about general wellbeing, below is an inference made for design and space requirement for girl child observed in 4 gardens (out of which 2 have been mentioned below) surrounded by residential areas, with a mix of commercial activities. The comparative study of 3 types of activities was done for the above-mentioned parks, indicated below in Figure 2. Observation was made from 6am to 10 am and 4pm to 8pm (as per the park timings).

- a. Shivsena Chief late Balasaheb Thakrey Udyan having an area of 1189.60 sq,m
- b. Bharatratna Bhimsen Joshi Udyan having area of 16000 sq,m (<https://www.pmc.gov.in/en/garden-list>)

As observational analysis it is concluded:

In Bhimsen Joshi Udyan, as lawn area is not fragmented, kids prefer to run/ play active games like badminton/ football/ volleyball, running, jumping on the lawns. Balasaheb garden, the lawn is divided by design into

varied pockets, which helps kids play in a group in varied pockets as per their age and activity types. Hence more vigorous activities are observed more as compared to Balasaheb Thorat Udyan. The girls prefer to play in small/ individual pockets as compared to a continuous stretch of space, as the interventions from other age groups and boys in minimised.

In Bhimsen Joshi Udyan, the walking / jogging track is designed such that it covers the entire lawn area. As compared to Balasaheb Thorat Udyan where the walking/ jogging track is designed with pauses/ intersections. Design is such that people can choose to walk as per their convenience. They need not cover the entire stretch compulsorily. Thus people prefer to use the walking/ jogging track in a fruitful manner in the second garden. The girls prefer paths which have multiple pause points/ intersections as they feel safe/ secure while using it.

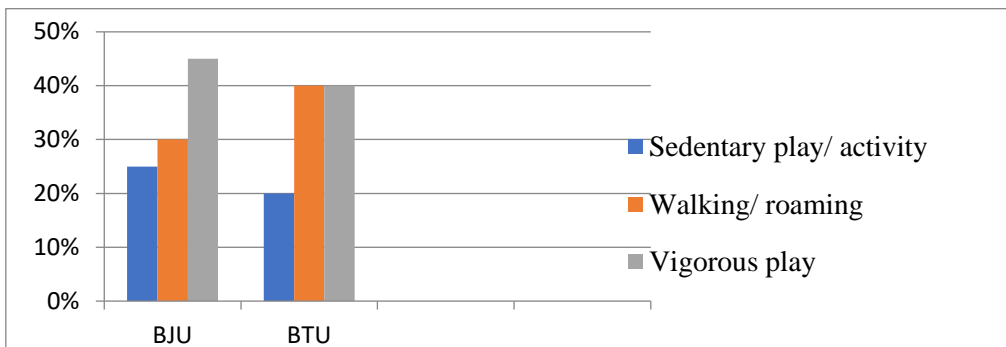


Figure 2: Overall Activity level mapping for Bhimsen Joshi udyan- BJU and Balasaheb Thorat udyan -BTU (Source: Author)

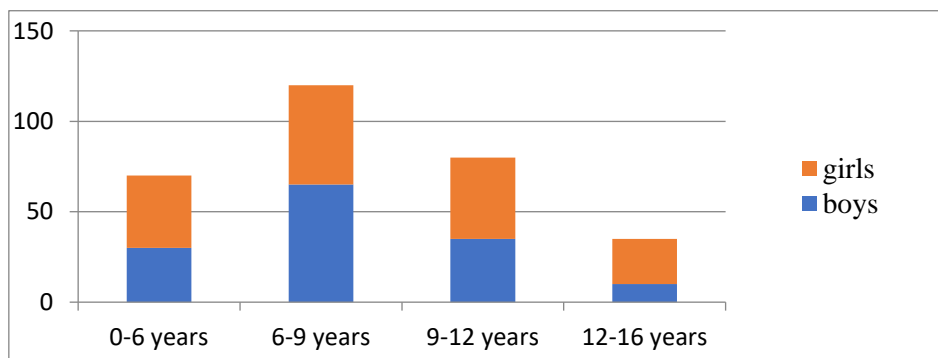


Figure 3: Number of park users by gender for Bhimsen Joshi Udyan (Source: Author)

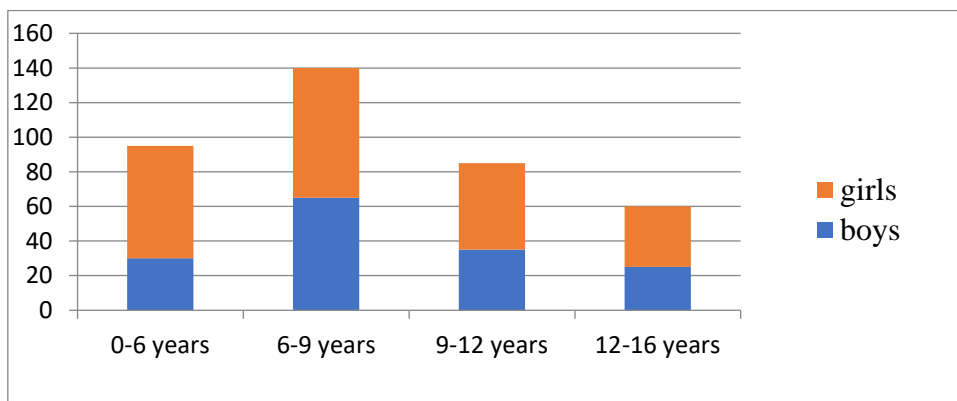


Figure 4: Number of park users by gender for Balasaheb Thorat Udyan (Source: Author)

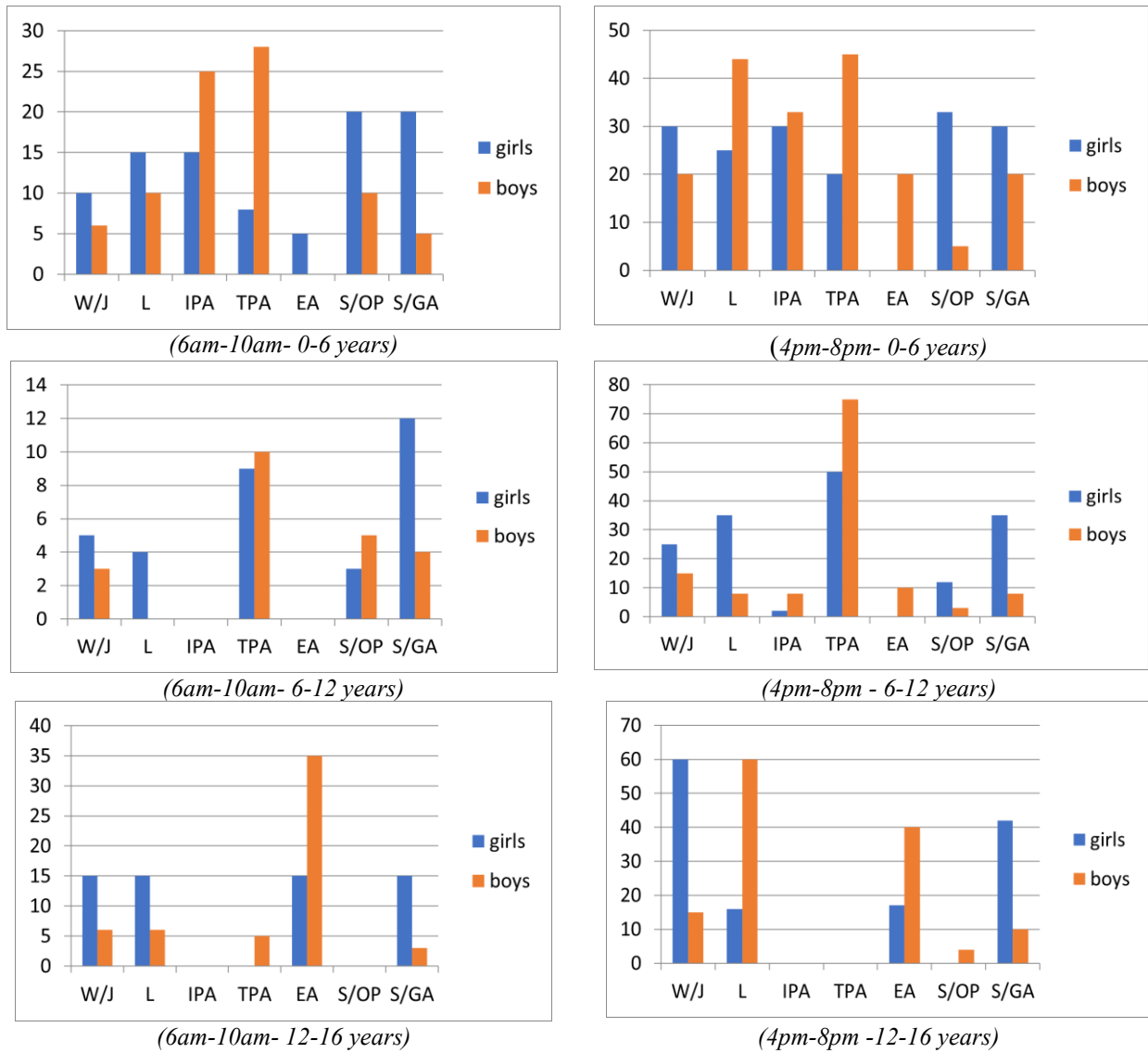
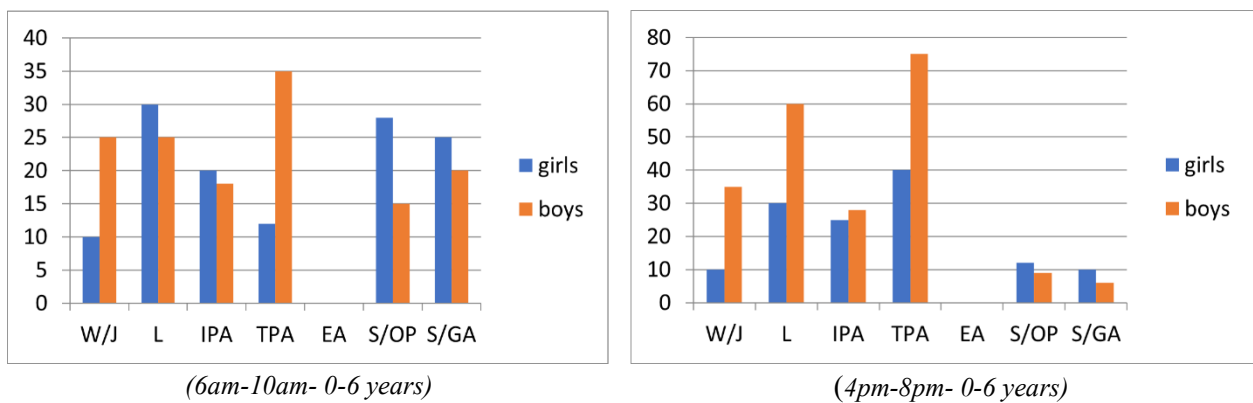


Figure 5: Occupancy analysis of BJU (Bhimsen Joshi Udyan) for - Boys / girls during weekdays (Source: Author)





Understanding the Spatial Requirements...

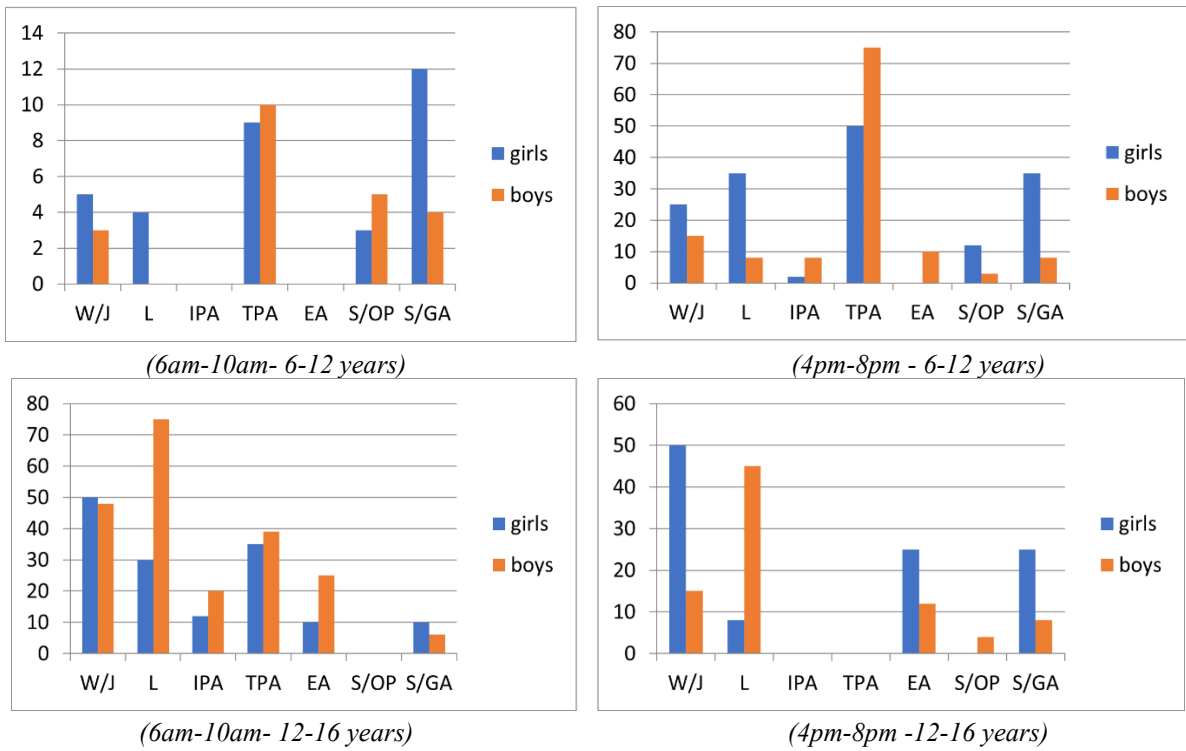
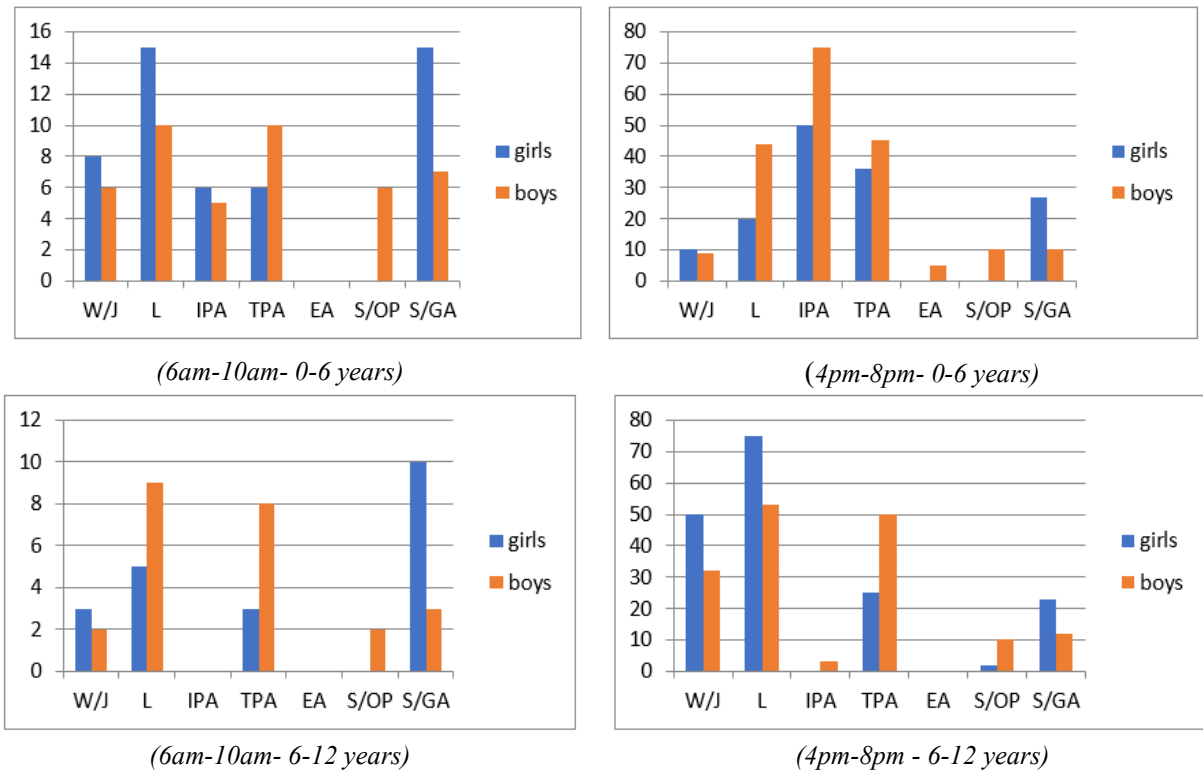


Figure 6: Occupancy analysis of BJU (Bhimsen Joshi Udyan) for - Boys / girls during weekends (Source: Author)



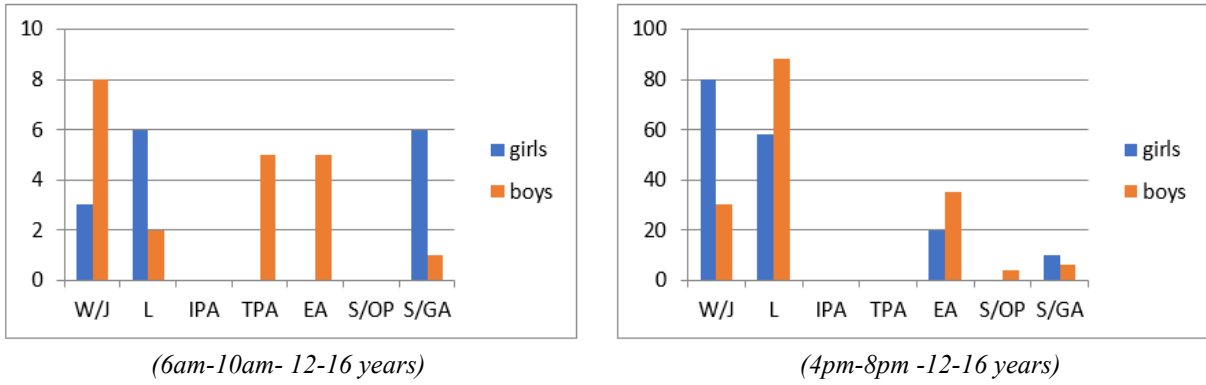


Figure 7: Occupancy analysis of BTU- Balasaheb Thorat Udyan for - Boys / girls during weekdays (Source: Author)

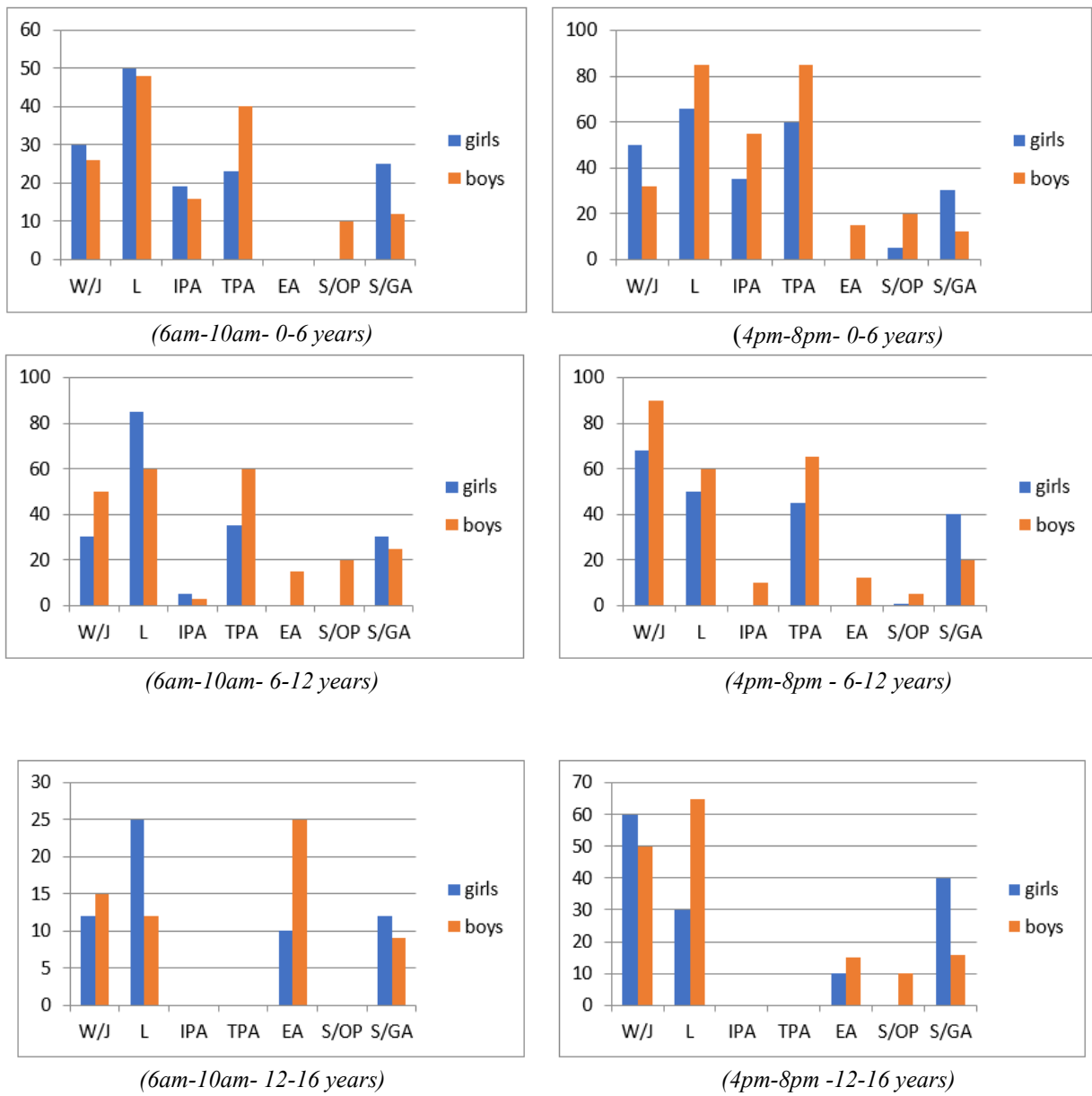


Figure 8: Occupancy analysis of BTU- Balasaheb Thorat Udyan for - Boys / girls during weekends (Source: Author)

Table 2: Space Analysis (Source: Author)

<b>UP-1 Bala Saheb Thakre udyan</b>					
Age group	Behavioural observation	Spatial relationships	Space requirements for varied age group and segregations	Features and aesthetics	Access and safety
0-3 yrs	Enough play space available for equipment play	Exploration of textural qualities such as gravel, lawn, leaves, benches etc. done more	Apt segregation of equipment based play.	Apart from equipment based play, colours of the stables, sculptures attracts attention	Controlled points of access and exit
6-9 yrs	Pretend play takes precedence over actual play	Individual pockets of greens are explored more	More boys tend to use play equipment provided for children as its more of climbing, ropes, hanging. Girls tend to avoid and play in groups.	NA	Lots of vegetation/ clumps and grouping makes it difficult to locate.
9-12 yrs	Prefer to walk more on walkways as it cuts through the garden segregating the active play and passive interaction spaces	Often found near gazebos, seats, covered spaces for interaction and control based play activities.	Prefer to use mix spaces	NA	In the evenings, they are generally accompanied by adults or are generally observed to gather around a well light space.

Table 3: Space Analysis (Source: Author)

<b>UP- 2 Bhimsen Joshi udyan</b>					
Age group	Behavioural observation	Spatial relationships	Space requirements for varied age group and segregations	Features and aesthetics	Access and safety
0-3 yrs	Girls seems to use available space aptly and associate more with artificial models more	Free play is more preferred, as parents accompany and play together	No segregation in terms of equipment play.	Artificial animal models attract more children, girls tend to explore the touch/feel more rather than climbing the models	As there is one entry and exit, the safety concern is not an issue. The park is visited by mostly surrounding societies and school nearby.
6-9 yrs	as boys mostly dominate the equipment. Mostly swings are used by this age group more.	As more girls tend to interact with each other, use of open lawn is preferred.	No segregation observed.	Girls were observed to use the gazebo space more interestingly, pluck flowers, leaves and use of shaded areas more.	NA
9-12 yrs	Group activities were observed more, involving chatting, playing games like langdi, badminton, and interactive games. Less of equipment based involvement was observed.	Waling , sitting in one place is more preferred, open lawns etc. are not much used	NA	NA	As the girls between 9-10 years are also accompanied at times or with peer group, safety concerns are not much, but late evenings are not preferred.

Table 3: Study of girl child preferences of play spaces and deriving spatial outcomes for the same (Source: Author)

Age group	Girls preferences	Spatial outcomes based on girl- child centred approach
(0-3) years	Prefer small activity areas with multi-sensory plays like jungle gym, small equipment based play.	
(3-5) years	<ul style="list-style-type: none"> <li>a. Prefer activities with close knit group and limited space.</li> <li>b. Personal interactions take precedence over spread out activities.</li> <li>c. Prefer focused activities like if playing on equipment- play only on equipment.</li> <li>d. Prefer to play on ground, lawns, near small shrubs, pluck flowers, leaves; sit under trees- basically more natural environment is preferred.</li> </ul>	<ul style="list-style-type: none"> <li>a. Multi-functional space is required.</li> <li>b. Segregation of activities based on                             <ul style="list-style-type: none"> <li>a. individual interaction,</li> <li>b. group interaction,</li> <li>c. focused/ targeted play,</li> </ul> </li> <li>c. Activities involving speed, force, needs to be segregated from other forms of play.</li> <li>d. Quite corners comprising of serene areas such as- lawn, shrubs, sandpits, seating areas should be designed without equipment.</li> </ul>
(6-9) years	<ul style="list-style-type: none"> <li>a. As motor skills are better developed, more of activities involving group discussions, community participations are preferred over individual activities.</li> <li>b. Free play is preferred with more of design interventions.</li> </ul>	<ul style="list-style-type: none"> <li>a. Prefer to use spaces not dominated by boys and teenagers.</li> <li>b. As a result, girls group are less active in presence of boys, thus the group tends to shift their play focus outside the play areas.</li> <li>c. Unorganised play is preferred with maximum interaction.</li> </ul>
(9-12) years	<ul style="list-style-type: none"> <li>a. Communication skills are developed, as a result like to commute, discuss, and chat in a group comprising of both genders.</li> <li>b. A sense of control is essential while playing, as a result skill based games are preferred over speed or fast paced games.</li> </ul>	<ul style="list-style-type: none"> <li>a. Due to parental and safety concerns playing out late is not allowed as spaces are not well-light, guarded and well approachable.</li> <li>b. As the girls prefer talking, chatting, any quite corner which is well light, has seating, space for gathering is more used rather than centre space in the ground/ gardens.</li> </ul>

After interviews and discussions, the Girls had some specific issues: Few of which are mentioned below.

**Issues regarding visit to parks alone:** ("Girls my age in other countries go to parks on their own and play without their parents, why can't I also go to the park and play on my own. My mother and father refuse to send me alone"- Girl 1- Aged 6)

**Issues regarding distance of visible play:** ("When my other friend- boys and girls are together in the park and we are playing, my mom doesn't let us me go far away while playing, they start walking towards where we go to make sure that we are not running out of sight, I feel like I can't play on my own. I feel bad, but my cousin in New Zealand says she goes to park, plays alone, without mom and her parents are ok with that. Why not me"- Girl 2- Aged 9)

Based on the overall study and analysis of the varied parameters, interventions in the public realm should be done so that girl child do not face constrained mobility outside their homes. A girl-child's movement as she leaves home to travel to any public place should be safe, secure and without hindrance. Thus design should be interdisciplinary without boundaries by applying the findings in city planning and park design in particular.

## 6. Learnings as directive for design:

As the visibility of children in cities is increasing, the importance of children's issues, concerns and design is increasing. The role of gendered considerations is also a matter of concern, as indicated in the research, the design considerations related to the same should be addressed for a healthy environment. The qualities of play spaces mentioned above are more specific to the users involved.

As mentioned in tables and as per the chart analysis and observation methods followed, few conclusions based on above analysis are as follows:

### 1. *Effect of designed/ undersigned spaces- behavioral observations:*

- a. It is generally observed that girls prefer to have separate spaces for certain activities like pretend plays.
- b. Multi-functional spaces are preferred for multiple activities, which at times do not involve speed based/ force based/ games.
- c. Ample seating and being in nature is preferred across all ages.

### 2. *Spatial relationships and associations with spaces:*

- a. Each girl child prefers to associate with their own space within the larger space available to them, hence it helps build a sense of belonging and association, which is very crucial for psychological and social connections.

### 3. *Space requirement of varied age group based on their play patterns and observations:*

- a. Segregation of active and passive play spaces is the utmost requirement for the girl child user. As an observational analysis it can be perceived that girls tend to be actively involved in play and passively involved as well, where they need their own space separate from the crowd. Here is where the Social Learning Theory plays a vital role in overall development and observational learning takes precedence.

### 4. *Features and Aesthetics:*

- a. Features are of prime concern as far as girl's perspective is concerned. Few concerns include, well-light spaces, open and interactive spaces, connectivity in terms of visual and physical. Controlled entry/ exit points. Placement of activities in accordance to stages of play for better organization and management.
- b. Girls tend to be attracted more and they participate more in spaces which are well designed and visually appealing.

### 5. *Access (Proximity):*

- a. Proximity or nearness to the available urban park plays a major role in whether girls will use the space or not. As per the standard norms, the play spaces should be walkable distance from the home. If the distance is more than the time spent in the Urban park is completely based on the time availability of accompanying adult. So proximity plays a major role.

6. **Safety:** The location of Urban park, surrounding spaces, activities, area of access to the park, location of entry/ exits, presence of security personals, visual safety and physical safety play a major role in deciding the use of space by girl child.

## 7. Conclusion:

As per the Equity act 2010, it is mandatory for public sector to give equal preference/ opportunities to usage of public spaces by both genders. Thus gendered preferences should be considered while designing of spaces. Taking into consideration, the girl child centric approach, many awareness programmes are being designed and catered to for physical well-being. But it would be an ideal situation for city planners, urban planners and architects to consider the safe "gendered mainstreaming" of spaces and design of gendered neutral activity spaces in urban parks accordingly.

The result of this research paper focuses on the addressing the gaps in literature review: Firstly- Limited research has been done on the way girls perceive the urban parks, the social implications of the same on their lives. Secondly- Extremely limited quantitative study has been done on perceptions of users (in this case girls of varied ages mentioned above) regarding the influence of gender-neutral spaces and influences on daily life. Thus, in continuation with the study conducted above, one can focus on involvement of physical, social, socio-cultural, psychological and emotional well-being of the girl child while designing urban parks. Operational findings can be based upon how, why do the girls perceive certain spaces in certain ways. This will surely help us build a safe space for girls.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Investigating Placemaking as a Tool to Minimize Social Fragmentation of Heterogeneous Marginalized Gated Neighborhood in a Metro City - A Case of Project Affected People's Neighborhood in Mumbai

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## **Abstract:**

*Mumbai is a financial and commercial capital of India. Migrants who contribute significantly to the local economy from different parts of India came to Mumbai for job opportunities and better quality of life. Mumbai saw this influx because of industrialization, commerce, and policy reforms. But because of lack of integrated policy, affordable housing lacked pace with housing migrants. Migrants started building slums on public land near the area of their work. Infrastructure development projects were undertaken by Mumbai Metropolitan Regional Development Authority (MMRDA), Mumbai Corporation of Greater Mumbai (MCGM) and Maharashtra Housing and Area Development Authority (MHADA), the government agencies to meet growing demand. The slums under public land under varied policies including The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act, 2013 (RFCTLARR Act, 2013), were displaced to clear for infrastructure development under Mumbai Urban transport Project. They were put to already existing built housing under Slum Redevelopment Authority (SRA).*

*Highly dense communities from varied socioeconomic backgrounds started living in gated communities as heterogeneous communities. In absence of any common ground of coming together, there was a social fragmentation, which resulted in safety and security concerns, fragmented cultural activities, social exclusion, isolation, and disparity in public services provision, and abused unbuilt spaces.*

*The study aims to investigate placemaking as an important tool to minimize social fragmentation of heterogeneous marginalized neighbourhoods in a metro city. It examines the impact of exclusionary planning on displaced communities, focusing on the role of the built/unbuilt environment, various theories of heterogeneous communities, and placemaking. The research is limited to the study of displaced communities in Mumbai under MUTP. The Methodology adopted is a mixed methodology of primary and secondary surveys. Secondary Survey includes research papers, reports and primary survey includes focus group discussion, MMRDA officials' interviews, Observation, individual interviews*

**Keywords:** *infrastructure development; marginalised communities; displacement; social fragmentation; placemaking*

## **1. Conclusions:**

Mumbai's location is in a region that has been inhabited for a very long period. In the third century BCE, the Maurya Empire included the islands of Mumbai (Dwivedi, 1990). Several dynasties, including the Portuguese, Gujarat Sultanate, Silhara dynasty, Maurya empire, and Silhara dynasty all had an impact on the area (harvard.edu/exhibits/show/hornby-vellard, n.d.). Mumbai was given to the British by the Portuguese in 1661 as part of Catherine of B'raganza's dowry (harvard.edu/exhibits/show/hornby-vellard, n.d.). Mumbai was



developed into a significant trading port by the British East India Company. The city developed into a significant hub for the manufacture of cotton textiles (harvard.edu/exhibits/show/hornby-vellard, n.d.). Important infrastructure was also constructed such as railroads and harbours. Mumbai became the Maharashtra state's capital after India got independence in 1947 (Infrastructure and Transportation, 1857–1947, n.d.). The city got its prime importance as the country's economic, financial, and entertainment hub. In the 1990s, Global markets started investing due to India's economic reforms to liberalize economy. Mumbai played a significant role in the process of increase in foreign investment and the development of sectors like banking, information technology, and services (Panagariya, 2004).

To improve the city's transportation infrastructure, the Mumbai Metropolitan Region Development Authority (MMRDA) initiated the Mumbai Urban Transportation Project (MUTP) (MMRDA, n.d.). The project's aim was to increase the connectivity, capacity of Mumbai's transportation network. Urban evictions and displacements, majorly of marginalized communities have also resulted from it. These communities are relocated because of evictions carried out to clear land for infrastructure construction, potentially upsetting their livelihoods and social networks (Deepak Kumar, 2022). To address this issue, the Slum Rehabilitation Authority (SRA) has implemented several regulations and programs (SRA, n.d.). These initiatives work to address problems like inadequate compensation and resettlement barriers while rehabilitating slum dwellers by providing them with better housing and amenities (Rashid, 2009). To ensure fair compensation, rehabilitation, and resettlement of impacted persons in cases of land acquisition for various purposes, including infrastructure projects, the Government of India passed the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation, and Resettlement Act (RFCTLARR Act) in 2013 (The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement (Amendment) Ordinance, 2015, 2015). A Social Impact Assessment (SIA) must be conducted in accordance with the RFCTLARR Act to determine the social, economic, and environmental effects of the proposed acquisition. Despite the options for rehabilitation and resettlement, there have been instances where marginalized communities have struggled to secure enough compensation and opportunities for new livelihoods. (Vanclay, 2017)

Marginalized gated communities in big cities like Mumbai have a very diverse population, with people from all socioeconomic levels, ethnic backgrounds, and life experiences living there (Parthasarathy, 2009). Displacement exacerbates social fragmentation in these environments as individuals and families struggle to establish connections and feel a part of their new community. Physical layout and inherent segregation in gated neighbourhoods can also increase social divisions and prevent the development of integrated neighbourhoods. (Dawn Alley, 2007) Our knowledge of how placemaking could lessen social fragmentation in diverse, underserved gated communities is growing because of this work (Dawn Alley, 2007). (Madanipour, 1996)

This study specifically focuses on the neighbourhoods of Mumbai residents who have been impacted by projects to analyse the problem of social fragmentation among diverse marginalized gated communities (ROY, 2011). These communities battle immensely to preserve communal coherence, social integration, and a sense of belonging since they are made up of individuals and families who have been displaced by construction projects (ROY, 2011). The physical design of gated communities and the diversity of the population further exacerbate the social dispersion in these districts (Roitman, 2010).

The study's objective is to increase our understanding of how placemaking could lessen social dispersion and foster social cohesion in displaced, underserved gated areas. The findings will provide insights into practical strategies and recommendations that could direct future interventions and policies aimed at fostering inclusive and cohesive communities in big cities, particularly in the context of Mumbai neighbourhoods where study participants reside.

## **1.1 Research Objectives:**

1. To evaluate the level of social fragmentation among the diverse, marginalized, gated neighbourhoods of Mumbai's project-affected residents.
2. To look at the concept of placemaking and how it might be used to lessen social isolation in distant gated communities.
3. To identify existing placemaking projects in Mumbai communities where project participants reside and evaluate them for their effectiveness in fostering social cohesion and community growth.
4. To research the difficulties and obstacles encountered when putting placemaking ideas into practice in underserved gated communities and to suggest solutions.
5. To offer guidelines and recommendations on how to undertake successful placemaking interventions to reduce social fragmentation and foster social integration within diverse minority gated neighbourhoods for policymakers, urban planners, and community development practitioners.

## **2. Literature Review:**

### **2.1 Overview of social fragmentation in marginalized gated neighbourhoods:**

Residents of marginalized gated communities frequently come from various socioeconomic backgrounds (Madanipour, 1996) (Roitman, 2010). These differences in wealth, education, and work prospects can lead to social divisions and obstruct neighbourly exchanges and social relationships (Sandercock, 04 Apr 2011.). Residents of marginalized gated communities may come from different linguistic groups, nationalities, and cultural backgrounds (Roitman, 2010). Insufficient intergroup relationships, a lack of shared experiences, and challenges creating cohesive groups can all be caused by cultural differences (Logan, 1988). Physical barriers like walls, gates, and fewer access points result from the privacy and security priorities that are frequently given priority in gated neighbourhoods (Roitman, 2010). While these elements give homeowners a sense of security, they can also impede neighbourhood social interactions and unofficial relationships (Madanipour, 1996) (Roitman, 2010). Sometimes, individual dwelling units take precedence over community areas in the structure and design of gated communities. Residents' abilities to interact, mingle, and participate in community activities may be hampered by the lack of or inadequate development of shared facilities like parks, community centres, and gathering places (Carr, 1992). Residents of gated communities may feel cut off from the larger urban fabric, which limits contacts with other communities and limits access to public services, amenities, and job possibilities. This distance can exacerbate social fracturing and a feeling of isolation (Parthasarathy, 2009). Marginalized gated communities could lack formally organized community interaction platforms and resident involvement in decision-making (Roitman, 2010). This lack of active community involvement might impact citizens' ability to work together to solve problems and feel a sense of ownership (Carr, 1992). Marginalized gated communities may experience condemnation and unfavourable preconceptions from the larger society, which will further make them isolated and excluded members (ROY, 2011). Because of this social shame, social breakdown may continue in the area.

### **2.2 The concept of placemaking and its relevance to social cohesion:**

Creating and upgrading public areas with the goal of fostering a feeling of place, community, and social cohesion is the emphasis of placemaking, a multidisciplinary approach. It entails a collaborative design, activation, and management approach for public places that considers the wants, goals, and cultural identities of those who utilize them. For several reasons, the idea of placemaking is crucial to social cohesiveness (Dawn Alley, 2007) (Madanipour, 1996). The building of welcoming and inclusive public spaces that accommodate the many needs and preferences of individuals and communities is prioritized in placemaking (Carr, 1992). Placemaking enables the co-creation of spaces that represent the distinctive qualities and goals of the community by incorporating inhabitants and stakeholders in the design and activation processes (Madanipour,

1996). The areas are accessible to all thanks to inclusive design principles, encouraging equal possibilities for social engagement and togetherness (Madanipour, 1996). Placemaking initiatives seek to bring life to public areas by promoting social interaction and community connectivity. Placemaking enhances social bonds, creates social networks, and promotes a sense of belonging by giving individuals the opportunity to congregate, participate in activities, and exchange experiences (Carr, 1992). These contacts encourage understanding and unity among various groups by facilitating the interchange of ideas, values, and cultural customs. Building a Sense of Ownership and Pride: Residents who take part in the placemaking process grow to love and be proud of their public areas. People are encouraged to actively participate in the upkeep, programming, and maintenance of the places because they feel a feeling of ownership. As a result, the spaces are effectively utilized, lively, and significant to the neighbourhood, strengthening social cohesiveness and neighbourhood identity (Madanipour, 1996). Fostering civic engagement and empowerment by encouraging locals to take part in decision-making and contribute to the development of their communities. Placemaking promotes a sense of agency, improves social links, and equips communities to act jointly to achieve common objectives by integrating locals in the design of their public places. The sense of shared responsibility and communal cohesion that results from this participation and empowerment. By designing areas that unite people and cross social barriers, placemaking can help fight social isolation and fragmentation. Placemaking encourages interactions and connections between people from different backgrounds, developing understanding, empathy, and social cohesion. This is achieved through making welcoming areas that are open to those with various interests and skills. These settings offer chances to meet others, break down social boundaries, and foster a sense of community (Dawn Alley, 2007).

### **2.3 Placemaking and social cohesion-related theoretical frameworks and models:**

To comprehend how placemaking and social cohesion are related, several theoretical frameworks and models have been created. These theories provide insights on the processes and components that promote social cohesion in placemaking activities.

#### **2.3.1 Social Capital Theory:**

The social capital theory talks about social networks, trust, and shared norms are essential elements of social cohesiveness in a community. This theory says that through creating inclusive and engaging public spaces, placemaking can improve social networks, interactions, and the trust building among residents. By developing social capital, placemaking activities can increase social being together (Häuberer).

#### **2.3.2 Sense of Place Theory:**

This idea focuses on the psychological and emotional attachments community makes to their physical surroundings. It can strengthen relationships between people and foster social cohesion when they have a sense of identification and belonging to a particular place. Two benefits of placemaking programs are building a feeling of place and promoting social cohesion which emphasize a place's distinctiveness, character, and importance (Lewicka, 2011).

#### **2.3.3 Social Interaction Model:**

This theory highlights the importance of social contacts in fostering social cohesion. Social integration and community development can be improved through placemaking activities which encourage social interactions, such as creating meeting areas, organizing events for the local community, and promoting group activities. It talks strongly about the value of positive interpersonal connections in promoting social cohesion across placemaking projects (Pauline van den Berg, 2017).

#### **2.3.4 Place Attachment Model:**

It examines the mental and emotional bonds community develops with specific places. This theory emphasizes that placemaking attempts can promote place attachment if they create memorable experiences, support local identity and cultural heritage, and provide opportunities for personalization and ownership. Strong place attachment is linked with increased social capital, increased social engagement, community involvement, and social cohesion (Raymond, 2010).

### **2.3.5 Community Development Models:**

The importance of community engagement, participation, and empowerment in promoting social cohesion is emphasized by a number of community development models, including Asset-Based Community Development (ABCD) and Participatory Action Research (PAR). These methods highlight the importance of community involvement in placemaking activities, inclusive decision-making processes, and group problem-solving (Geoghegan, 2004).

### **2.3.6 Environmental psychology theories:**

It gives information about the built environment's psychological and emotional components. The Environmental Identity Theory and the Restorative Environment Theory are two examples. These theories contend that placemaking activities can promote social cohesion by boosting psychological health, reducing stress, and fostering enjoyable social interactions in public spaces (Weyers, 2011). Understanding the mechanisms and elements that contribute to social cohesion within placemaking interventions is based on these theoretical frameworks and models. They provide insightful information on placemaking initiatives that are intended to strengthen social cohesiveness and create resilient communities.

## **3. Case Studies:**

### **3.1 The High Line in New York City, USA:**

It is a wonderful example of thoughtful placemaking. The High Line is a public park that was built on an old, elevated railroad track that has been turned into a long, linear green space (The Highline, n.d.). An abandoned elevated train track was turned into a unique and imaginative public park as part of the High Line project. By preserving the existing structure and repurposing it, the concept honoured the city's industrial background while creating a new and vibrant public area. Major community involvement was important for the building of The High Line and community organizations. Their recommendations and critiques helped the park's concept and programming to be modified to meet the needs and aspirations of the area. The High Line's architecture combines natural and industrial elements with carefully selected plantings, dining areas, art installations, and pedestrian walkways. The park organizes a variety of activities and events that interest the diverse communities of tourists and residents of all age groups, including art exhibitions, performances, educational events, and social spaces. The High Line was accessible to everyone with ramps, elevators, and accessible pathways. The High Line's development has had a big impact on the neighbourhood in the area. By introducing new businesses, restaurants, and cultural institutions to the area, it has enhanced economic growth. Now a popular holiday spot, it draws visitors from all over the world. The local economy has grown, and additional employment has been created as footfall has increased. Native plants, rain gardens, and other sustainable design elements are used in The High Line's green infrastructure. These factors improve the area's ecological health by lowering stormwater runoff and supporting urban wildlife habitats. It offers stunning views of the city, fascinating peeks into urban life, and a sense of escape from the hectic streets below. The park has been transformed into a destination for gatherings, spot for relaxation, and a venue for cultural activities, strengthening community ties (Carr, 1992) (Njunge, 2020).

### **3.2 Medellin, Colombia:**

It has undergone significant alteration over time because of innovative urban design techniques and community interaction. The city of Medellín has focused on creating inclusive public spaces that cater to all of its residents' needs. The city has invested in the construction of parks, plazas, and community centres in underserved neighbourhoods to ensure that all residents have access to high-quality public spaces for recreation, social interaction, and community participation. The public transportation network of Medellín, which includes the Metro cable car network, has been integrated to enhance accessibility and connectivity. Cable cars efficiently link various areas of the city and promote social integration by providing quick transportation as well as access to public amenities and recreational areas. The Medellín transit system, which includes the Metro, is being improved to provide accessibility and connectivity. Cable cars efficiently link various areas of the city and promote social integration by providing quick transportation as well as access to public amenities and recreational areas (Levy, 2017). The city of Medellín has actively involved its residents in placemaking through participatory design and community engagement projects. Local communities can have an impact on the establishment of public spaces by participating in decision-making processes. The success of programs that address the needs and objectives of each neighborhood is a result of this strategy's encouragement of a sense of pride and ownership among people. Medellín has embraced art and culture into its placemaking efforts to promote creativity, expression, and social harmony. Festivals, street art projects, and cultural events promote a lively environment in the city's public spaces. Public art initiatives can make ordinary districts more visually appealing and intriguing, attracting tourists and fostering a sense of community. Medellín has sought to promote environmental sustainability and increase the number of green spaces in the city. Building urban parks like the Botanical Garden and Arv Park enhances the aesthetic attractiveness of the city while also providing opportunities for leisure, recreation, and environmental education. These green spaces improve the urban ecosystem and improve the general wellbeing of the populace (Levy, 2017).

### **3.3 The Zabbaleen:**

It roughly translates to "garbage collectors," are responsible for recycling and rubbish collection in Cairo (Assaad, 1993). The Zabbaleen community has always resided in unofficial colonies, frequently close to places used for rubbish collection. Placemaking initiatives have centred on improving these communities by supplying necessary infrastructure, better housing, and access to amenities like water, sanitary facilities, and healthcare. The physical environment of the communities can be improved, which would enable the residents live in better conditions and have a stronger sense of place. The Zabbaleen community has always resided in unofficial colonies, frequently close to places used for rubbish collection. Placemaking initiatives have centred on improving these communities by supplying necessary infrastructure, better housing, and access to amenities like water, sanitary facilities, and healthcare. The physical environment of the communities can be improved, which would enable the residents live in better conditions and have a stronger sense of place. The Zabbaleen community's placemaking projects also emphasize social and economic development. It entails offering training and capacity-building programs to improve the inhabitants' skills and knowledge, allowing them to broaden their economic options beyond waste collecting and recycling. Access to microfinance, career development, and entrepreneurship assistance open doors for diversifying sources of income and enhancing socioeconomic conditions. Community participation and engagement are prioritized in placemaking activities in the Zabbaleen neighbourhood. Residents have a voice in determining how their communities grow because they engage in decision-making processes. Placemaking efforts are in line with the needs, goals, and cultural values of the community thanks to this participatory approach. The Zabbaleen community's placemaking initiatives also target health and wellbeing issues. This entails expanding access to healthcare providers, setting up sanitary systems, and encouraging good hygiene. The general well-being and quality of life of the residents are improved when the physical and environmental conditions of the communities are improved. The Zabbaleen community's placemaking initiatives also target health and wellbeing issues. This entails expanding access to healthcare providers, setting up sanitary systems, and encouraging good hygiene. The general well-being and quality of life of the residents are improved when the physical and environmental conditions of the communities are improved (Assaad, 1993).

### **3.4 Alag Karo:**

The goal of this collaborative placemaking initiative is to create welcoming spaces in Mumbai's underprivileged areas. The project's objective is to revitalize underutilized spaces by incorporating communities in their design and activation. It lays a major emphasis on the environment to foster community relationships and provide spaces for creative expression, professional development, and business opportunities (Alag Karo, n.d.).

### **3.5 The Kibera Public Space Project:**

Its main goal is to give Kibera, one of Africa's largest informal communities, a sense of place (Chelina Odbert, 2014). The intention was to reduce social fragmentation and marginalization in the area using several placemaking strategies. The project involved residents, community organizations, and local stakeholders in the design and planning process, to make sure the spaces represented the needs and aspirations of the community. The physical environment was improved along with creating aesthetically pleasing and useful spaces for neighbourhood gatherings and activities. This was accomplished by creating new public spaces, redesigning existing ones, and reworking on the neighbourhood's aesthetics. Residents of the neighbourhood were given training and skill-development programs enabling them to actively participate in the placemaking process while promoting entrepreneurship and economic opportunities. The project involved the provision of basic infrastructure, such as toilets, water supplies, and lights and social services. These changes improved the safety and wellbeing of the community (Chelina Odbert, 2014).

To promote social connections, create social capital, and support community bonds, the project organized community events, workshops, and cultural activities. One may examine the effects of these placemaking matrices on the marginalized and heterogeneous neighbourhood of Kibera, by evaluating changes in community cohesion, economic empowerment, increased access to social services, and the general liveability and sense of pride within the community.

Table 1: Comparative analysis of the case studies (Source: Author)

Indicator	The High Line	Medellin, Colombia	The Zabbaleen	Alag Karo	The Kibera Public Space Project
Location	New York City, USA	Medellin, Colombia	Cairo, Egypt	Mumbai, India	Kibera, Kenya
Physical Transformation	Abandoned railway track turned into a linear green space	Parks, plazas, green spaces, and transit infrastructure	Infrastructure improvement in waste collection communities	Revitalization of underprivileged areas	Creation of new public spaces and improvements
Community Involvement	Major community involvement and feedback	Actively involved residents in placemaking through participatory design	Community engagement and participation	Community engagement and involvement	Involved residents, community organizations, and local stakeholders
Accessibility and Connectivity	Accessible to everyone with ramps, elevators, and pathways	Integration of public transportation networks for accessibility	Improved access to amenities and healthcare	Focus on environment and community relationships	Improved safety and wellbeing
Economic Impact	Enhanced economic growth through new businesses and cultural institutions	Improved transportation, economic development, and diversification of income sources	Economic development through skill-building programs	Focus on professional development and business opportunities	Economic empowerment and entrepreneurship opportunities
Art and Culture Integration	Art installations, cultural events, and exhibitions	Promotion of art and culture through festivals and public art initiatives	Social and economic development through training and capacity-building programs	Emphasis on creative expression and community relationships	Skill-development programs and community events
Environmental Sustainability	Sustainable design elements and green infrastructure	Creation of urban parks for environmental improvement	Environmental sustainability through infrastructure improvement	Emphasis on the environment	Improvement in livability and sense of pride
Health and Well-being Improvement	Access to healthcare, sanitary facilities, and good hygiene	Improvement in healthcare and well-being	Health and well-being initiatives	Health and well-being improvements	Safety and well-being improvements
Social Capital and Community Bonds	Strengthening community ties and gatherings	Sense of pride and ownership among residents	In line with cultural values	Fostering community relationships	Promotion of community bonds and cohesion

## 4. Findings, Analysis through Literature:

### 4.1 Social fragmentation dynamics:

According to the assessment of the literature, physical barriers, a lack of shared spaces, and the limited social interactions among varied people all contribute to the social fragmentation that frequently occurs in heterogeneous marginalized gated neighbourhoods in metropolitan areas. Socioeconomic gaps, cultural differences, and historical aspects all have an impact on this fragmentation.

### 4.2 Principles of Placemaking:

Key placemaking concepts including community involvement, participatory design, inclusivity, cultural sensitivity, and the building of multipurpose public places are identified in the literature. These ideas are thought to be crucial for promoting social cohesiveness and addressing social divides.

### 4.3 The value of public spaces:

The case studies demonstrate how crucially important well-designed public places are in reducing social fragmentation. Successful programs design warm environments that foster impromptu connections, cross-cultural interchange, and enable residents to participate in group activities.

#### **4.4 Participatory design:**

The case studies emphasize how important it is to involve locals in the planning and decision-making stages. Placemaking projects that placed the needs of the community first created a sense of empowerment and ownership that strengthened ties between people and created a sense of community.

#### **4.5 Cultural inclusivity:**

Social inequalities can be bridged more successfully through inclusive placemaking designs that honour the cultural richness of underprivileged communities. Public places become hospitable and accommodating to all citizens by including aspects that resonate with different cultural backgrounds.

#### **4.6 Shared Identities:**

Social fragmentation is reduced via placemaking initiatives that encourage the development of common narratives and identities within the neighbourhood. Public areas serve as venues for commemorating common histories and goals.

### **5. Case study of Project Affected community in Mumbai:**

People from various socioeconomic backgrounds live in the resettlement and rehabilitation colony of Gautam Nagar in North Govandi, Mumbai. In the colony, there are nine structures with sixteen wings each (Graham, 2013). Each structure has seven stories, each of which contains twelve apartments. There are approximately 1520 households in total. 5500 people make up the approximate total population, giving the area an average density of over 4500 PPH. (figure -1). Ten percent of the population has a degree. Men make up 97% of the workforce, while women make up only 20%. Homes are self-owned in 66% of cases, while 34% are rented. The average maintenance and electricity expense is between 800 and 1000 rupees per month. (Figure 2). A one-time collection system for public trash is in place. Apart from that extremely high intensity garbage seen around buildings, on main street and in house gullies in between buildings. Fever, cough, and colds, TB, malaria, typhoid, dengue, skin, and jaundice are among the frequent illnesses. (Figure 2). The ideal setback is  $H/3$  for a single building or  $2(H/3)$  or  $H/1.5$  between two structures of equal height. Both the NBC and the city's DCR 1991 general regulations specify this. The SRA rule from DCR 1991 (SRA, n.d.), however, imposes a setback of just 1.5 m (which translates to  $H/16$  for 24 m tall buildings) or 3 m between two buildings, creating a narrow ravine with no entry or exit to buildings from there and inadequate lighting and ventilation to the flats (SRA, n.d.). The colony's layout includes undeveloped open areas designated as recreation areas. In all, 49 and 51 percent, respectively, of the land is built up to unbuilt up. Figure-1). The percentages of undeveloped areas are as follows: 27% for main roads, 37% for large open spaces, 21% for tiny open spaces, and 15% for house gullies. A total of 21% of undeveloped land is used for littering, 15% for parking, and 1% for each of hawking and playing. (Figure 3). Various festivals are observed by various communities at various times of the year on the unbuilt areas (In-Charge, 2011-2012) (Mumbai Environmental Social Network (MESN), n.d.).



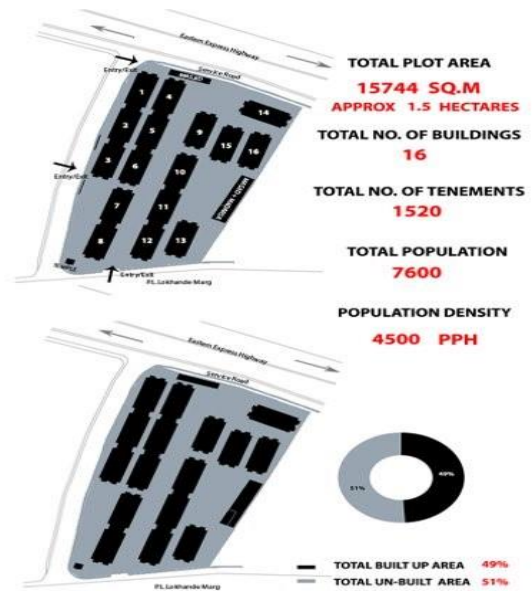


Figure 1: Gautam Nagar, Govandi (Source: Google Earth)

Figure 2: Demographics (Source: Mumbai Environmental Social Network)

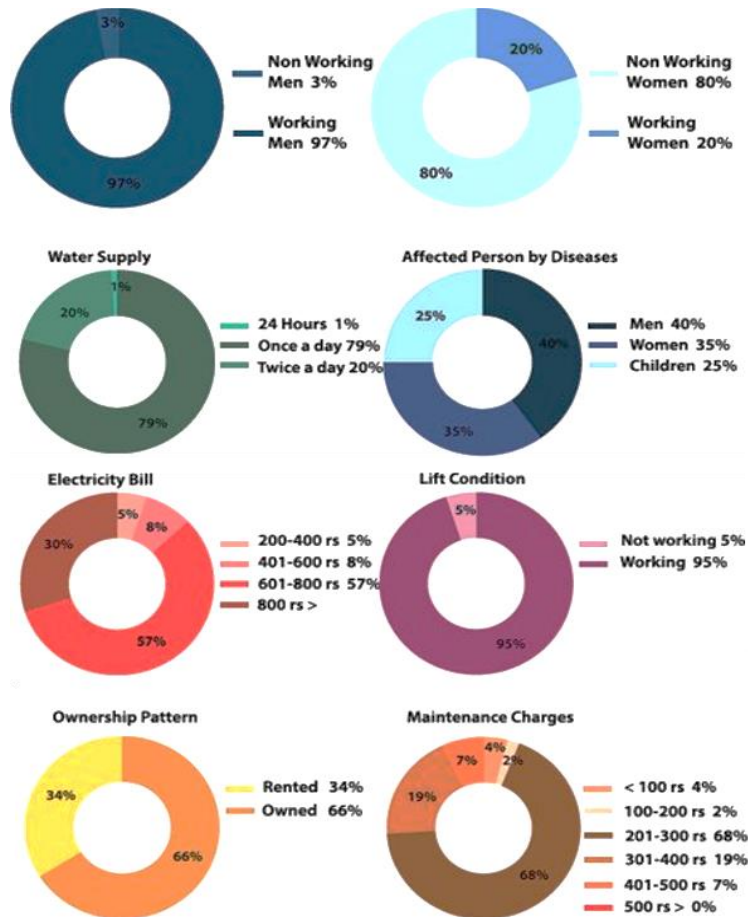


Figure 3: Socio-economic data (Source: Mumbai Environmental Social Network)

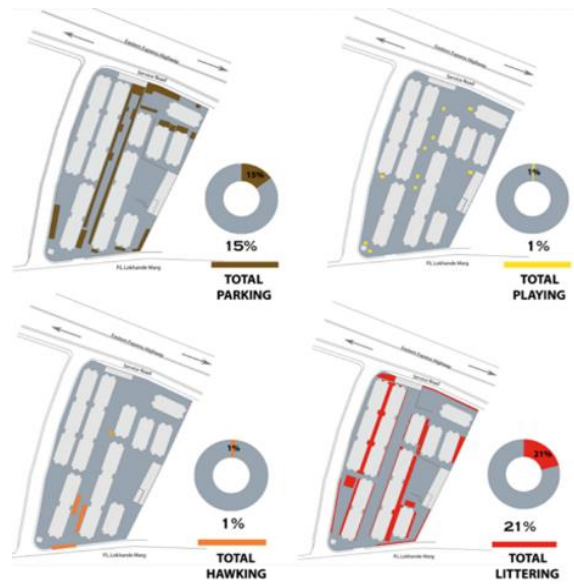


Figure 4: Unbuilt spaces (Source: Mumbai Environmental Social Network)

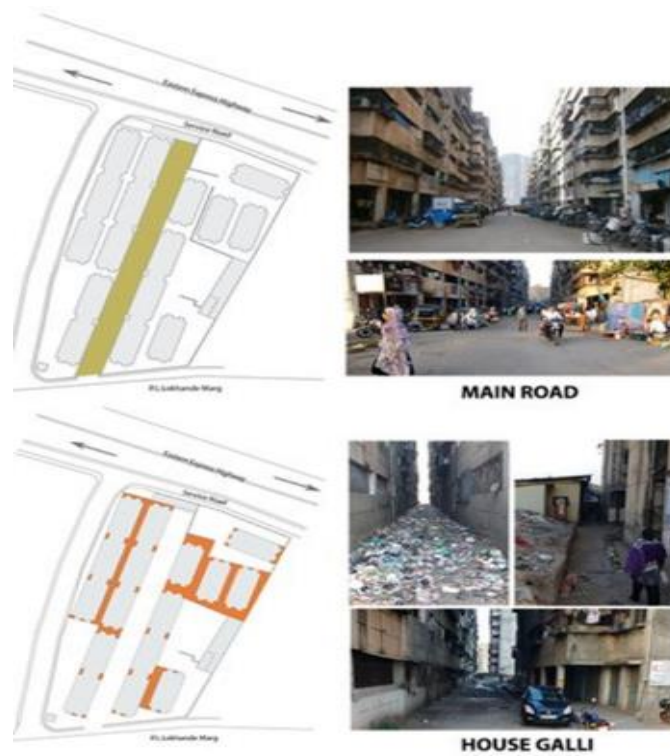


Figure 5: Main road and house gallis (Source: Mumbai Environmental Social Network)

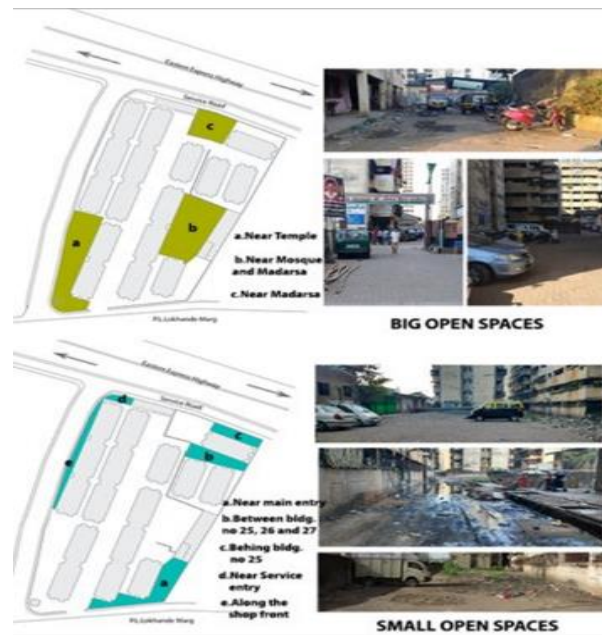


Figure 6: Main road and house gullis (Source: Mumbai Environmental Social Network)

## 6. Findings/ Analysis and suggestions:

Lack of a sense of community is brought on by the varied socioeconomic and language barriers that make it difficult for people to communicate with one another. The high percentage of rented-out and abandoned properties presents difficulties for fair elections forming societies and federations that consider the common interests of the neighbourhood. Renter maintenance is difficult to collect, which makes it tough for overall upkeep and wellness. Low literacy causes a lack of awareness of hygiene, which contributes to the community's high rate of post-illness spending. Due to underdeveloped environment, religious beliefs that encouraged unlawful activities, and illegal construction bringing in protection and security, the open areas were situated far from the buildings, making it used extremely infrequently by the population in particular children, women, and elderly. The home gullies are extremely dark and provide a haven for any unlawful activities, including a place to discard trash. There is a great deal of tension and personal risk among the many communities in the colony over disputes around the use of the public places. With excessive water usage and waste littering, cleanliness is a serious problem in public settings. In the lack of strict regulations, street sellers, rubbish, and outdoor parking encroach on public spaces. Without any rules, different tribes celebrate their festivals in different locations, which can lead to disputes because it can hurt people's feelings. The MMRDA's period of handholding is ended, yet residents are still having trouble managing their public spaces and other locations. Through a variety of programs and capacity building, the Mumbai Environmental Social Network, the UN, and the MMRDA helped the community construct these public spaces that are driven by the community. The initiatives failed due to a lack of a clear post-long-term management plan, an empowered community, an unintegrated approach, and local different populations' willingness and ownership.

Table 2: Issues and suggestions (Source: Author)

Societies/Federation Issues	Suggestions
Lacks experience and managerial capacities	<b>Individual Capacity building</b> and development of Guidelines on operations and management. <b>Creation of parallel committee</b> to work together with elected members
Most people residing are not the first owners and have no voting rights	Guidelines to have an <b>online system for voting</b> for first owners. Elections <b>followed by an event</b> might encourage owners to come for voting. <b>Involving first owners</b> in federation and various activities
Collection of maintenance charges from rental residents	<b>Fine system for offence</b>
Few residents have a separate compound wall	<b>Shared social cultural activities</b> during the year in the common public spaces among residents will increase trust building.
<b>Social Challenges</b>	
Lack of a sense of community and ownership of common assets	<b>Creating awareness and togetherness</b> for enhancement of common assets that enhance individual well being and also assets. <b>Creating occasions of common interest</b> at different time of the year involving each stake holder in different public spaces within society. <b>Development of public space for multiple use and users by involving them in the process</b> for development of public spaces for children play area, gym, sports, recreation , interaction, festivities, parking and hawking.
Women have restricted access to public spaces due to social beliefs and safety concern. 97 percent women are not working	<b>Dedicated secluded yet well lit public spaces</b> <b>Creating awareness and confidence</b> amongst women by capacity building through farming, skill building, financial planning, personality development and recreation, clean campaign
Presence of drug addicts in undeveloped public spaces and terraces	Developing, maintaining and continuous using the public spaces . Growing own crops in terraces will frequent the use and generate economy. Making public space more accessible and safer. Channelizing youth energy into designing and making of public places, skill development, placements, involvement in the federation
Stress between communities over the use of public spaces	Strong guidelines for shared interest and frequent use by each resident of public spaces
<b>Maintenance of Public Areas</b>	
Excessive waste and water littering	<b>Encouraging women volunteers to create awareness regarding keeping spaces clean. Fine</b> for the offence.
Encroachment of public spaces by by outside parking, street vendors	<b>Create Inventory</b> of owners and rentals and define areas for parking and hawking by taking fees to use it for the society and public spaces maintenance. In no case bigger public spaces to be used for parking
Irregularities in the allotment of public amenity rooms, and public spaces within the colony by societies/institutions is common	A mechanism to allot amenity rooms for society welfare to be developed.

## 7. Discussions:

### 7.1 Integrated Approach:

A comprehensive strategy that integrates placemaking concepts with knowledge of local socio-cultural dynamics is essential, as highlighted by the analysis of the literature and case studies. Effective placemaking understands that addressing underlying social and economic issues is necessary since physical design alone cannot alleviate social fragmentation.

## **7.2 Community Empowerment:**

The degree of community involvement is directly related to how well placemaking projects are received. By involving locals in the design process, public places are improved, and people are given the tools they need to actively improve their community. Encouraging women volunteers in Gautam Nagar, where 98 percent of the population does not work, to raise awareness of the importance of maintaining clean spaces. Additionally, this will increase confidence. Directing the youthful vitality of children.

## **7.3 Overcoming Challenges:**

The conversation explores potential obstacles to placemaking projects, such as resistance to change, unequal involvement, and conflicting desires, in addition to the already-present obstacles. Transparent communication, fostering conversation, and considering other points of view are all approaches to overcoming these difficulties. In Gautam Nagar, it's crucial to foster unity and awareness among the many different communities to improve the shared resources that boost people's wellbeing and assets. Person, society, and federation Building capacity to create creative and practical rules to address obstacles. One strategy for enhancing the current federation is the establishment of parallel committees. collecting fees as determined by the federation to define and distribute regions by creating an inventory of parking and hawking. Setting aside places for communal festivities will unite the neighbourhood. To prevent conflicts, set aside space and locations for other communities' festivities. Introduce a fine system for any infraction, such as failure to pay rent, parking, hawking, encroachment, misuse of water, and littering of waste, as agreed upon by everybody, allowing other neighbourhoods to use public spaces by maintaining them at a cost. They will be safer as a result.

## **7.4 Long term Sustainability:**

Long-term sustainability is a critical factor to take into account is the long-term viability of placemaking activities. Maintaining public places throughout time will require continual community involvement, maintenance techniques, and adaptive design that can meet changing needs. Complete transparency in management and operating procedures will benefit the community in the long run. Public areas must be designed for various users and sustained use.

## **7.5 Policy Ramifications:**

Integrating placemaking principles into urban planning strategies is particularly crucial. By encouraging community involvement, providing materials for design workshops, and giving public space construction in underserved areas priority, policymakers can assist inclusive placemaking.

## **7.6 Replicability and Adaptability:**

Although the case studies offer insightful information, it's crucial to remember that every neighbourhood is different. Placemaking initiatives should be flexible enough to be applied in different contexts while considering local demographics, history, and aspirations.

## **8. Conclusion:**

The study's findings show that marginalized gated communities in major cities, especially those where project beneficiaries reside, struggle with serious social fragmentation issues. Residents of these areas are divided and isolated because of factors including social inequality, cultural diversity, physical design, and the experience of displacement. Within heterogeneous marginalized gated enclaves in major cities, placemaking, which is governed by the ideals of community participation, inclusivity, and cultural sensitivity, has the ability to reduce

social fragmentation. Placemaking may help build more cohesive and lively communities by developing shared identities and designing effective public spaces. For a placemaking intervention to have a lasting impact, difficulties with community engagement and long-term sustainability must be properly addressed. However, barriers in placemaking initiatives include scarce resources, unequal power relations, and governance issues might undermine the effectiveness of these interventions. In order to encourage social integration and encourage fruitful interactions among inhabitants, public areas must be activated through a variety of community-driven activities. Inequitable gated communities can benefit from the incorporation of placemaking principles into their policy frameworks, urban planning procedures, and community development programs. Further study is needed to better understand the long-term effects of placemaking initiatives, the applicability of findings to various contexts, and the role of technology in fostering social cohesiveness in these neighbourhoods.

The research's conclusions offer insightful opinions and practical suggestions that advance the overarching objective of developing equitably dynamic urban settings.

### **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Co Living a Future Trend in Urban Housing in Metropolitan Regions of India

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## Abstract:

*Metro areas have seen migration from different parts of the country who are in need for accommodation. Across metro cities in India, housing is available at extremely expensive rates, usually far beyond the affordability of the prospective buyers. Homes are usually bought through financing with steep EMI's. Renting an alternative to buying a home also becomes expensive. Apart from the financial challenges, current housing is orientated towards families living in separate apartments. The social fabric of apartments makes it difficult for transitory or rental individuals to become a part of the discourse. To address the social and financial challenges, co-housing as a concept is seen as a solution. Co-housing allows for sharing of apartments, services and infrastructure with all residents with focus on having shared kitchens, cafeterias, laundries, social spaces, etc. that allow for an inclusive experience. The paper attempts to bring to light the significance of co-housing as an upcoming trend and how it has been implemented in various parts of the world through a comparative case study.*

***Aim:** The following research paper tries to identify the trends in co-living as housing solution and how it is seen across the world and in India.*

### **Objectives:**

*To understand the current trends in co-living in India through case studies,*

*to understand trends in co-living globally through case studies*

*To draw conclusions on amenities and infrastructure needed in co-living spaces.*

**Keywords:** *co living; housing; metropolitan; apartments*

## 1. Introduction:

Residential typologies are mainly classified with units having separate living, eating, cooking and sleeping spaces or rooms however Co living in most cases is referred to a group of people living in accommodations with shared spaces like common kitchen, laundry areas, recreational facilities, cafeteria, conference room, gym. It is a new trend accepted by young people who like to mix and mingle with other trend setters and entrepreneurs willing to collaborate.

The rent is generally charged on the basis of the private spaces and the shared spaces used. This kind of staying facility has increased the affordability of living in cities with high rental estates.

Co-living spaces provide a modern lifestyle with amenities and convenience for young professionals in cities, ideal for bachelors and singles. "These are fully-furnished homes, where the tenant's privacy is maintained as they enjoy a private bedroom in most cases. However, common areas such as kitchen, living room, etc., are



often shared," (*Outlook India, 2022, Santhosh Kumar, vice chairman of real estate company ANAROCK Group*)

### **1.1 Concept of Co-Living in India and necessities of user group:**

India has the youngest populations in the world, with a share of the 15-34-year age around 30% till 2030s. "With an urbanization rate of 2.3%, close to 35% of its population lives in these areas. Considering the age bracket, this category will be in the initial years of career growth. This means that they will prefer rental accommodation over purchasing real estate. Big cities like Bangalore, Pune, Delhi, Mumbai, and Chennai are evolving day by day attracting students and freshers from remote areas of India to come out and be a part of this trendy world." (*Times of India, 2022*)

Hybrid work models of work from home and coliving are intertwined. The requirements of gym, wifi, workstations and ambience that can boost productivity and ease of living. "Co-living spaces tend to provide these amenities and manage the services efficiently." (*Times of India, 2022*). Other spaces that may be welcomed are gyms, common areas, gaming centres, dining halls, meditation and wellness centres.

As the world resonates with the hybrid working model, a large portion of the workforce will spend more time at the place of their residence. Their requirements will also include workstations, reliable internet, and surroundings that will inspire productivity. Co-living spaces provide these amenities and manage the services efficiently. Living spaces that have all amenities like a gym, common areas, game zone, and in-house dining will be trending.

### **1.2 Co- Living:**

Co-housing, largely an urban trend that developed in Europe, is slowly being adopted in the urban areas India. India has a booming urban population. Housing in the urban areas is becoming increasingly strained and the demand for housing is leading to unprecedented rise in cost. Housing today is crossing over to luxury.

In such a scenario co housing is emerging as a viable bridge between the demand and affordability. Co-housing that accounts for common spaces and shared spaces leads to unburdening of space for a person which can reduce the cost. This can bring significant savings when considering cost per square feet as a standard of measuring rent.

### **1.3 Trends in Co -Living:**

"Today's workforce is on the move and does not prefer compromising on their lifestyle. The pandemic has compelled people to choose places that offer greater safety along with fully furnished facilities. Considering the extensive offerings by co-living spaces, along with ensuring enhanced safety protocols, this alternative will gradually become a necessity for modern migrants" (*Butwani, 2023, and Kahraman Yigit, co-founder and CEO of a co-living and student housing brand.* )

Colliers' latest report – Future of Co-living in India – concluded that India's co-living market is expected to double by 2024 with 4,50,000 beds by the end of 2024 against the 2,10,000 beds as of 2021-end. (*Colliers, 2021*)

Also, a trend reversal can be seen with respect to the rental rates of co-living spaces that had experienced a 15-30 per cent reduction – the rates are going back to the pre-pandemic levels," (*Butwani, 2023, with observes Saurabh Mehrotra, executive director, valuation and advisory, Knight Frank India.*)

### 1.4 Future Projections:

As per Outlook India, after a pandemic hiatus, the co-living segment is expected to bounce with the reopening of offices and colleges. The market is targeting urban working migrants aged 18-35, whose numbers have grown manifold in cities due to the availability of work. (*Outlook India, 2022*)

According to IBEF, there are more than 75 coliving companies in India.

**By 2025, the coliving market in India is expected to grow to 5.7 million from 4.19 million**

**. The size of the sector across India's top 30 cities is expected to grow two-fold and reach \$13.92 billion from \$6.67 billion at present.**

According to Colliers' report, by 2024,

the sector is expected to have 4,50,000 beds driven by organised players.

Figure 1: Future prospect of co-living (Source: <https://yourstory.com/2022/04/6-homegrown-coliving-startups-stanza-living-colive-your-space-settl-isthara>)

### 1.5 Anatomy of Co-Living spaces:

Co-living consist of private and shared/ common spaces. A laundry, kitchen, swimming pools, work spaces, leisure areas, gyms and spa are among the common facilities that coliving offers tenants, who include numerous liberal professionals and digital nomads. They usually enjoy private in-suite bedrooms and organize events for residents to get together and socialize. (*Iberdrola, n.d.*)

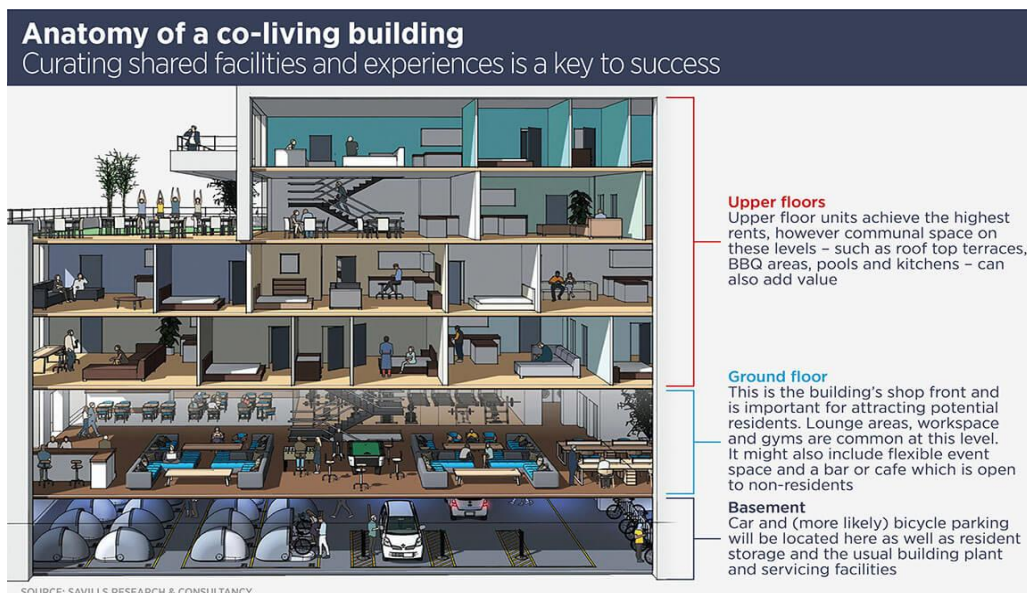


Figure 2: Anatomy of co-living a conceptual section (Source: Savills Research Consultancy, 2020, <https://www.savills.com/prospects/sectors-co-living-evolution.html> )



Figure 3: Picture showing the Creativity Co housing with transition passages and shared kitchen (Source: <https://archello.com/project/creativity-an-urban-eco-community> (Callejas, n.d))

## 2. Case Studies:

### 2.1 India -Creativity Co-housing, Auroville:

This Co housing was designed as prototype by Ar. Anupama Kundoo to house 50-60 residents to offer affordable solution with positive environmental impact. The complex was designed using cluster planning principle with buildings offering residences for singles, couples and families around central courtyard. the residents had shared common facilities like kitchen, laundry and multipurpose hall.

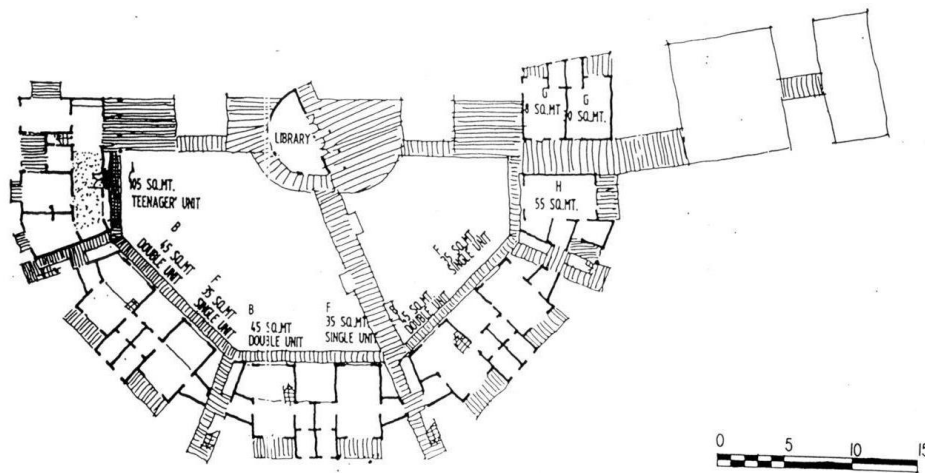


Figure 4: Plan of Creativity Co-housing based on cluster planning around courtyard (Source: <https://archello.com/project/creativity-an-urban-eco-community> (Callejas, n.d.))

The common spaces offered spaces to interact with other residents and fostered stronger relationships. The building was constructed using rammed earth and other sustainable techniques reducing the carbon footprint.

## 2.2 Global Case Study:



Figure 5: Lyf One North exteriors and interiors (Source: <https://www.archdaily.com/988293/lyf-one-north-co-living-development-woha>)

### **lyf One-North Co-Living Development by WOHA Architects:**

Located in Singapore this Co living building offers beautiful composed massing with well-connected transition spaces. The plan has a typical arrangement of linear 324 living units arranged in with services for easy access. The Two masses are interlinked with each other with a connector block. The Triple height space below the central mass houses an amphitheatre that offers unique public and communal space for socializing and recreation.

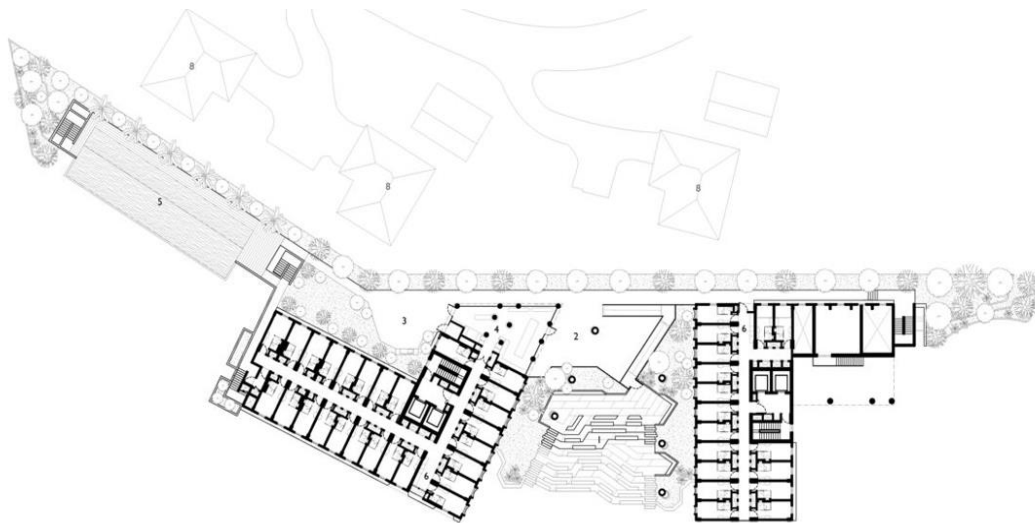


Figure 6: Plan of Lyf One North exteriors and interiors (Source: <https://www.archdaily.com/988293/lyf-one-north-co-living-development-woha>)

## 3. Findings and Probable Trend:

Coliving in India is a growing trend with various players like Colive, ZOHO, Zolo Stays, StayAbode, OYO Life, Stanza Living, Hour and HackerSpace to name a few. These organizations offer rental apartments to Tech professionals, Students and young startup professionals.

## 4. Conclusion:

Co-living housing has its own set of advantages and disadvantages. Although it provides for a completely new housing lifestyle, it may not be completely free of faults. The added amenities come up with added costs, it also changes the ownership structure as most of them are rental or subscription-based models. However, for users that are constantly migrating and may feel isolated in large apartment complexes, co-living can provide a suitable option as it has common spaces that can allow social interaction and discussions, making them more humane and liveable.



Figure 7: Diagram illustrating benefits of co-living (Source: <https://www.homa.co/post/benefits-of-co-living>)

Most young professionals are digital nomads and demand convenience. Therefore, co-living spaces are gaining traction because they are located at prime locations with good connectivity and in-house amenities like furniture, house help, etc. But, on the other hand, it will cost more if they look for an independent apartment for rent.

"Most occupants find it is challenging to make time for household chores, and co-living spaces come with in-house staff and food facilities. So co-living spaces provide all the facilities at a much cheaper cost than the setup cost of rental apartments or PGs," (*Outlook India, 2022, with Nikhil Sikri, CEO & co-founder of co-living platform Zolo.*)

Co living spaces also offer low carbon footprint due to sensitive sustainable design as well due to common facilities like communal kitchen and common kitchen gardens etc.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Defining the Urban Context of the Heritage City of Satara

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## Abstract:

*Contextualism in architecture involves designing structures that consider both tangible and abstract elements of their environment. It comprises a wide range of factors. Primary considerations include climate and topography, while subsequent stages of design explore elements such as massing, materials, landscape, and urban factors like surrounding buildings, open spaces, and road networks. In theory, architecture should seamlessly align with its surroundings, reflecting and interacting with the society it serves. However, in practice, design decisions may either align with or challenge these contextual factors. There are numerous examples where the architect has taken a contrasting approach to design with respect to the context. For example, the Louvre Pyramid by I.M.Pei in France and the Dancing House by Frank Gehry in Prague. Although these buildings are iconic, there will always be debate about the contrasting approach. Since the culture and heritage are the most deep-rooted aspects of any settlement, these factors are considered some of the crucial aspects of contextual studies. One city that exemplifies the interplay of urban contextualism with culture and heritage is Satara in Maharashtra. The city's rich history of Maratha Rule is evident through its geographical location, cultural practices, and architectural style. The enduring presence of Maratha architectural marvels, such as forts, temples, stepwells, and palaces that grace Satara's landscape, narrates its rich historical tale. Over time, the city has seamlessly woven together multiple layers of context, including its geographical significance, cultural heritage, and political history. The latest addition to this intricate tapestry is the influence of urbanization. As urbanization threatens to rob the city and its identity, it is important to understand the contextual layers for a heritage city like Satara. This paper aims to study the existing urban characteristics of Satara and to define a context for future reference. This study was carried out through photographic documentation and analyzed through observations and inferences.*

**Keywords:** contextualize, heritage, urbanization, architecture

## 1. Introduction:

***“You can put down a bad book, avoid listening to bad music, but you cannot miss the ugly tower block opposite your house” – Renzo Piano***

Contextualism in architecture is a design philosophy which emphasizes designing and constructing buildings that are responsive to and respectful of their physical, cultural and historic surroundings. It aims to design structures that harmonize with their context rather than disrupt it. The context is the environment in which architecture occurs, but what is the scale and extent of this environment?

1. Intimate (direct context): the group of buildings or spaces directly neighbouring a building
2. General context: It is the environment surrounding the building and completing its image, which can be its neighbourhood or district or even its city.
3. Cultural urban landscape: When layers of functions, economy, infrastructure and local societal patterns are added to the general context, it can be considered as the urban landscape. Then when culture and history get intertwined in the urban scene, this can be called a cultural landscape.

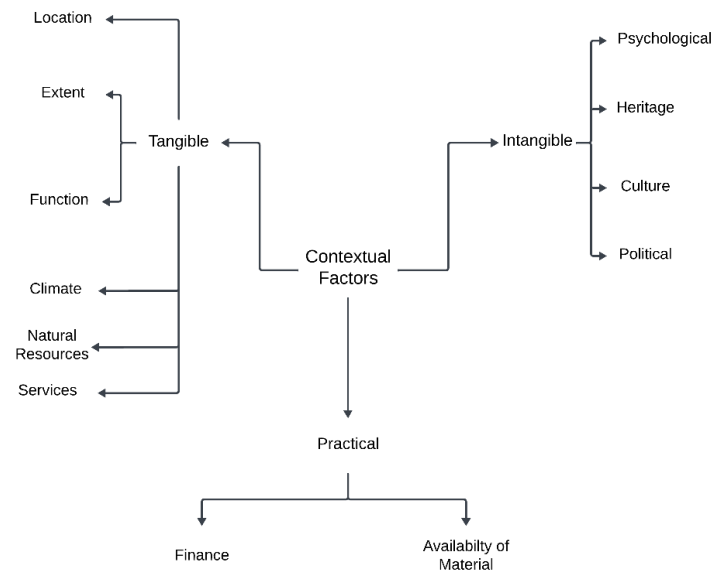


Figure 1: Contextual factors (Source: Author)

Contextual design in architecture encompasses a wide range of factors that collectively constitute the project's surroundings. Figure 1 illustrates various factors involved in contextual study through a flowchart. These factors, whether tangible or intangible, influence the architect's design decisions and are considered at various stages of the design process. Studying these factors allows us to comprehend the context at hand. It is important to acknowledge that context cannot be precisely defined, as it incorporates dynamic elements that continually change and evolve alongside people, technology, and cities. Within any design process, certain factors are deemed primary, while others assume a secondary role, all of which ultimately impact the efficiency of the building design.

Apart from being catalysts of economic growth, cities also preserve Culture and Heritage reflecting the communal identity and spirit of a society over different periods of its existence. Heritage links the past and present, shaping the community's future. These historical imprints offer crucial insights about ancient culture, lifestyles, development, construction methods, materials, art, architecture, as well as society's physical, social, and economic aspects. Hence in many situations, the history and heritage of a city is the strongest context for the impending design problem. The existing urban and cultural landscape of a city represents its history and heritage. (Wassef, 2023) When any new building is designed in this landscape it can either complement or contrast the existing urban landscape. In cities like Rome or Paris, the downtown districts hold their cultural heritage in such high regard that it can be difficult for new projects to depart from traditional forms to express their individuality.

In the past decade, the world has seen an exponential increase in urbanization. The wave of urbanization has not only hit metropolitan cities but also smaller cities. While urbanization fosters economic growth, better infrastructure and even educational and health care facilities it also attempts to intimidate the history and heritage values of the city. To understand how urbanization can affect urban settlements with a strong historical background, the city of Satara has been chosen. Satara, an esteemed heritage is at the acceleration stage, in the process of urbanization. Currently not being classified as even a tier 2 city, the upcoming decade is expected to bring a substantial wave of urbanization. This makes the present moment ideal for engaging in this dialogue, facilitating future construction that harmonizes with the preservation of its heritage.



### 1.1 Location and Extent:

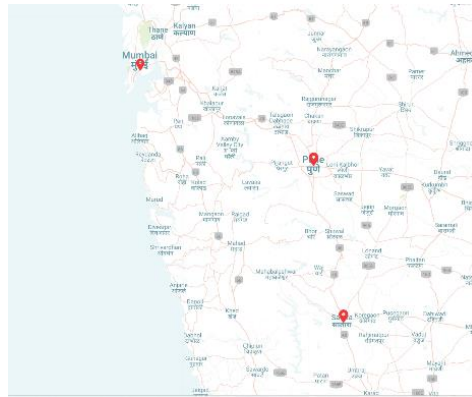


Figure 2: Satara-Pune-Mumbai (Source: Author)

Satara City, serving as the capital of its corresponding district within Maharashtra, India, stands proudly at an elevation of 697 meters above sea level. Positioned approximately 110 kilometres away from Pune, 123 kilometres from Kolhapur, and 270 kilometres from Mumbai, it enjoys a vital location at the junction of the Krishna and Venna rivers. This city is embraced by the grandeur of seven mountain ranges, contributing to its distinctive terrain. The Mumbai-Satara Highway plays a crucial role in facilitating travel to Pune and Mumbai, underscoring Satara's reputation for blending natural beauty with seamless connectivity.

### 1.2 Physiography:

Satara city is nestled within a natural bowl-shaped terrain, surrounded by encircling mountain ranges. In the South-West, notable landmarks include Ajinkya Tara Fort and Sajjangad, while the North-West is marked by the presence of Kalyangad Fort. The city's urban landscape begins on the slopes of these mountains, gradually descending toward the North and East. Roads near the mountains have steep inclines, adding to the city's distinctive topography. Moreover, Satara is intersected by about seven water channels, contributing to its natural drainage system. The South-Western part of the city, known as Gaothan or Old Satara, is densely populated and holds traces of the city's historical roots. This area serves as a cultural and residential hub, reflecting the heritage and traditions of Satara's residents. Satara's geographical features showcase its captivating natural setting, with mountains enveloping the city and water channels weaving through its landscape. These attributes enhance the city's visual appeal and establish a unique identity within the region. The city's physiography plays a pivotal role in shaping future development decisions.



Figure 3: Aerial view of Satara city (Source: Google Stock Photos)

### 1.3 Climate:

Satara district is situated in the river basins of the Bhima and Krishna Rivers. The physical settings of Satara show a contrast of immense dimensions and reveal a variety of landscapes influenced by relief, climate and vegetation. The climate ranges from the rainiest in the Mahabaleshwar region, which has an average annual rainfall of over 6000 mm to the driest in Man tahsil where the average annual rainfall is about 500 mm. The vegetal cover also varies from the typical monsoon forest in the western parts to scrub and poor grass in the eastern parts (<https://en.climate-data.org/>)

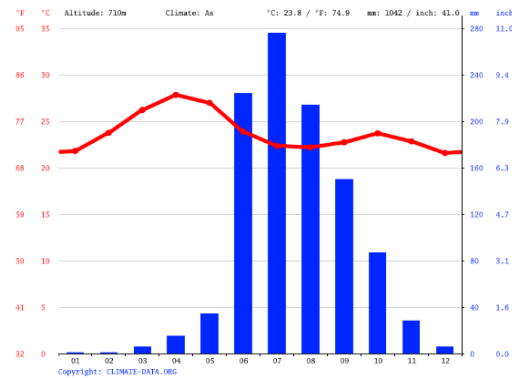


Figure 4: Climate of Satara (Source: <https://en.climate-data.org/>)

### 1.4 History and Cultural Heritage:

Under British colonial rule, it is understood that seven settlements (referred to as 'peths') were established, each associated with a specific day of the week. In subsequent years, additional peths were founded by notable individuals, and as a result, these settlements came to bear their names.

**Shaniwar Peth:** This stands as the largest among these settlements, housing numerous long-established families. The collective history of these families promises a wealth of untapped historical insights waiting to be unveiled.

**Somwar Peth:** Within this settlement lies the renowned Ganpati Temple at Futka Talav. Historically, this body of water was known as Imampura Lake and served as a vital water source, attracting settlements that eventually coalesced into what is now known as Somwar Peth.

**Pratapganj Peth:** This settlement takes its name from the era of Pratap Singh Maharaj, who played a pivotal role in its founding. Pratap Singh Maharaj extended invitations to individuals from diverse trades and castes, including Marwaris, Gujars, tailors, and more, to facilitate the expansion of this settlement.

**Bhawani Peth:** Also known as Marwar Ali in contemporary times, is believed to have been named after Bhavani Devi, an ancient goddess who was initially enshrined in the old palace. Notably, a straight road, referred to as Rajpath, begins from this point. To the north of the former municipal area lies Moti Lake, historically known for its unique feature of boiling Ova water.



Figure 5: Rajwada Palace (Left) (Source: Author) and Adalat Wada (Right) (Source: [https://commons.wikimedia.org/wiki/Main\\_Page](https://commons.wikimedia.org/wiki/Main_Page))



Figure 6: Bara Motachi Vahir (Left) (Source: <https://11nq.com/mIs5s>) and Small Shrine (Right) (Source: Author)

In the 16th century, Chhatrapati Shahu Maharaj's conquest of Ajinkyatara fort laid the foundations for what is now Satara, originally named Shahunagar. This city held immense significance for the Marathas, and under Shahu Maharaj's rule, two significant palaces were commissioned. The area that is today Guruwar Baug was once the site of Takhtacha Wada, a grand palace used as a court gathering place. Nearby, at the base of the fort, the three-story Rangamaharal palace served as the residence for queens and was where Shahu Maharaj eventually passed away. Unfortunately, Rangamaharal was destroyed by fire, and its remnants now make up part of the Cooper Corporation. In close proximity, Adalat Wada initially functioned as a civil justice center until 1876 but later transformed into a royal residence for Shahu Maharaj's descendants, where they still reside today. These structures not only bear witness to the city's historical importance but also showcase Maharashtra's distinctive architectural style. Among these landmarks, the octagonal Bara Motachi Vahir, a stepwell built between 1719 and 1724 by Virubai, Shahu Maharaj's wife, stands out with its 12 moats and an attached Mahal used as a resting place by Chhatrapati Shahu Maharaj.

### 1.5 Religious monuments:

Satara City is believed to be home to around 60 temples, each varying in size and location. The prominent shrines are conveniently situated, often surrounded by communal spaces. Beyond the previously mentioned Futka Talav Ganpati Temple, there are numerous others dedicated to different deities. The Vishveshwara Temple, founded in 1758 in Mangalwar Peth, holds great significance. It was built by Ramchandra Gangadhar Joshi Rahanar Pavas in memory of his village deity when he permanently settled in Satara. Similarly, Krishnaji Janardhan Chaskar constructed the Krishnashwara Temple in Venkatapuna in 1724; he was the brother-in-law of the first Bajirao and served as a caseworker in the city.

In addition to these, smaller shrines also dot the landscape. These temples, whether large or small, are integral to the city's cultural and historical heritage. Many of them, however, face the threat of urbanization. Communities hold strong religious sentiments, making it essential to safeguard these monuments, given the

uncertainties surrounding the consequences of ongoing urban development. Preserving these temples, regardless of their size, is imperative for the city's heritage.

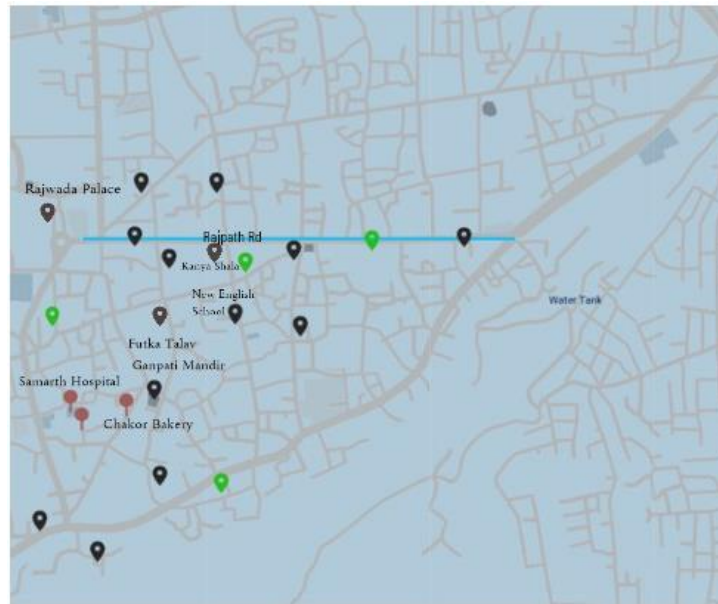


Figure 7: Area under study (Source: Author)

## 2. Introduction:

For the purpose of this study specific areas within Satara have been selected. The focus is primarily on Rajpath Road which is one of the main roads connecting to the highway. The Rajwada Palace is located at the end of this road. In connection to this road, several parts of Shanivar Peth, Malhar Peth and Guruwar Peth have been studied. The Futka Talav Ganapati Mandir on the outskirts of the city is an important religious monument. The space between these two locations has been meticulously studied, taking into account its unique characteristics and urban dynamics.

## 3. Aim:

To understand and define the context of Satara and create a database for future development.

## 4. Objectives:

- To identify factors defining the city of Satara.
- To understand existing urban fabric
- To study the influence of these factors on the character of architecture in Satara

## 5. Literature Review:

The literature review for this paper mainly involved understanding heritage conservation within evolving urban landscapes. Studying similar examples like the White Town area – Pondichery, Amritsar - around the Golden temple precinct, Jaipur - Main Street.

Table 1: Understanding Heritage Conservation within evolving Urban Landscapes (Source: Author)

Name	Author	Summary	Comments
<b>BUILDING IN A HISTORICAL CONTEXT STANDING OUT OR FITTING IN?</b>	<a href="#">Medhat Wassef</a>	How can the balance between freedom of expression and urban homogeneity be realized when building in an existing urban culture?	Discussions on cities whose architecture is deeply rooted in their history and heritage. Concluded that buildings are cultural products, not just stone and concrete.
<b>A STUDY OF URBANIZATION IN SATARA DISTRICT OF MAHARASHTRA</b>	<a href="#">Ankush Barakade</a>	Statistical data about Satara's urban growth	Satara is in the acceleration stage of urbanization, next decade will bring in a lot of changes
<b>DISCOVERING WALLED CITY AMRITSAR -AGENDA FOR ACTION</b>	Ar. J.K. GUPTA*	Talks about cities as engines of economic growth and also repositories of cultural heritage. Discusses the case of Amritsar in detail. Urban Issues in the walled city and proposes strategies for preservation of heritage	Cities are repositories of culture Vital connection between past and present Important that these links are carefully preserved To ensure no loss
<b>POTENTIAL OF RELIGIOUS TOURISM IN SATARA TEHSIL: A GEOGRAPHICAL PERSPECTIVE</b>	Dr. Arjun Gena Ohal. Associate Professor, Department of Geography, Mahila Mahavidyalaya, Karad	Discusses the potential of Satara as a tourism destination. Currently considered a pilgrimage destination, it also has a potential to fuel its economy through tourism	Not directly related to the discussions of this paper, but tourism can be an after effect of heritage preservation in Satara
“Asa Ghadla Satara Jilha”, Nagar Wachanalaya, Satara	Published by G.R.Mate	This book talks about the history of Satara District. The importance of the Peths, temples, mosques	This proved to be a great insight into the contribution of the Maratha rulers in the forming of Satara city

## 6. Data collection and Methodology:

The initial stage of writing this paper included discussions on contextualism in architecture and whether a contextual approach to any design problem can be achieved through a set of defined steps. To speculate about the question at hand it was necessary to identify a site with a strong context where the approach to contextual design can be studied. Most important step was to break down the concept of context in architecture. The factors which influence context, are the different contexts a site has or can have. Amongst all the possible context's a site can have (see Figure 1), heritage is one of the strongest contextual factors. Gaining firsthand information of the city of Satara through visit provided major insights. Knowing the historical background and heritage value of the city, it was disappointing to the existing urban sprawl. The city holds the promise of

emerging as a pivotal hub for preserving Maharashtra's heritage and traditional architecture. The primary focus of the paper is to understand how the city of Satara has responded to urbanization, in the light of its heritage background. Hence the area around the Rajwada Palace was selected for this study. All of the data was collected in the form of photos and videos taken during another visit to the city. These photos were then studied to form observations. To present the data and observations, consideration is given to urban factors like built-unbuilt relationships, open spaces, road networks, material palette and urban scale. This study stands as the sole exploration undertaken, providing an introductory glimpse rather than an in-depth analysis, capturing the initial impressions.

## 7. Observations and discussion:

### 7.1 Road Network:

Satara's road network is adequately developed. All the roads are built in tar. They follow a distinct hierarchy. The highways are the primary access roads to the city. These are wider and can have vehicular traffic. As the road starts branching out, the width decreases. These small roads are not designed for vehicular traffic. The Rajpath Road is an extension of one of the highways connecting the city to the neighbouring cities.

### 7.2 Built-Unbuilt relationship:

The location of a new project within the existing urban scape and its relation to the open spaces and adjacent structures plays an important role in deciding the design strategies and approach. Figure 10 shows the different spatial relationships.

- Infill: When a new building fills in a gap in the urban morphology. The building is linked physically to neighbouring buildings. This phenomenon is usually seen in dense urban areas.
- Enclosure: When a new building is built around an existing historical building.

Due to the limited land availability in Satara, most buildings are filled with one another. As a result, new concrete buildings are seen adjacent to old wooden buildings or wadas. Even some of the smaller shrines are infilled between two concrete towers. This is creating a sense of congestion in the city. Not only do the cultural monuments not get adequate open space in their vicinity but also are not easily accessible or visible to passers-by. In some cases, the community shrine is enclosed within several residential buildings.

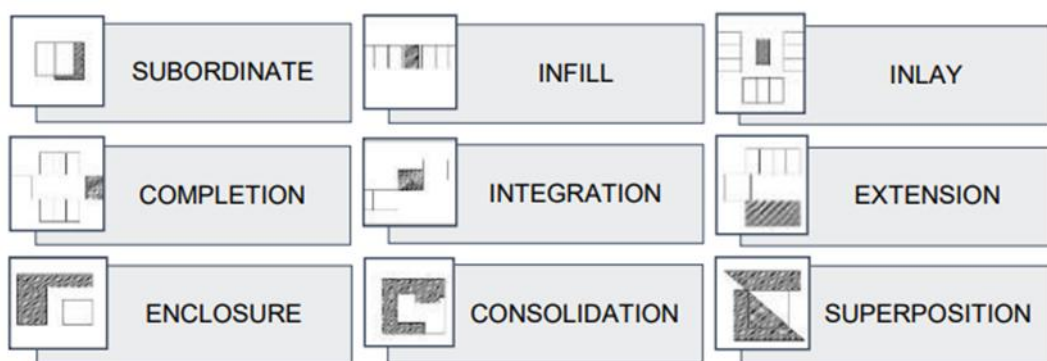


Figure 8: Spatial relationships (Source: Wassef)



Figure 9: Infill in Satara  
(Source: Author)



Figure 10: Infill in case of religious monuments  
(Source: Author)



Figure 11: Enclosure of Community temple  
(Source: Author)



Figure 12: Community space in front of Futka Talav (Left) (Source: Author) and Commercial areas on Rajpath road (Right) (Source: Author)

The geographical extent of the city is limited, being surrounded by mountain ranges on all four sides. As a result, the current urban sprawl seems congested. The built area is more than the unbuilt area with only two parks in the area under observation. The built area includes a mix of residential, commercial, public and religious buildings. The Rajpath Road being wider, mainly has commercial shops, food joints and branded stores. As we go further away from the main road, fewer commercial shops can be seen. The inner parts of the city are mainly residential and several bungalows can be seen. The majority of the buildings are three storeys tall, with a few exceptions of the newly constructed buildings which are going up to five floors.

### 7.3 Material Palette:

Unlike a few cities around the world, Satara does not have a distinct colour palette or material palette. Although most apartment buildings are constructed in cement, either load-bearing or RCC, the material palette can better be studied at a larger scale. On a larger scale, the materials used are cement, brick, aluminium sheets, wood and even cloth. The building is largely in cement except for a few wadas which are built in brick, with metal sheet roofing. A lot of temporary shelters can be seen that use aluminium sheets or cloth to create an enclosure.



Figure 13: Metal Sheets  
(Source: Author)



Figure 14: RCC (Source: Author)



Figure 15: Wood (Source: Author)



Figure 16: Glass (Source: Author)

## 7.4 Urban Scale:

Urban scale in the city of Satara can be studied under two titles: vertical scale and horizontal scale. Horizontal scale refers to the extent of the city. The city is spread across an area of 22.42 km<sup>2</sup>. The vertical scale refers to the building's height with respect to human height and road width. In areas where the roads are wider, the buildings are perceived at a human scale. Almost all buildings have the same height but as the road width decreases the same height can be perceived as overpowering. Another way of studying the scale can be a building-to-building comparison. The relation between the heights of two adjacent buildings and that between two opposite buildings can be used to determine the perceived scale of the city. In many places, small-height wadas or kacha houses are adjacent to tall apartment buildings. This creates an abrupt change of scale for the viewer.



*Figure 17: Building height/ road width  
(Source: Author)*



*Figure 18: Street view (Source: Author)*

## 8. Conclusion:

As Satara is presently not even categorized as a tier 2 city, the impending decade is expected to bring a substantial wave of urbanization. Urbanization will bring about economic growth, an increase in job opportunities, infrastructural development, cultural exchange and better education and healthcare facilities. At the same time, it will dare to threaten the heritage and cultural value of the city. This makes the present moment ideal for engaging in this discourse, facilitating future construction that harmonizes with the preservation of our heritage.

In the advent of urbanization, the character of old Satara is experiencing a gradual decline, slowly fading into the background of rapid modern development. The city's growth has not followed a natural, gradual, or well-organized process but has instead occurred in a disorderly manner, often driven by immediate needs or user demands rather than thoughtful long-term planning. While the Rajwada Palace has been preserved through adaptive reuse and converted into offices, several other monuments remain under the threat of dilapidation over the course of years. As the city is trying to cope with the rampant urbanization its heritage value is diminishing.

The above study leads to the following conclusions:

- The city of Satara is defined by its historical background, geographical location, terrain and heritage structures.
- Satara has an organically developed urban fabric. The settlement has adapted to the topography and sprawls across the gentle slope of the city. A compactly woven urban fabric with varied typologies of buildings.



- The temple architecture of Satara is an important factor that should be retained.
- The extent of Satara is such that further development will lead to congestion and exploit the available land.

The above discussions lead to questions on how the conservation of these heritage sites can be conserved. The area in front of Rajwada Palace serves as an ad-hoc marketplace where vegetable vendors, fast food stalls, and even toy sellers set up shop. In order to retain the heritage value of the Palace one conceivable suggestion can be that the vendors in the Palace precinct be relocated and the precinct be designed under the urban design guidelines. The material palette or certain design elements of the Palace can be retained. Similarly in the case of Futaka Talav Ganapati Mandir, the informal interactive space in front of the temple can be redesigned with the architecture characteristics of the temple in order to retain the heritage. The smaller shrines should also be thought of in terms of revitalization, precinct development.

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## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Redevelopment as Catalyst for Commercial Gentrification And its Effect on Socio- Economic Changes in Neighbourhood

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## **Abstract:**

*Urban areas undergo revitalization and redevelopment projects; the process often leads to a transformation of neighbourhoods. This process is associated with the existing residents being displaced, and thus replacement of local shops with upscale establishments, referred to as commercial gentrification. The Redevelopment initiatives play a role in commercial gentrification, leading to various consequences like increased project costs, delays, and conflicts among stakeholders due to the changing dynamics of the neighbourhoods. The complex interplay between redevelopment, commercial gentrification, and construction must be analyzed. Consideration of the socio-economic and environmental factors in the planning and execution of redevelopment initiatives with appropriate approach is a prerequisite to mitigate the negative impacts of gentrification.*

*This research aims to study redevelopment projects and its relation with commercial gentrification, and challenges in construction activities during these transformative processes. It analyses the various factors contributing to commercial gentrification, such as changes in land use policies, market dynamics, and the influx of new businesses and residents. This study utilizes a mixed-methods approach, combining qualitative analysis of case studies, quantitative data from surveys, and interviews with industry professionals in the neighbourhoods of Kothrud, Karve Nagar, and the core city of Pune. The analysis will likely inform architects, planners, and decision-makers with strategies and best practices in gentrifying areas with the minimum adverse impact of the commercial gentrification phenomenon.*

**Key words:** *redevelopment; commercial gentrification; Pune*

## **1. Introduction & Background Study:**

The Indian urban areas are growing quickly, which is causing working-class neighbourhoods and city centres in urban areas to experience process of renewal and decay (Gokhale,2011). Urbanization brings about, the radical socio-spatial transformation of society as analysed by Lefebvre.(Soja, 1980). Environments in urban areas undergoing continuous social, political, and economic change are frequently associated with gentrification, a multifaceted phenomenon encompassing a range of issues from enhancing the built environment and boosting the economy in local areas, to displacement and demographic shifts. (Saha, 2022; Joshi, 2023). Construction management, redevelopment, and gentrification are interconnected concepts that often go hand in hand in urban development.

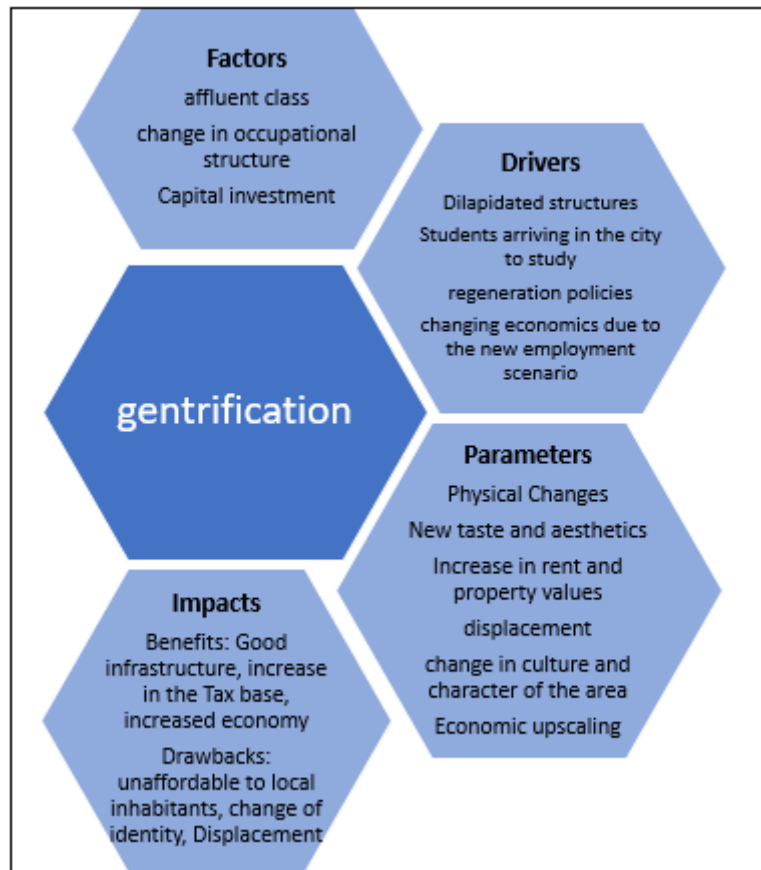


Figure 1: Phenomenon of Gentrification. (Source: Joshi, 2023)

This study looks at how redevelopment affects social and economic developments in neighbourhoods and the building sector as one of the parameters influencing the commercial gentrification of the locality. The methodology adopted is by documenting the changes in the physical environment with photographic evidence. Analysis of the statistical data available to understand the socio-economic changes.

### ***Space and its reconstruction are devices of capitalist development:***

Redevelopment and urban transformation processes involve demolishing existing structures and using the cleared space for new development initiatives. Redevelopment involves the revitalization or renewal of existing buildings or areas to improve their economic, social, or environmental conditions. It typically involves demolishing outdated structures and constructing new ones that meet contemporary needs and standards. Redevelopment projects can range from individual buildings to entire neighbourhoods or districts. The role of Redevelopment projects needs to be examined to study its impact on gentrification process. In India, gentrification has frequently manifested as slum clearance or rapid, extensive redevelopment on the periphery of major cities (Doshi, 2015). Urban redevelopment has a close connection to gentrification, which begins by the displacement of original residents, as seen by large-scale redevelopment projects carried out by URA in Hong Kong, such Lee Tung Street, Langham Palace, and Kennedy Town. Therefore, as more neighbourhoods get gentrified, urban morphology will constantly evolve and change. (Qian Xingyu, Yin Chengzhi , 2018)

As a technique for urban revitalization, South Korea chose wholesale redevelopment, turning low-rise, mediocre neighbourhoods into high-rise commercial housing complexes with maximum density. The leftover apartments after being distributed to the participating property owners could be sold on the new housing market to recoup development expenses and generate revenue. This was done to lessen the amount of funds that

residents had to contribute to JRP projects. One socio-spatial effect of JRP projects was the gentrification of deteriorating areas with low incomes brought on by redevelopment. (Shin, 2009).

Irving L. Allen's conversation, "The Philosophy of Thick Neighborhood Redevelopment," is of sociocultural way to deal with the belief systems undergirding neighborhood redevelopment. "Class Analysis of Gentrification" by Smith and LeFaivre, on the other hand, provides a Marxian or political-economic analysis of aspects of the revitalization movement and the behavior of the group involved (Palen & London 1984).

When neighborhoods undergo significant redevelopment, like the building of luxury homes or mercantile spaces, it often attracts wealthier residents and businesses. Redevelopment also leads to speculation. (Kan, Chen 2021). Speculation leads to gentrification.

## 2. Literature Insights:

Glass (1964) introduced the idea of gentrification and its effects on urban neighborhoods, focusing on how local economies change. Neil Smith (1996) examines how redevelopment projects frequently serve the interests of rich financial backers, bringing about the relocation of lower-pay occupants. Gentrification as an urban renewal process affects the neighbourhoods fabric, both culturally and socially and is marked by the arrival of residents that are wealthier leading to increase in values of properties. Creativity and entrepreneurship are the new aspects of emerging economic life (Florida 2003), and it gets reflected in the spaces provided in the redeveloped properties. Gentrification often occurs in areas that have undergone redevelopment.

Ley (1996) argues that gentrification and redevelopment are processes that are interconnected, and thus connects it with commercial development playing a significant role. The business improvement changes business scenes answering the changing purchaser culture, where the relocation of little ethnic or low-pay shops and the presentation of current style influences the socio-spatial credibility of streetscapes.

Gentrification is an outcome of changes in the tastes of middle-class and a demand for new urban living (Smith 1996). The process of gentrification has focused more on class context but the new social geography in which these processes are happening needs to be understood. Gentrification in its new forms is seen both in higher middle-class neighbourhoods as well as middle class neighbourhoods that are redeveloped. (Lukens 2020).

The two streams of current literature that explain why gentrification happens are production-side and consumption-side. The consumption side has mostly concentrated on the rise of gentrifiers, or new urban elites made up of administrative, technical, and professional personnel, and their consumption habits. (Hamnett, 1991, Ley, 1980, Munt, 1987). Production-side critics, however, highlight the emergence of gentrifiable properties and contend that gentrification process is a product of capital's "back to the city movement" rather than the emergence of new urban gentries (Smith, 1979). The "rent gap" concept of Neil Smith, which focuses on the political economics of "place" and its connections beyond local borders, has been the most well-known contribution from production-side critics. At times when demolition takes precedence over other strategies for narrowing the rent disparity, gentrification may also occur transpire via redevelopment (Williams, 1984). The humanist and the socio-cultural side of gentrification approaches the process at the individual scale (Butler 1997, Ley 1996). Commercial or retail gentrification frequently coexists with residential gentrification and takes the form of trendy eateries, cafés, and often replace the low-income stores. (Sakızlıođlu & Lees, 2020).

Commercial gentrification is the process in which a neighbourhood or an area undergoes significant changes and attract high end businesses, frequently ends in the eviction and displacement of residents with current lower-income and the transformation of the area's fabric and identity. Redevelopment plays a crucial role in driving commercial gentrification by introducing new construction projects, such as luxury housing, upscale retail spaces, and trendy commercial developments. (Atkinson & Moon, 1994). Commercial gentrification affects the neighbourhoods economic, social and cultural aspects. The commercial gentrification is represented

by the class transformation of commercial landscapes responding to the changing consumer culture, where the displacement of stores with low income as well as small ethnic retail outlets and introduction to modern aesthetics affects the socio-spatial authenticity of streetscapes. Commercial development results in neighbourhood revitalization that impacts the city by increasing sales revenue, tax revenue, and property values (Talen & Jeong, 2019). Commercial gentrification" refers to the invasion of new enterprises that drive away established retailers or preferred neighbourhood food shop due to rising rents. It might be the arrival of hip cafés, fashionable shops, and upmarket fast-food joints, which would alter the neighbourhood they know and love, for good or bad. The economic existence of a firm may be affected by commercial gentrification, as rising rents could end up in business closures and displacement.

### **3.The Indian Scenario:**

Mixed use developments in many Indian cities have ground-floor for business and office space and is typically combined with residential purposes on upper stories (Shenvi and Slangen, 2018). Urban development occurs unevenly in India and might not always be easy to comprehend these urban transformations and the dispossessions they cause (Das, 2020).

The spatial and social separation is a result of rising housing prices. Real estate builders found areas of Prabhadevi, Parel, Lower Parel, Dadar, Chinchpokli and Sewri particularly appealing. Thousands of families lived in slums around the mills at first, but today the neighbourhood is home to showrooms for four-wheelers and luxury brands from around the world. As a result, the neighbourhood's land values rose, and it became appropriate for the richer segments of society to occupy. Mulund, a suburb in Mumbai has also witnessed similar gentrification defying the conventional understanding of the process. Mulund was earlier an industrial suburb with active pharmaceutical and engineering businesses and majority of these former industrial buildings have been replaced with high rises, shopping centres, and multiplexes in today's gentrified neighbourhood. The suburb has seen a revolutionary shift due to gentrification and these days; it is marked by a decline in the cost of residential housing, an increase in commercial and retail space, and an expansion of urban services, all of which led to an urban spatial transformation. (Bhattacharjee, 2019).

Sholinganallur that transformed into an IT hub, in Chennai is a case of suburban gentrification. With the growth of residential and commercial activities, the region has experienced major changes recently (Gupta 2023).

India has property-based redevelopment rather than wholesale redevelopment. Redevelopment has turned low-rise, subpar, or middle-class neighbourhoods into high-rise, upscale residential estates, or high-rise commercial buildings along with residential properties leading to maximizing of density in numerous Indian cities. The extra flats are sold in the housing market, after the distribution of flats to original dwelling owners to recoup development expenses and make profits.

Urban development, on the one hand, strengthens the built environment and infrastructure, as well as the local economy, thereby revitalising the community. However, gentrification pushes low-income neighbourhoods out by raising the cost of living and real estate. Redevelopment also leads to speculation.

### **4.The Pune case:**

Pune has undergone significant urban redevelopment in recent years to accommodate its growing population and changing economic landscape. Due to increased migration, multiple educational options, and growing businesses, Pune has experienced significant population expansion in recent decades. The Pune Municipal Corporation (PMC) and other pertinent authorities have launched numerous reconstruction projects throughout

## Redevelopment as a Catalyst...

the city to solve these challenges. At the city level Smart city mission, Pune metro, slum rehabilitation projects, river front development projects etc are some of the states led projects that has led to the infrastructural development and hence influence the urban renewal through redevelopment. Redevelopment is happening in residential as well as commercial projects.

Kothrud, a suburb of Pune towards the south-west, has observed rapid development since 2005. Kothrud is rapidly developing suburbs in Pune. It is located on two important roads Karve Road and Paud Road and is among the city's most sought-after neighbourhoods. Together with luxurious residential construction, business expansion was facilitated by excellent connections and significant advancements in infrastructure. Kothrud with excellent basic amenities necessary for daily life, like reliable electricity and water supply and boasts of a robust social infrastructure. The necessities of its residents are met by a number of eateries, banks, ATMs, retail brand stores, markets, and shopping centres.

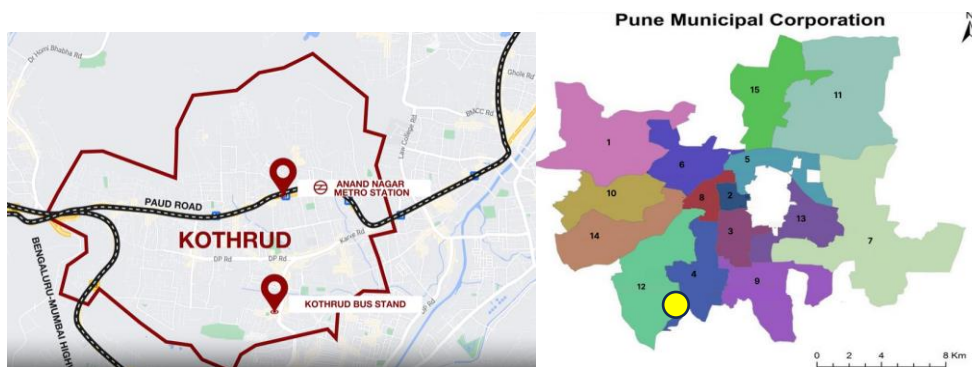


Figure 2: Kothrud connectivity (Source: Pune Municipal Corporation)

Kothrud is well-known for its educational institutions in addition to being a desirable residential neighbourhood. Excellent schools and colleges are in the vicinity of this locality. These premier educational institutions draw students from all parts of the country and from some Asian and African countries. This sizeable number of transit student population also makes for the vibrant culture of the locality while helping in boosting the economy of the city. Kothrud is a good option for people wanting to invest in residential as well as commercial projects as the environment is great and pleasing. Several residential projects with high-class amenities and specifications are developed. Kothrud has information technology companies and has also a minor manufacturing activity. Numerous startups offices are also found here.

The area along GA Kulkarni path along Karishma society that was once a predominant residential area now has many upscale residential projects that are being redeveloped and is also now the destination for trendy cafes and multicuisine eateries that are in high demand by the youngsters. This presents a classic case of commercial gentrification.



Figure 3: Redevelopment of old residential area into commercial complexes with residential areas



*Residential property build in early 80s.*



*Redevelopment hoardings announce the change*



*Redevelopment in progress*



*New face after redevelopment*



*Figure 4: Large scale redevelopment of private properties in Kothrud on the main road and inner bylanes*



*Figure 5: Redevelopment of residential society*



*Figure 6: Selling of dreams through redevelopment and trendy commercial spaces introduced in residential areas.*



## 5.Data method and methodology:

This study utilizes a mixed-methods approach, combining documentary analysis of case studies quantitative data from surveys to examine the effects of commercial gentrification due to redevelopment and the demand for new housing and commercial area. Photographic surveys and statistical data available through property sites have been used.

The present property rates for a multi-storey apartment flat in Kothrud are varying between Rs. 8000 per sq. ft. to Rs. 9500 per sq. ft. based on the area, neighbourhood as well as amenities offered by the builder. The rates for procuring a residential house in this area also fluctuate within the same range. Kothrud has seen a notable increase in residential demand over the years from young IT professionals, business community, NRIs, and other professions such as physicians and lawyers (moneycontrol .com, 2013).

Table No:1. Increase in the commercial property rate near Paud Road in Kothrud (Source : <https://www.e-stampdutyreadyreckoner.com/reckoner/2022/pune/haveli/kothrud>)

<b>DIVISION /VILLAGE: KOTHRUD</b>					
Commencement 1st April 2022 to 31st March 2023					
Type of area	Urban				
Local body name	Pune Municipal Corporation				
Landmark	Paud road Properties				
<b>Rate of land + building in per sqm built-up</b>					
	land	residential	office	shop	Industrial
Current Rate	40400	110490	135880	201080	0
Previous year	40400	108050	135880	191500	0
Increased amount	0	2440	0	9580	0
Percentage	0.00%	2.26%	0.00%	5.00%	NaN%

Table No:2. Increase in the residential property rate in PMT bus stop in Kothrud (Source : <https://www.e-stampdutyreadyreckoner.com/reckoner/2022/pune/haveli/kothrud>)

<b>DIVISION /VILLAGE : KOTHRUD</b>					
Commencement 1st April 2022 to 31st March 2023					
Type of area	Urban				
Local body name	Pune Municipal Corporation				
Landmark	PMT bus Stop near road leading to Varaje road				
<b>Rate of land + building in per sqm built-up</b>					
	land	residential	office	shop	Industrial
Current Rate	33300	98790	113610	134420	0
Previous year	33300	94730	96060	128010	0
Increased amount	0	4060	17550	6410	0
Percentage	0.00%	4.29%	18.27%	5.01%	NaN%

Development of Kothrud started much earlier in the 80’s. The proximity of Kothrud towards Pune-Mumbai highway added to its significance. Culturally admired Yashwantrao Chavan Natya Gruha is a prominent landmark of Kothrud. Taking into account Kothrud's pricing trends and the growing demand, the locality also became investment opportunity for many. The remarkable increase in property values resulted in the development of several projects. Pune’s commercial market has been on rise as many central areas like Kothrud, Deccan etc. have hardly left any space for development leading to large scale redevelopment. (Times of India, 2022)



Figure 9: Growth of property rate in Kothrud (Source: [https://housing.com/price-trends/property-rates-for-buy-in-kothrud\\_pune-P59h88syphonfafev](https://housing.com/price-trends/property-rates-for-buy-in-kothrud_pune-P59h88syphonfafev))

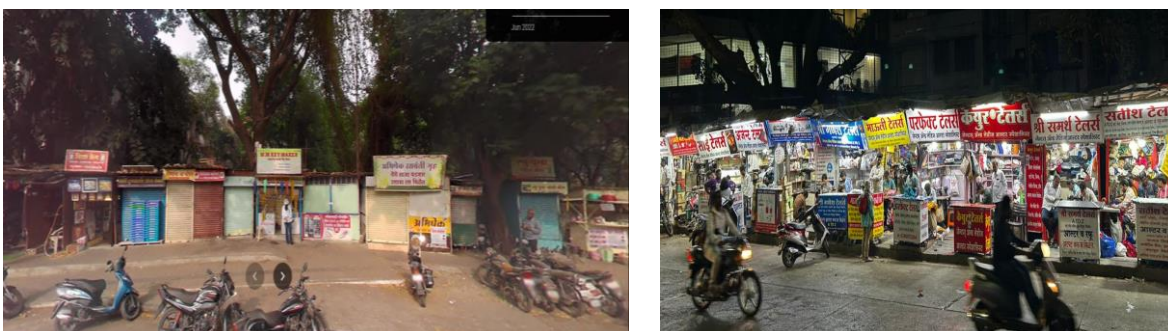




Figure 10: Traditional local shops in Kothrud serving the daily needs.



Figure 11: Trendy and branded showrooms and establishing is the recent years

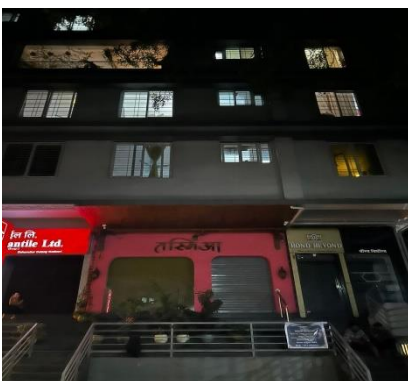




Figure 12: Residential societies redeveloped with commercial shops and Redevelopments with boutiques on lower floors

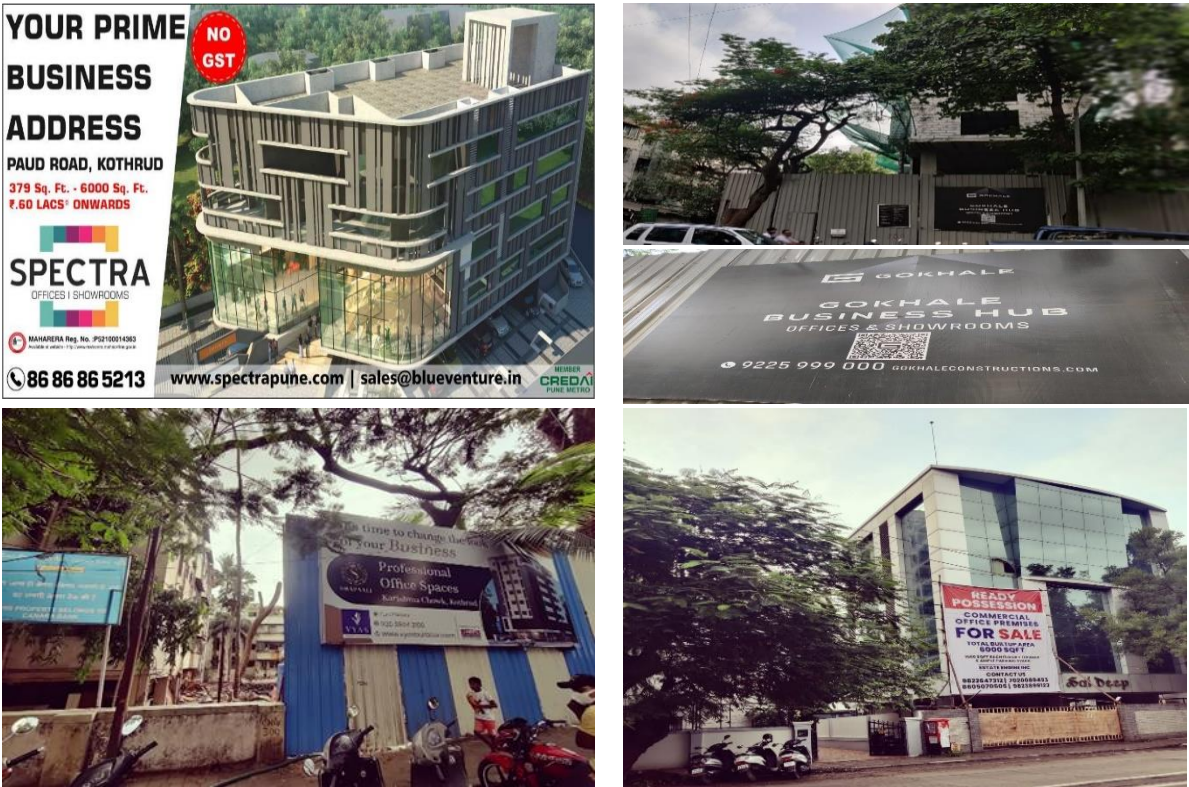


Figure 13: The demand for offices and commercial spaces

## 6.Data Analysis and findings:

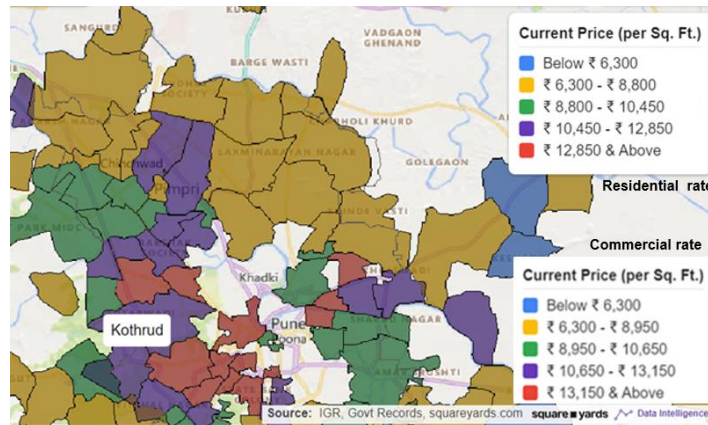


Figure 14: (Source: <https://www.squareyards.com/property-rates-in-pune>)

Table no:3. Rate in Kothrud as on 2023 (Source: housing.com)

Location	Year	Buying Rate	Rental rate
Kothrud	2023	Rs 12,685 /- to 25,362/- per sqft	Rs 27,304/- to 60,000/- per month
Residential	2023	Rs 12685/-per sqft- average	Rs 27,304/- per month (average rent)
Commercial	2023	Rs 15,000/- 20,000/- per sqft	Rs 25,000/- Rs 50, 000/-per month

In terms of price appreciation/depreciation, flat rates in Kothrud changed by 16.1 % in the last 1 year, 22.5 % in the last 3 years, 35.5 % in the last 5 year and 88.0 % in the last 10 years. (Source: <https://www.99acres.com/>)

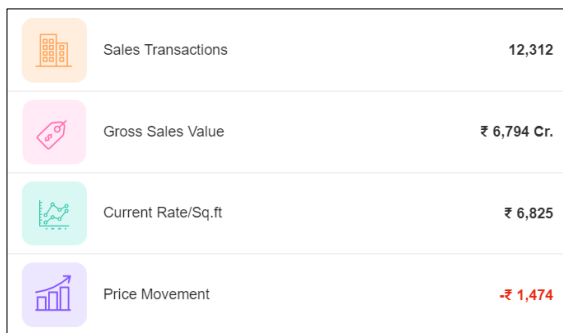


Figure 15 : Property Rates In Pune for Resale

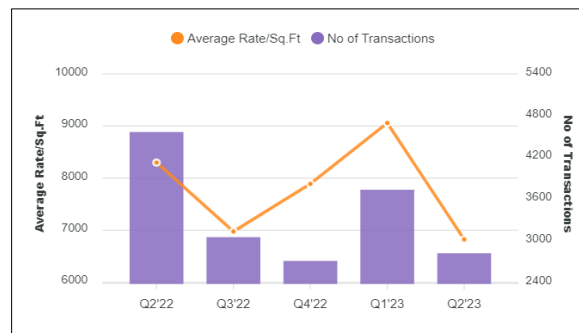


Figure 16:current rate for resale Rs 6825/ sqft

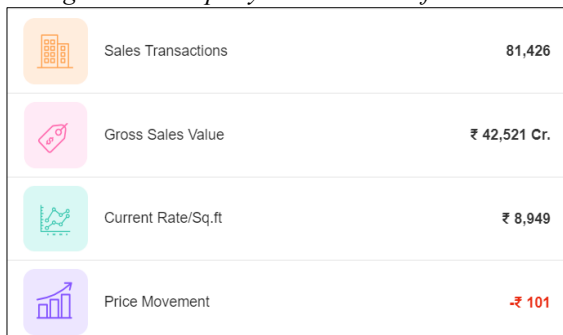


Fig no 17: Property rates in Pune for sale

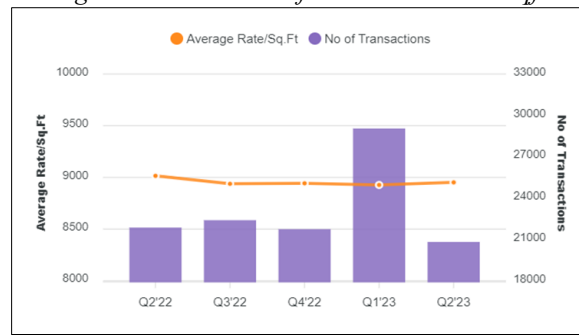


Figure18: Pune's current rate for sale Rs 8949/ sqft





	Sales Transactions	1,017
	Gross Sales Value	₹ 823 Cr.
	Current Rate/Sq.ft	₹ 15,178
	Rental Rate	₹ 27

Figure 19: Property rates in Kothrud

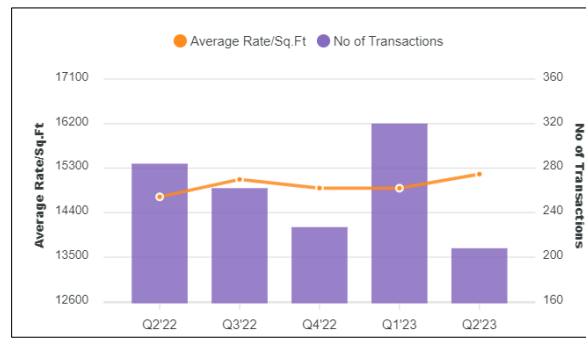


Figure 20: current rate in Kothrud Rs 15178/ sqft





	Sales Transactions	16,628
	Gross Sales Value	₹ 11,843 Cr.
	Current Rate/Sq.ft	₹ 10,512
	Price Movement	+₹ 379

Figure 21: Property rates in Pune west

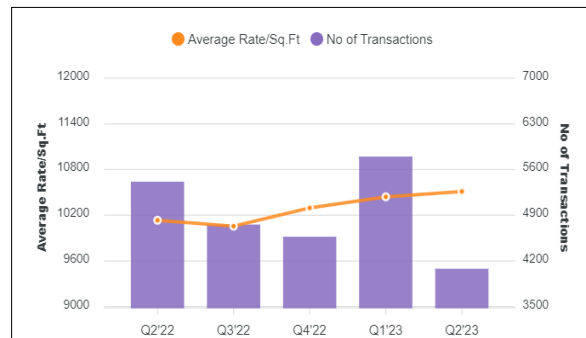


Figure 22: Current rate in Pune west Rs 10512/ sqft

## 7. Discussion:

Kothrud’s development that began in early 1980s and is still growing. The rate in this area in 2006 was Rs 2200- to Rs 3500 per sqft. (The Economic Times, 2006). Pune the IT powerhouse has experienced a real estate boom. Numerous residential and commercial buildings, including high-rise apartments, IT parks, and shopping centres, have been built as a result of this boom. The growth of software companies and IT sector has been seen in Hinjewadi, Magarpatta and Kharadi areas in Pune. The transformation of these areas has led to the arrival of young professionals that has led to commercial gentrification with high end restaurants, cafes hotels targeting the new demographic.

Hinjewadi has been the epicentre of this IT revolution starting in 2003 and its effects have rippled across the city leaving a great impact on nearby localities, especially Kothrud, that saw increase in demand for office spaces, retail establishments and residential properties.

The commercial environment of Kothrud has seen a substantial transformation. There has been a noticeable increase in demand for goods and services, entertainment, and eating places. Kothrud, once known for its traditional markets, has seen the emergence of modern shopping centres. The malls and shopping centres cater to the burgeoning urban population, offering an array of international brands and entertainment options. The area is now a hub for food enthusiasts, offering cuisines from around the world. The traditional office spaces have also transformed to modern tech- friendly workplaces.

The housing market in Kothrud has been directly impacted by the IT boom in Hinjewadi. The high-paying jobs in the IT sector have attracted IT professionals which has raised housing demand. Real estate developers have built high-rise flats and contemporary housing complexes to capitalise on the demand, driving up the value of real estate in Kothrud.

### **Socioeconomic Implications:**

Kothrud's demographics have changed due to considerable influx of young professionals and families. This transition has had an impact on the area's social structure.

The coexistence of the traditional Kothrud with the rapidly changing commercial and housing landscape presents both opportunities and challenges. The growing disparity in income between the local population and the IT workforce has raised questions about economic inequality and social inclusion. The demand for offices has resulted the rise in commercial building construction or residential building redeveloped as commercial on lower floors and residential on upper floors and thus contributing to gentrification in the previously typically residential areas. The community Dynamics also changed and have been reshaped by the fusion of traditional residents and the IT crowd. Efforts to create a harmonious coexistence are ongoing. Hinjewadi's IT sector and its effect on Kothrud's commercial and housing development exemplifies the dynamic nature of urban centres. The transformation of Kothrud has brought in gentrified neighbourhoods and along with cultural fusion. The commercial gentrification has led to increase in rental and property prices and has raised the issue of affordability of the low-income group and displacement of people to more affordable areas near Kothrud. (Economic Times, 2006)

Redevelopment began in Kothrud area around 2012. (Punekar news, 2022). Redevelopment has become the need of the hour. Cooperative society act came, and Pune saw its first physical change in the 1980s and 1990s when old wadas were converted into three- or four-story buildings. A fresh wave of this change, wherein three- to four-story buildings are becoming eight- to eleven-story ones, has been brought about by redevelopment. The first makeover areas included significant suburbs like Kothrud, Bibewadi, Sahakar Nagar, etc. These locations are once again desirable sites where the second wave of development-induced transformation is starting to take shape. Redevelopment is being considered for buildings more than 30 years old. In terms of availability, land is scarce in metro areas. Redevelopment has boosted real estate and construction industry. Aspects like residents' reluctance to move to different areas of the city has also been instrumental in getting support from citizens. (Hindustan times, 2017)

The recent past has been very difficult for the real estate business. Builders have been hesitant to invest in large projects in the annexe regions due to demonetization, the global slowdown, and the present pandemic crisis. For builders, the projects' return on investment was a major concern. For them as well, redevelopment has ushered in a new sense of hope. Redevelopment initiatives offer the best foundation for recovery and developers are investing in such projects at a reduced cost with the confidence of making a return within three years. The non availability of new land for development has made redevelopment a more viable approach. (Society Plus 2021)

### **8.Conclusion:**

The rise in commercial space and increase in rental property leading to affordability issues present the role of redevelopment in the construction industry in gentrifying areas faces the challenges such as rising land prices, increased competition and changing consumer demand. Also, the usage of modern and innovative technology enables the construction industry to meet the changing demands. This shows that gentrification can be induced by redevelopment as one of the parameters. In most of the cases redevelopment acts as a catalyst for gentrification.

### **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Impact of Architecture on Safety and Comfort of LGBTQ+ Users in Public Spaces

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## Abstract:

*Recent psychological surveys have indicated that lesbian, gay, bisexual, transgender, queer etc. (LGBTQ+) youth in cities are at higher risk of psychological problems, twice in cases of homosexuals and four times in case of transgenders, as compared to their cisgendered, heterosexual counterparts (National Alliance on Mental Illness, 2022). One of the major factors that influences psychology is the space that one is in. We spend almost 90 percent of our time in architecture, and the remaining, in at least proximity to it, according to Evans and McCoy. (Evans/McCoy 1998: 85). Thus, architecture becomes a shaping factor in psychology. Cities are spaces for all, yet they become dangerous places for minorities, such as the LGBTQ+ community. From access to basic facilities to feeling safe, the nuances of design affect the way spaces are perceived. This paper is an attempt to examine the factors that make a public space safer and more comfortable for queer users. The study involved asking queer participants from metropolitan areas about their perception of urban spaces using a questionnaire. The assessment was carried out focusing on three areas of study, viz. streets, public gardens, and public toilets, on the parameters of safety and comfort. Responses were studied for their commonalities in factors which are preferred by LGBTQ+ users. This study aims to bring these expectations to the forefront, making architects and designers sensitive to the needs of minorities and take design decisions which make public spaces accommodating for a wider spectrum of users, making the city inclusive.*

**Keywords:** *public space; safety; LGBTQ+; inclusive design; gender studies*

## 1. Introduction:

*“The colourful designs, brochures and advertising campaigns invariably focus on young, prosperous and successful heterosexual couples and nuclear families, and sometimes on professional singles.”*  
(DODERER 2011)

Here, the author is talking about how heteronormativity is the way of life, be it in media or reality. When looking at private family units, historically the outer areas are seen as the ‘male-dominated’ spaces, like the living room and sitting areas, while the kitchen is specifically designed to accommodate the woman’s comfort. When walking along a public street, all the toilets seen are clearly segregated as men’s and women’s. Shopping districts have separate checking booths at the entry, one for men and one for women. Spaces are gendered. And moreover, spaces are heteronormative. Heteronormativity is defined as of, relating to, or based on the attitude that heterosexuality is the only normal and natural expression of sexuality (Merriam-Webster, 2022). They are designed for the default cisgendered male user and barely accommodate anyone else.

Architecture is one of the most important factors that make a city more comfortable, safe, and usable. Especially in cities where people belong to different backgrounds, the way a space is designed changes the

way it is perceived by the users. While cities like New York, San Francisco, Sydney, Berlin are at the forefront of pride movements, their design also influences the way the LGBTQ+ population interacts, lives, and thrives.

*“The queer architecture exists outside the traditional male/female dichotomy and the rigid notions of gender and sexuality. Queer spaces function as a counter architecture, which appropriates, mirrors, and choreographs the orders of everyday life in new and liberating ways and subverts the traditionally constructed identities.”* (Diego Santos Vieira de Jesus 2021)

The main aim of all these design solutions is to break the norms that govern public spaces, dictating the way the users behave and live, by small factors that are preferred by queers. Safety in public spaces becomes a concern, especially in places like public toilets and during events like pride parades. This research aimed at formulating a comprehensive list of factors that make a space safe, comfortable, and eventually preferred by LGBTQ+ users. Designing queer spaces will help create a more inclusive city- accommodating all irrespective of where they come from.

## 2. Findings and Probable Trend:

Coliving in India is a growing trend with various players like Colive, ZOHO, Zolo Stays, StayAbode, OYO Life, Stanza Living, Hourr and HackerSpace to name a few. These organizations offer rental apartments to Tech professionals, Students and young startup professionals.

A wide range of spatial studies regarding queer users was conducted. The main intention of most of the works on this theme is to highlight the importance of queer spaces and challenging heteronormativity. Studies about gendered spaces show that these factors influence behaviour in intangible ways. Safety of women in cities has been in discussion recently, providing a base for further delving into LGBTQ+ users instead, as the minority in focus.

Personal experiences add to most of the studies, wherein the authors, being queer themselves, experience spaces differently and study it further. The tyranny of gendered spaces – reflections from beyond the gender dichotomy by Petra L. Doan explores the field by writing about how the rigid categorization of spaces into the duality of genders becomes a factor of severe discomfort by conveniently marginalizing transgender and intersex users and focuses on personal experiences as the crux of the research.

*“Part of my intellectual journey has involved coming to grips with the way that the spaces in which I live, work and play are inherently gendered. For many years I literally only expressed the gender of my true self in the most secret spaces within the privacy of my own home – in the very real confines of a large walk-in closet.”* (Doan 2010)

Thus, various spaces can be translated into visual and spatial representations of oppression and retaliation for users who don't fit into the gender dichotomy, as seen in this study. The author explores spaces from public to private- parking lots, public restrooms, shopping malls, the workplace, and the home.

One idea central to queer communities is street activities, ranging from peaceful pride marches to activist movements. Placing LGBTQ+ urban activism by Alison L Bain and Julie A Podmore explores the theme of urban environments and queer activist movements, from a historical to a contemporary perspective. Cities form the backdrop for most of queer history, and this relationship between urban spaces and queerness is studied in LGBTQs in the city, Queering Urban Space by Yvonne P. Doderer.

*“City life broadens horizons and challenges dominant gender arrangements — a scenario which is not only important for women (as described by Elisabeth Wilson, 1992) but also for LGBTQs. The urban domain allows for difference, whilst the queering of urban-societal spaces questions dominant gender regimes.”* (DODERER 2011)

Thus, cities, urban life and urban spaces become an important aspect when studying queer users. In studying existing material on the topic, it is observed that public spaces form the crux of research for a vast majority of works, while heteronormativity in private spaces is studied as a separate topic by few. One notable work in the private domain is *Queering California Modernism- architectural figurations and media exposure of gay domesticity in the Roosevelt era-* by Jose Parra Martinez, Maria-Elia Gutierrez-Mozo and Ana-Covadonga Gilsanz-Diaz. In this piece, three houses built for gay patrons between 1937 to 1941 are studied through a historical lens, translating every element of the building into a piece of representation for the users. Landscape and sexuality are another separately studied domain, wherein impalpable feelings and thoughts are translated through personal and collective interpretations into designs on land. The paper ‘Queers in space: Towards a theory of landscape and sexual orientation’ talks about landscape theories and the need for safe queer outdoor spaces. (Ingram 1993)

### 3. Methodology:

To study the way spaces, affect queer users in metropolitan areas, a questionnaire was circulated, focusing on different public spaces.

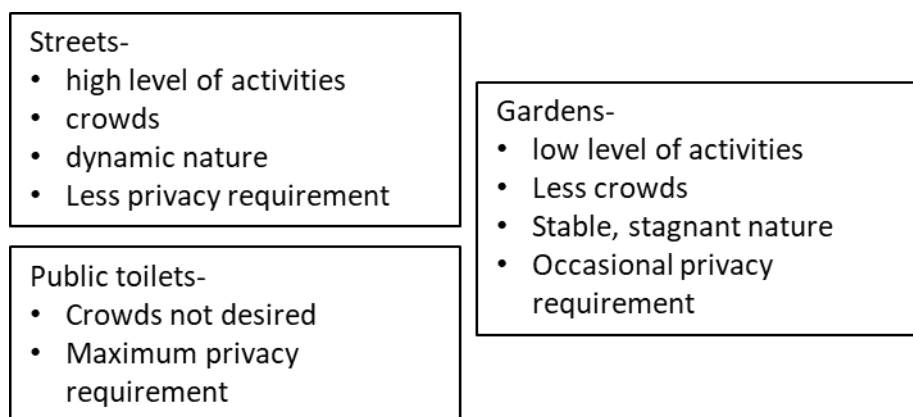


Figure 2: Public Spaces (Source- author)

The Charter of Public Space defines Public Spaces as ‘all places publicly owned or of public use, accessible and enjoyable by all for free and without a profit motive’. These are further divided into four categories- a) streets, b) open public spaces, c) public facilities and d) markets (The Charter of Public Space 2015). Out of these, streets, public gardens (open public spaces) and public toilets (public facilities) were chosen as the areas to study (see, figure 1).

In the three chosen areas, activities happen differently, privacy is desired in varying degrees and is at different priorities. These spaces were studied through the lens of two factors which affect how much a space is preferred- safety and comfort. Users were asked to recall their past experiences by ratings based on safety and comfort, as well as give potential solutions as factors which would personally make them prefer a space more. Questions also focused on comparisons with cisgendered heterosexual counterparts, highlighting the experiences prominently on grounds of queerness.

Furthermore, their position on the LGBTQ+ spectrum was noted, with the intention to study how their personal standpoints affect the reactions within the spectrum too, especially focusing on transgenders and homosexuals as two separate groups. This was to accommodate the differences in preferences due to differences in users- one is a minority in terms of gender and the other is a minority in terms of sexual orientation.

The responses were collected from a wide range of users- with no barrier on age, gender, or location. Users from Pune were asked to rate the specific instances in Pune, providing a base to compare the local scenario with universal expectations.

The study tried to dive into the contradictory desires often faced by minorities in danger- the notion of being seen/noticed in a space by being visible and confident under public gaze, versus the notion of being hidden away in the safety of invisibility. The questions were designed to discreetly gauge the preferences of the respondents in various spaces, and the responses were studied to analyse and categorize the different ways the respondent prefers to occupy spaces based on age and position on the spectrum.

#### 4. Data Collection and analysis:

A total of 104 respondents formed the extent of the survey, out of which 70 shared their experiences in Pune as well. Following are the responses recorded by the author. (Figure 2, 3)

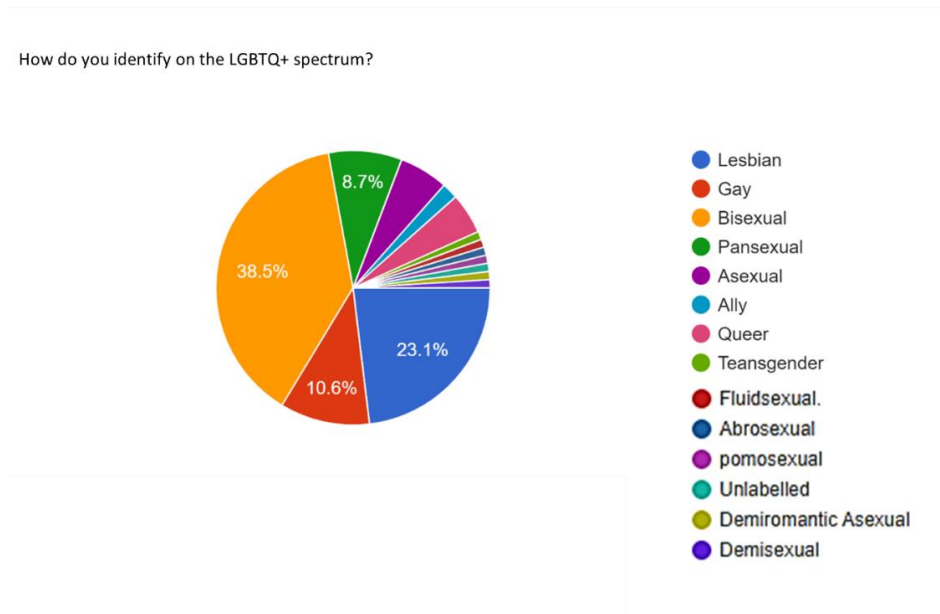


Figure 3: Sexual Identification of respondents (Source: Author)

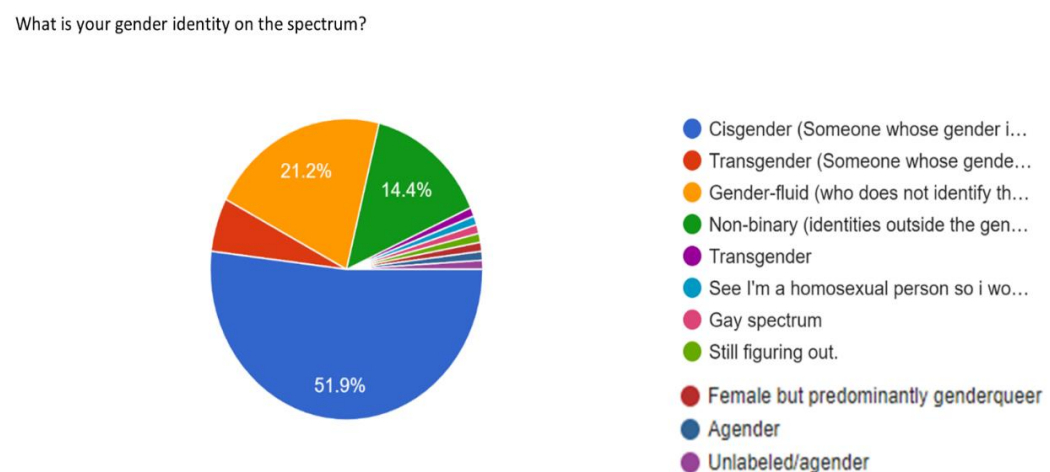


Figure 4: Gender Identity of respondents (Source: Author)

An expansive range of responders was addressed, and the data was collected from users with many different identities. In sexual orientation, most respondents were Bisexuals and Lesbians, while in Gender Identity, most of them were Cisgender, genderfluid and non-binary.

While the entire LGBTQ+ spectrum was to be studied for public spaces, specifically people with non-conforming gender identities like transgenders and non-binary people were chosen for the study of public toilets.

One major aspect to be researched was the notion to be seen or perceived versus the desire to be hidden in safety while in a public space, especially because of non-conformation to societal norms and hence, fear of violence (see, figure 4). These can be translated into design decisions as well-lit spaces with visual transparency and presence of people, or closed, private corners with less footfall.

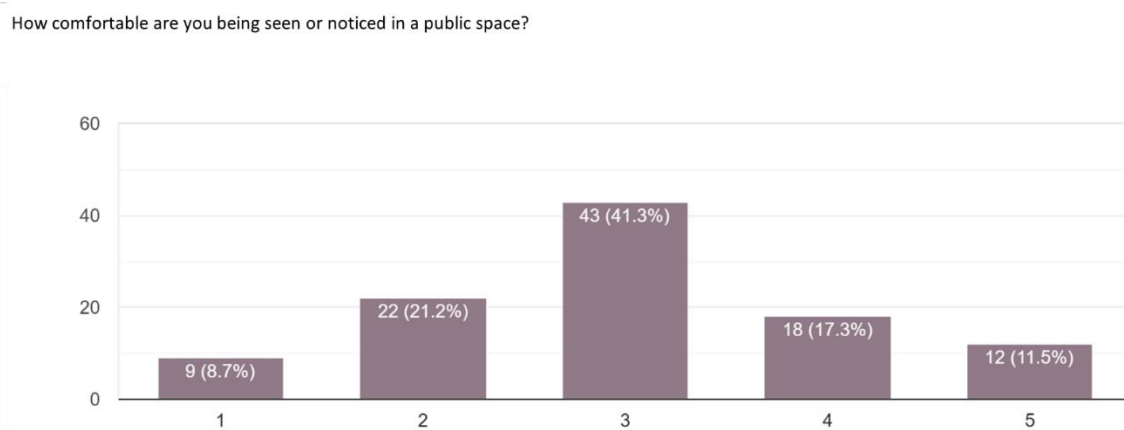


Figure 5: Comfort in public spaces (Source: Author)

The responses show that while many people have a neutral take, some people specifically prefer being hidden, or confidently take up space. Thus, it can be inferred that spaces with a balance of obvious public openness and private, intimate enclosures would be the best solution in public spaces.

Do you feel uncomfortable in public spaces compared to your heterosexual/cisgender counterparts?

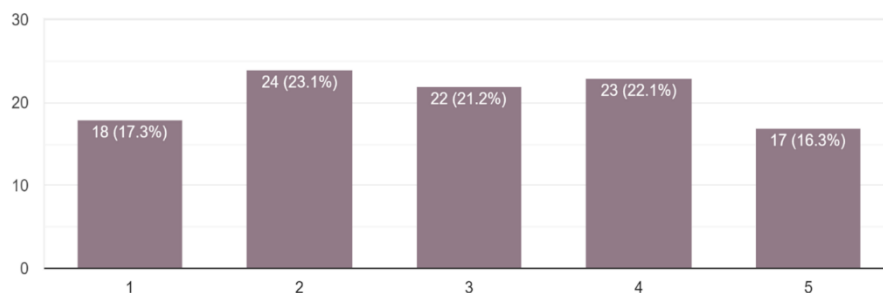


Figure 6: Responses- Comparative comfort in public spaces (Source: Author)

Another thing to be considered was the comparative facet, wherein the same space is experienced differently by people from a minority group, as compared to the majority. The element of non-conformity changes the way the user experiences comfort, which in turn changes their expectations from spaces, especially public spaces (see, figure 5).

Have you ever faced discrimination in public spaces because of your identity?

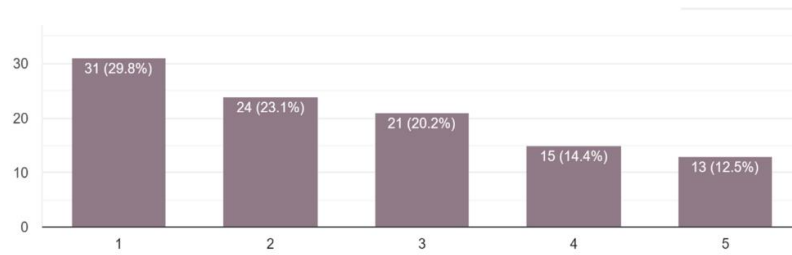


Figure 7: Responses- Discrimination in public spaces (Source: Author)

How queer-friendly do you think the streets/gardens/public spaces in Pune are?

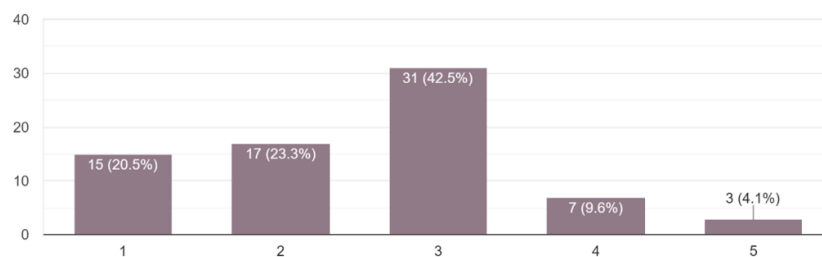


Figure 8: Rating Queer-friendliness (Source: Author)

While the responses show that most people haven't faced discrimination in public spaces because of their identity, the number of people who have faced it is concerning (see, figure 6).

While studying the specific local scenario of Pune, it is seen that many people find the public spaces in Pune average in terms of accommodating the LGBTQ+ community (see, figure 7). But the number of people who find the spaces queer-friendly is less compared to the people who find it unfriendly. This shows that the public spaces in Pune need to be rethought, to make them more accommodating. Pune is a rapidly developing city with a lot of youth population, as 62 % of the population in Pune is under the age of 30 (World Population Review, 2023) thus safety because of identity or sexual orientation isn't found to be a concern by most people, but not all (see, figure 8). The factors that make a street more comfortable were studied, and it is seen that light is the most important aspect that more than half of the users look for. The presence of trees and landscaping elements also make a space more preferred, and large spaces with no barriers are chosen over small, private spaces. Many people prefer crowds with places to sit and interact. Shops and shoppers are preferred by less than half of the respondents (see, figure 9).

How safe do you find the streets in Pune?

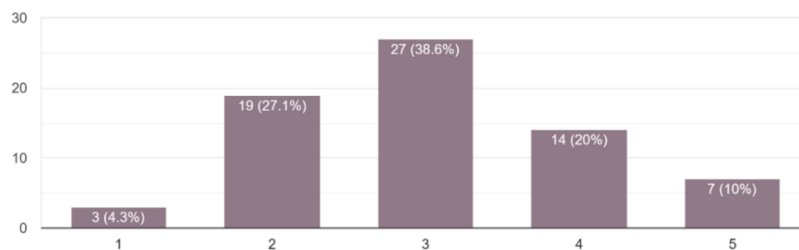


Figure 9: Responses- Safety on streets (Source: Author)

What factors make a street more comfortable to you?

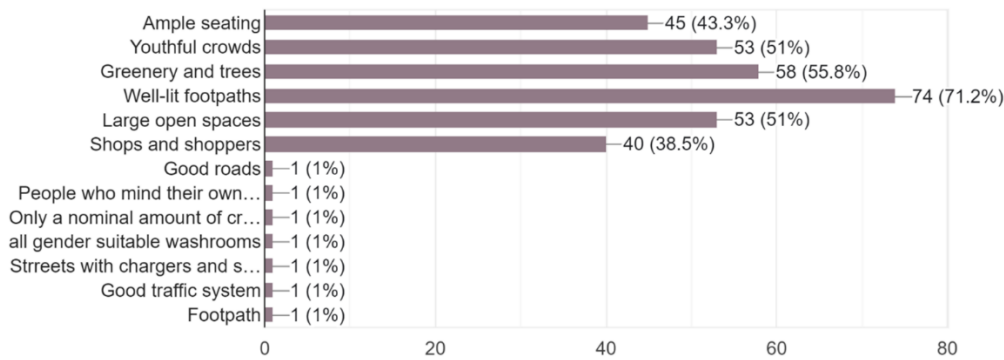


Figure 10: Responses- Comfort on streets (Source: Author)

An example of such a street is Fergusson College Road in Pune, with seating spaces and youthful crowd around, but the large footfall makes the small space uncomfortable.

Some other points that were mentioned by the respondents were availability of amenities like charging systems and toilets for all genders.

How safe do you feel using public toilets?

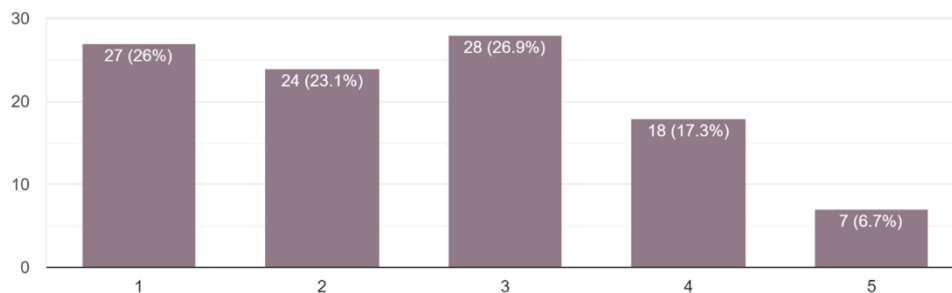


Figure 11: Responses- Safety in public toilets (Source: Author)

When studying the case of toilets, the most important aspect was the association of toilets with gender identities, as it is one of the most gendered spaces (see, figure 10). While cleanliness and accessibility to toilets is a topic of recent discussion, especially when studying women and architecture, gender neutral toilets is another element to be studied.

Considering user groups beyond the gender dichotomy of male and female, respondents who identify as non-binary, gender-fluid, or who are transgender were asked their preference in gender-neutral toilets, and more than 75 percent of them responded positively (see, figure 11). On the other hand, when the transgender respondents were asked if they would prefer using toilets according to the gender assigned at birth or their actual gender identity, it is seen that most of them would rather use toilets according to the gender assigned at birth, or pre-transition gender (see, figure 12). This shows that such spaces aren't accommodating for users to freely accept themselves, and instead force them to use toilets that would ensure their safety from violence.



Would you prefer using gender-neutral public toilets?

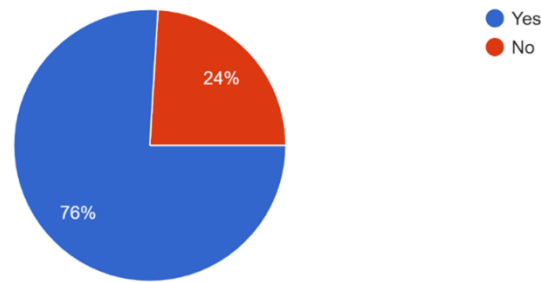


Figure 12: Responses- Preferences about gender-neutral toilets (Source: Author)

If you are a transgender, do you use public toilets according to the gender assigned at birth or your actual gender identity?

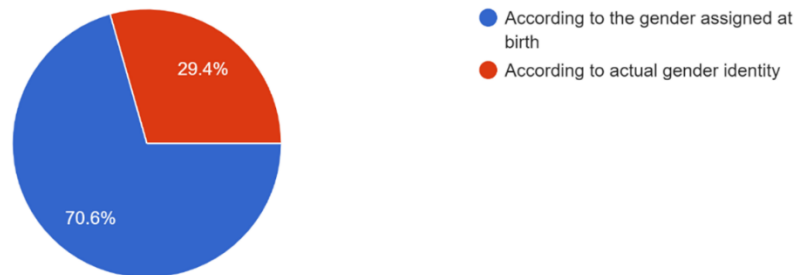


Figure 13: Responses- Usage of public toilets (Source: Author)

The conclusion is that firstly the duality in toilets needs to be broken, by providing universal, gender-neutral toilets, and secondly, safety in toilets needs to be addressed so every user can choose to use the toilets according to their true gender identity without fear of judgement or violence.

## 5. Discussion:

Considering all aspects that were studied, along both the dimensions of safety and comfort, some common observations were made.

When users belong to a minority group- be it through colour, race, gender or sexual orientation, the way a space is perceived by them changes. The reason for this, when dissected, was that these users experience judgement, marginalization, and violence on a more frequent basis, as seen from the results. These incidents are sadly normalized, and many people think it is justified, yet when they happen, they change the definition of safety for a lot of people from the community. And hence, their expectations from public spaces are affected. Thus, while a cisgender, heterosexual user would find a specific public space safe and secure, the same space might be dark, intimidating, and scary for a transgender. Another reason for this is the heteronormative nature in which the world is designed, wherein conscious efforts are needed to make a specific place accommodating for a different user group which falls beyond the normalized societal definitions (see, figure 13).

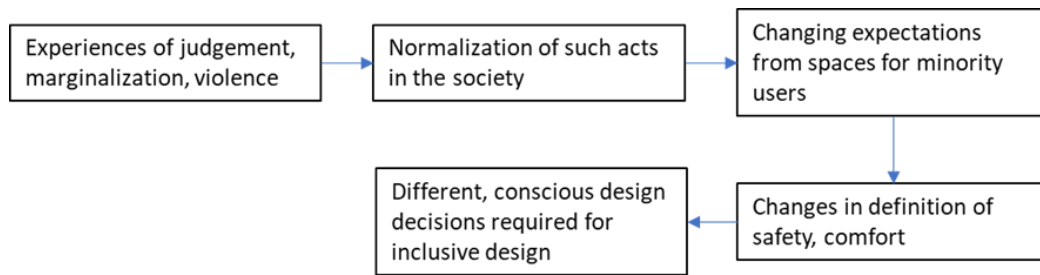


Figure 14: Need for Conscious Design (Source: Author)

Certain factors can be listed down which the queer respondents preferred in a public space. Greenery and presence of trees, and seating spaces are two things which make both streets and gardens more comfortable. In case of footpaths, light is an important factor, while a smaller number of people prioritize it in gardens. The reason might be the dynamic, functional nature of streets as opposed to the relaxing, calming atmosphere expected from gardens. Crowds make streets safer, and users prefer a moderate number of crowds on the street, while they make gardens congested. Openness is also appreciated more on streets than in gardens, which might again be because of the evident lack of openness on streets and the need of enclosure and privacy in spaces like gardens.

Toilets, when studied, surmise the dual nature of requirements. On one hand is the need of safety in the commonly found men's and women's toilets which will make them safer for transgenders. On the other hand, is the requirement of gender-neutral toilets for the non-binary individuals, who wouldn't fit into the gender dichotomy and need a space to be, just like everyone else.

## 6. Conclusion:

*“Queer spaces are far from being limited to gay- and lesbian-oriented architecture but suggest that lessons learned from queer occupation of space could be of use to rethink how our environments are designed and used.” (de Jesus, 2021)*

Cities, from the lens of a queer person, can be experienced differently. Especially public spaces, which are common for all, fail to accommodate the differences, and are predominantly designed according to the heteronormative society. When architects, planners and urban designers choose to design for all, these user groups have specific preferences in which their personalities and experiences are reflected, which should be considered. These expectations are different from their counterparts, and can be translated into small, concise points of focus. Like public gardens, streets and toilets, the nature of the space too affects the expectations from it, thus making design decisions complex, while both gender and sexual orientations cause changes in perception. Only when these nuances are considered can public spaces be considered safe and comfortable, and cities be said to be for all.

## 7. Scope for Further Research:

Market places form the fourth category of public spaces, according to The Charter of Public Space. While the other three are spaces to exist and travel- namely streets, gardens and toilets, marketplaces form an entirely separate entity in terms of functioning- one where the 'public' part is more noticeable. While individuals function as individuals on streets, in gardens and public toilets, marketplaces might encourage a community behaviour due to segregation of spaces. On the other hand, safety in marketplaces is a bigger concern due to more visibility, yet more interaction, compared to gardens or toilets, as well as a larger footfall. Studying marketplaces from a queer perspective might throw light on how communities' function in crowds, and how the architecture of those areas enhances safety and comfort in a crowded area.

Another area of study is the architecture of queer private spaces. One such example was the study by José Parra-Martínez, María-Elia Gutiérrez-Mozo and Ana-Covadonga Gilsanz-Díaz- named *Queering Modern California: Architectural Figurations and Media Exposure of Gay Domesticity in the Roosevelt Era*. In this, the authors studied the design of three private residences designed specifically for gay users, and thus, the rigid gender dichotomy seen in private spaces can be studied. While the default house is seen with one male and one female user as the primary residents, such queer examples break down the dichotomy and expand the boundaries of designing for a wider, more diverse user group, thus creating designs around user expectations instead of fitting users into existing designs.

A similar study exploring different domains separately in public spaces can be extended to cities like Mumbai, Delhi, etc. Considering the preference to use gender neutral public toilets as seen in this study, ways to make them safer for everyone can be explored further.

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## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Mythology, History and Reality: Changing Spatio-cultural Practices at Pandharpur

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## **Abstract:**

*Pilgrimage is an ancient cultural practice allowing commoners to experience leisure and spirituality, in India it is an important and celebrated aspect of life. Pilgrimage to Pandharpur is recorded since 12th CE, a part of Vaishnavite Bhakti movement. From modest historic beginning to organized form seen today, the event has important spatio-cultural practices shaped by mythological associations, historic events and personalities and modern practicalities. The paper looks at how these have changed over the years and subsequently changed the life of local population and experience of visiting pilgrims.*

*The paper focuses on the ultimate destination of the journey, the city of Pandharpur. For the Bhakti movement of Warkari Sampradaya the city was a refuge, the place of closest emotional attachment with the god and a destination for spiritual pursuit. With population growth, modernization post industrialization and rapidly changing socio-cultural practices post-independence, the spatial configuration of the city was exposed to major scrutiny and state initiated action plans leading to loss of historic character and planning wisdom. The expectations of rapidly growing number of pilgrims and comparatively small local population have remained at odds, though pilgrimage is the major economic engine.*

*The study focusses on three places where the locals and pilgrims are in close contact with each other- the temple, the circum-ambulation circuit and the riverfront. It records the mythological importance, memories of historic events, historic architecture and their present condition using secondary sources and field surveys. It observes the nature of negotiations in these places with respect to space and cultural practices. It aims to record the areas of conflict, at practical and emotional levels, as an effort to offer some insights for resolving the larger debate of convenience against memory, practicality against devotion and development against conservation.*

**Keywords:** *pilgrimage; Pandharpur; spatio-cultural practices; transformation; negotiations*

## **1. Introduction:**

Pilgrimage is an ancient cultural practice allowing commoners to experience leisure and devotion, in India it is an important and celebrated aspect of life. Pandharpur in south eastern part of Maharashtra, an Indian state, is a celebrated pilgrim centre. Renowned as Dakshin Kashi it is the abode of Lord Vitthal, a form of Lord Shri Krishna. Pilgrimage to Pandharpur is recorded since 12th CE, an important annual ritual of Vaishnavite Bhakti movement in the Deccan region. The temple of lord Vitthal, a folk deity evolved from amalgamation of mythical folk heroes with the personality of mythological Lord Krishna- the most celebrated avatar of Vishnu, and the river Bheema – popularly known as the Chandrabhaga- the crescent shaped flow, are the most important parts of the pilgrimage. Over the centuries numerous poet saints from all over modern Maharashtra and northern Karnataka contributed to the movement through poetry, spiritual discourses and sometimes by even following the annual ritual. From modest historic beginning to organized form seen today, the event has important spatio-cultural practices shaped by mythological associations, historic events and personalities and modern practicalities. However there has been gradual change over the years in not only in the spatio cultural

practices but also the number of participants and the way the event is organized and conducted. The respective polities of various era have consistently influenced the event in various ways by providing patronage as well as management. After independence the state government continued the legacy of British government of providing security, governance and patronage to the annual ritual. To fulfil this responsibility within the framework of secular democratic government it played an increasingly important role in temple governance, city planning and development which brought in major changes in city form, the life of local population and experience of visiting pilgrims.

The ultimate destination of the journey, the city of Pandharpur has evolved since 12th CE, the temple is attributed to Yadava rulers (Deshmukh, 2012), but was repeatedly modified or added on during 16th, 17th, 18th, and 19th CE (Davalbhakta, 2017). The archaeological evidences have shown the existence of priesthood since 1236 CE (Dingre, 1968). The mythological texts are replete with numerous stories about the presence of the chief deities-Vithoba- Rakhumai, in Pandharpur and also about various poet-saints of the tradition, their lives and how they achieved their salvation by their devotion. Scholars have recorded the process of confluence of various sects and cultures in the Warkari Sampradaya (Dhere, 2012) and the social bonding achieved through it (Sardar, 2019). During Peshwa rule in 18th and early 19th CE Pandharpur enjoyed a period of glory as an important pilgrimage destination. Royal and noble families as well as leaders of various sects of the Sampradaya built their mansions there and used them for prolonged stays which form the urban heritage in present (Davalbhakta, 2017). For the folk tradition and Bhakti movement of Warkari Sampradaya the city was a refuge, the nucleus of emotional attachment with the god and a destination for spiritual pursuit.

With population growth, modernization post industrialization and rapidly changing socio-cultural practices post-independence the spatial configuration of the city came under major scrutiny and state-initiated action plans. The expectations of rapidly growing number of visitors and comparatively small local population have remained at odds, though pilgrimage generates major economic activity in the city. Changing spatio-cultural practices in the city are examined here to bring forward the areas of conflict, at practical and emotional levels in an attempt to offer insights for resolving the larger debate of development against conservation.

Pilgrimage studies have gained momentum all over the world in the new millennium. Responding to temporality of human life, its susceptibility to dangers beyond human control, increased terrorism and warfare, humans are turning once again to religiosity for achieving peace of mind. The pilgrimage studies chart various territories such as its definitions, trends in pilgrimage studies, the reducing gap between pilgrimage and tourism (Greenia, 2018), environmental degradation of sacred sites (Shinde, 2007, Patange et al, 2013), the dangers of violence, natural disaster, stampedes and epidemic where people gather on large scale (Joseph et al, 2016) and the changing meanings and spatial character of pilgrimage sites (Liro et al, 2018). The mythology, history and religious symbolism and semantics associated with places of pilgrimage have also been studied in great detail (Singh, 1995); the tradition, culture and built heritage of a pilgrimage place are important considerations while planning for future (Singh, 2003). Frameworks for such studies have been proposed while arguing about the influence of religion on not only the culture of a place but also on architecture (Davalbhakta, 2017). Clearly the pilgrimage studies have moved away from the binaries to delve into expanding themes such as social linkages, role reversals, contradictions, hybridity and ambiguity (Eade, 2011). while the impact of earlier stages of *wari* pilgrimage have been studied (Shinde, 2023), the study of Pandharpur pilgrimage has been carried out by various authors bringing out various issues from health, urban management, condition of built heritage and epidemics. The contribution of literature review for present study is for understanding the various issues and various viewpoints for studying issues of pilgrimage centres.

The next section discusses the context of Pandharpur town with respect to pilgrimage. The research methodology is discussed in third section before delving in the details of the field of study in the fourth section. The fifth section analyses the qualitative data to bring forward the observations and conclusions in sixth and the seventh section.

## 2. Understanding the problem:

The city of Pandharpur with a population of about 3 lakh is the headquarters of eponymous Taluka in Solapur District situated on south east border of western Indian state of Maharashtra (see, figure 1).

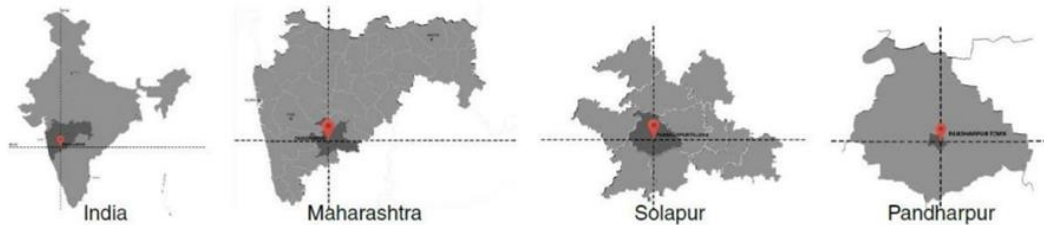


Figure 1: Pandharpur Location (Source: Chirag Balsaraf)

The town has extended beyond in all direction except east which is bound by the river. The modern town is extended in about a 2 km radius on all directions except east. The railway station once far removed from the town on western side is now surrounded by residential and institutional development (see, figure 2).

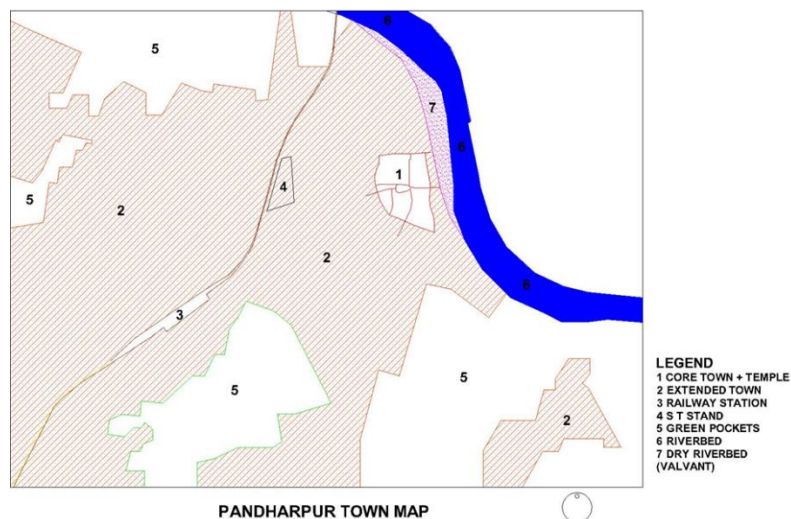


Figure 2: Pandharpur Town Map (Source: Author)

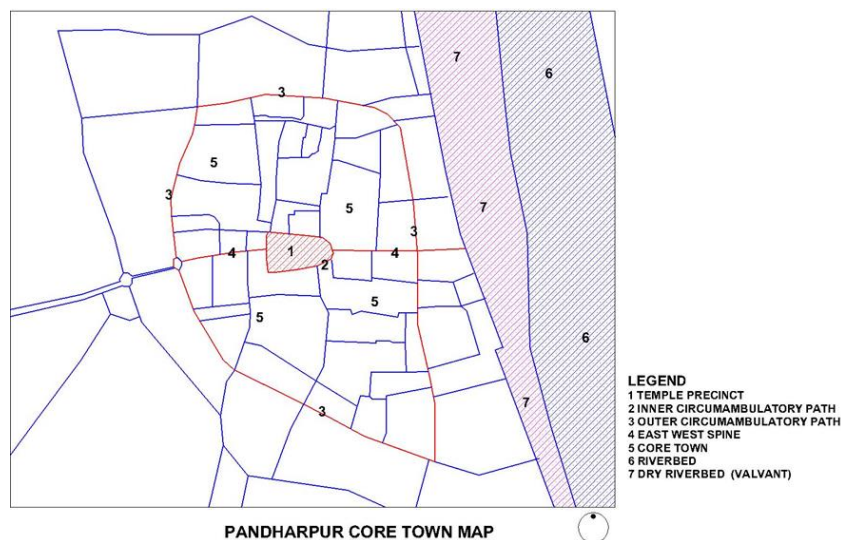


Figure 3: Pandharpur Core Town Map (Source: Author)

The main shrine of Shri Vitthal Rukmini is at the heart of the core town; numerous smaller temples, math (monasteries) and routes connecting certain places associated with the legend of the god and his devotees are spread around the city and visited by pilgrims. The Vitthal Temple is encircled by an immediate circumambulatory path surrounded by a densely organized core town; which is encircled by an outer ritual circum-ambulatory road (see, figure 3). The pilgrims generally have associations with the legacy of a particular saint or religious leaders known as Maharaj which decide the route or places to visit. The modern tourists and casual visitors are only taken to the most important places in the circuit. For local population residing in the core city around the temple, certain routes are important for their daily life as the schools, markets, banks and offices are packed in the core town and immediate surrounds.

The temporality of Pandharpur pilgrimage poses a great challenge to planners, administrators and local stakeholders. Modern transportation and rising interest in religious tourism has successively increased the number of pilgrims. The Ashadhi Ekadashi (11th day of waxing half of every month, Aashadh roughly occurs in July-August) attracts maximum crowd for a week. Kartiki Ekadashi ranks second in drawing crowds. Maghi and Chaitri stand at third place. The god is supposed to be resting in Pandharpur for four months of Chaturmas (Aashadh – Kartik) drawing a steady stream of pilgrims on weekends, festivals and auspicious days such as Ekadashi and Wednesdays. Adhik month, the additional month of Hindu calendar occurring after every 33 months to adjust the time difference between lunar cycle and earth's solar circumambulation is treated as very auspicious drawing crowds for the entire month. In contemporary times the Diwali and summer holidays of schools and colleges also mean an increase in religious tourism. There are about 120 important days every year drawing more crowd than usual. However, excluding these rest of the 240 days are quieter, with only the local population going about its routine life. Thus, any infrastructure raised for a certain average number of floating populations shall remain idle for about 8 months and shall be insufficient for about 40-60 days.

The city has over the centuries evolved its own special solution to the problem. Most property owners residing on the main roads in the core city run small businesses providing various services to pilgrims, offer them places to stay and sell them various goods. The pilgrims in turn can stay close to the temple and religious precinct, can shop, eat and get various other services in the close vicinity of temple. However, the entire core town turns into a pedestrian precinct during important days, becomes very crowded and in rainy season – very filthy. The local population dependent on pilgrimage for their livelihoods do not mind the crowd, inconvenience, noise and filth, those who have other occupations have wisely moved out of core city. Schools have holidays during *wari* days. Maintaining law and order, providing emergency health support and keeping the crowd moving becomes a hefty challenge for temple and state authorities.

### **3. Research Methodology:**

The aim of the research is to record the spatio cultural transformation of three important places of Pandharpur pilgrimage to bring forward the multiple conflicts that take place with respect to memory, religiosity and reality of everyday experience in case of pilgrims as well as local residents

#### ***The objectives of the study are:***

- To map and record spatial configuration of places of study.
- To understand the expectations and realities for pilgrims, the authorities and the local citizens.
- To understand the areas of conflicts or problems and the reasons behind them.
- To analyse the data to make observations regarding spatial transformation leading to change of experience.



The paper focuses on three places which are most visited, most crowded and hence most contested spots in the pilgrimage. Existing spatial conditions and cultural events that take place are recorded using researcher's observations, field notes, discussion with residents and visiting pilgrims, maps- photographs and drawings. The negotiations in these sites of interaction are analysed to bring forward pertinent observations about the spatio cultural transformation that has occurred and is expected to happen in future.

The research only records cultural events and their spatial implications and how the spaces restrict or enable specific cultural experiences. It only observes the public realm places including the main temple, the streets and the riverfront. It does not observe the interiors of other temples, math, phad and wada buildings which are also places of religious- cultural events and rituals, and may have undergone spatio-cultural transformation. The research shall be useful to understand the complex problem that planning for regeneration of core town of Pandharpur poses to contemporary planners.

#### 4. Culture, Memory and Reality:

This section discusses the ground realities while also describing the cultural associations associated with the places that are selected for this study. These places are at the core of the experience of the Pandharpur pilgrimage.

##### 4.1 Place I : Temple of Shri Vitthal Rukmini:

The 13<sup>th</sup> century temple has received many layers of restorations and rebuilding, the external wall was restored in 17<sup>th</sup> -18<sup>th</sup> CE strengthening original enclosure along with 18<sup>th</sup> CE addition of large covered wooden temple hall in eastern front open court (Davalbhakta, 2017). The temple has doors on all four cardinal directions which were freely used by locals and pilgrims at least up to 1980s on normal days<sup>1</sup> (<sup>1</sup> *Memories shared by local resident Dr. Shobha Dingre*)

After 1990 the economic liberalisation led to better transport infrastructure which boosted religious tourism. This saw steady increase in the number of visiting pilgrims every year. The temple was taken over by state authorities and operated through a state appointed committee. Various measures were adopted by the temple authorities to regulate and direct the flow of pilgrims at various times; some of them were temporary and some in incompatible modern materials harming the original structure.

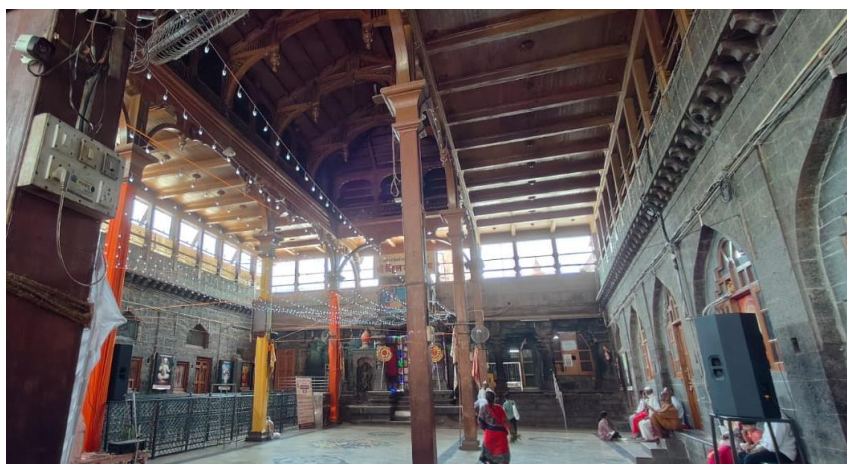


Figure 5: Main Sabhamandap (Temple Hall) of the Vitthal Temple (Source: Vijay Latke)

The activities such as Darshan, Bhajan, Namsmaran, Parayan (Reading religious texts), Rituals such as Nityopchar, Pooja, Naivedya were traditionally performed here. However, during the years some of them were restricted on account of better management of crowds and currently on the pretext of security. Bhajan, Kirtan, Pravachan and Parayan are group activities and are seldom allowed in the temple except some special auspicious days. The Sabhamandap of the main temple (see, figure 5). The temple is visited by Pilgrims, local devotees, the priests and temple managers and their staff in addition to police and security personnel.

The temple precinct itself is converted into a web of dividers, barricades and closed doors restricting the pilgrims' entry to only certain parts of the temple and only through a certain route. Hideous multi storied structures were erected right next to the historic temple for accommodating pilgrim lines with scant regard to the heritage status of the temple. Once inside the temple the devotees and the police on duty could not come out of the line, nor have access to drinking water, toilets or food, and they make take more than an hour to take darshan and come out in open. The devotees could only access the smaller deities on the defined route and have to skip many others. Locals can access the temple by a special door and a special pass only after 9 pm during crowded days. This facility kept changing according to whims of controlling officers on duty and created great problems for local residents. The accessibility additions such as wooden ramps are only placed at certain points, but very few physically challenged people are seen in the devotees indicating problematic conditions. The sabhamandap had some temples, memorials and stone light towers (deepmala) which have been relocated towards eastern end after 1990 to achieve a large open space (see, figure 6). Even after this the sabhamandap is divided in multiple divisions for various types of devotee lines (Mukhadarshan, VIP Darshan and so on) disturbing its spatial grandeur and visual impact. The local residents and devotees are allowed to enter here only during some important rituals such as Kala<sup>2</sup>, Kalyache Kirtan<sup>3</sup> and such others. The other sabhamandap near the Balaji Temple on south has a similar problem, but it is more frequently used for group activities than the larger eastern one.

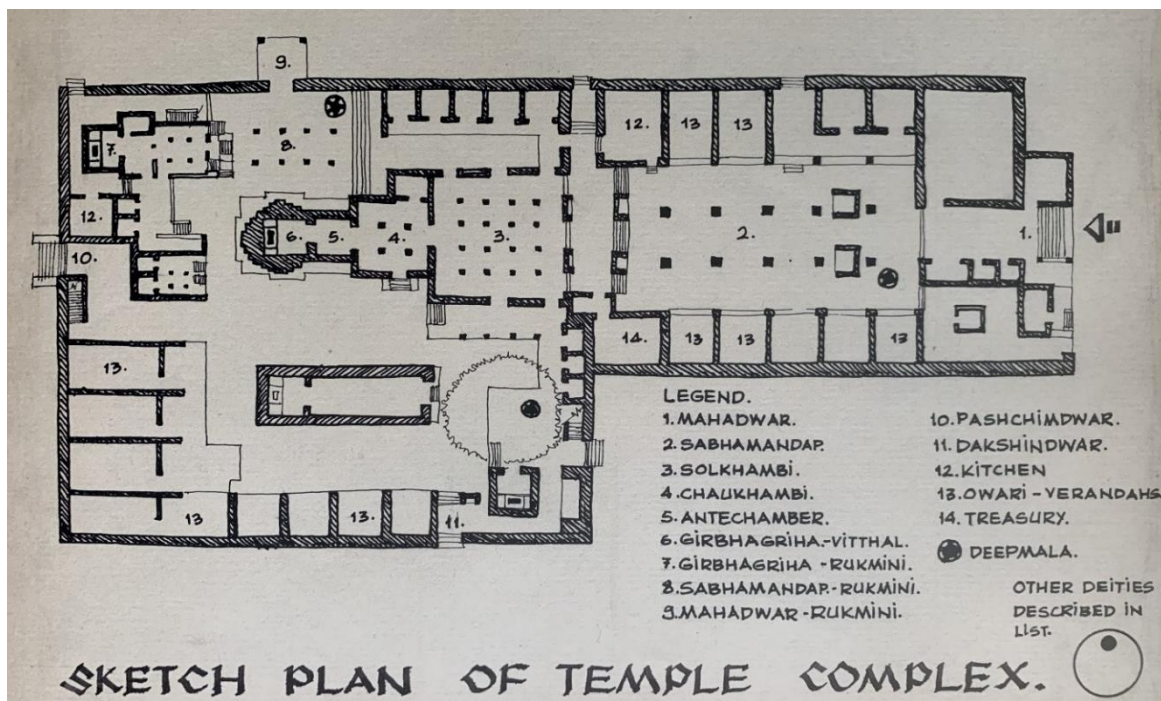


Figure 6: Sketch plan of the Vitthal Temple (Source: Author)

(<sup>2</sup> Performed on second day of Gokul Ashtami – the birthday celebration of Shrikrishna)

(<sup>3</sup> Ritual religious performance of story-song- dance and discourse by leading Maharaj of Matha)

The experience of pilgrimage is disturbed, diluted, broken by the negotiations with crowd, heat, physical inconvenience, being crammed in narrow spaces, having to stand in line for long duration. Similar experience for Priests, managers and security personnel who have long working hours.

#### 4.2 Place II a. – Inner circumambulatory path – Mandir Pradakshina Marg:



Figure 7: A, B, C, D Various informal uses of inner circumambulatory path showing the clutter and chaos on a normal day (Source: Vijay Latke)

This is a 40' town road widened from a narrow 15' wide road in 1983. Lined with illegal and informal minor roadside shops selling puja and prasad material, shoes stands and mobile lockers on one or both sides the road is paved in paver blocks and is meant only for pedestrians and occasional vehicles. Still a lot of two, three and

four wheelers appear on the road owned by the residents of the inner core town, the police, the temple officers and VIPs and the patients. The shops on these roads get the material by mini trolleys.

Many of these vehicles are parked for long time and haphazardly on the road. Thus, the effective road width is back to 25'. To stop the pilgrims and vehicles from touching and damaging the temple enclosure wall a steel barricade is erected all around at 5' distance from the wall. Beyond this the shoe stands and mobile locker cabins are erected. Some of the cabins directly touch the wall as seen in figure 7 E.

Shops on other side of road have erected awnings and weather-sheds by encroaching on the road by 6'-8'. The shopkeepers employ scouts who shout to advertise their ware and bring customers to their shops. Many shop owners use devotional songs and audio appeals for attracting pilgrims. The pilgrims also patronize these shops. Shoppers obstruct flow of traffic. There are no dividers to direct traffic in two directions. Keeping cleanliness, draining of rainwater is a challenge. Stray cattle and dogs are roaming. Cows are auspicious and fed by pilgrims, they litter the road (see, figure 7 A, B, C, D).

This road is used by devotees for Circumambulation on all days and saints' palanquins on auspicious days. Pedestrian devotees and local residents use it on all days along with controlled vehicular traffic.

All this creates visual and spatial chaos, clutter and sound pollution disturbing the pilgrim experience. The state government has widened the road while implementing the master plan in 1983, however discipline is not enforced with respect to encroachment by formal and informal vendors, illegal parking and bringing vehicles in restricted zone, cattle roaming etc.



*Figure 7: E Barricades and security cabins near the temple wall (Source: Sagar Sawant)*

The east west spine of the temple is the main approach from east and west. Most of the crowd approaches from the west as the railway station and S T Stand is situated on west. The east spine is the major approach to the riverfront and hence most crowded as the devotees approach the temple after bathing in the river from east. Moreover, many smaller lanes from the northern and southern halves of the core town join the east – west spine making it the most important road for connecting to the extended town for most core town residents (see, figure 3).

Many of the core town residents are directly or indirectly involved in some or the other economic activity related to pilgrimage such as selling puja and Prasad related goods, working for formal commercial establishments of larger scale, working for service industry or providing accommodation to pilgrims in their homes. The concept of home stays is not new in Pandharpur, it is being practiced since at least 17th CE4. There are many families who have developed pilgrim friendly housing units and earn well during 125 days to sustain

themselves for the rest of the 240 days. Even for pilgrims this accommodation works out to be cheaper than anything provided by the Mandir Committee (the Vitthal Rukmini Mandir Committee) or the private hotel industry. In addition, it is in the close vicinity of the temple reducing the travel time and expense. After Darshan, pilgrims may participate in religious group activities organized in various Mathas, phad or *valvant*.



Figure 8: Narrow winding lanes of core town are pedestrian friendly (Source: Vijay Latke)

The narrow winding lanes of the core town are pedestrian friendly, shaded by tall buildings and provide a shortest route to temple, *valvant* or outer circumambulatory road. However today some of the lanes are used for vehicular traffic and parking by the core town residents making them prone to congestion and accidents. Hence the proposed master plan of 2011 (not yet implemented by PNP -Pandharpur Nagar Palika) proposes to widen them by taking 5'-10' on both sides. This is viciously opposed as it will entail rebuilding of existing buildings on a large scale and it may render some of the buildings almost non-usable (see, figure 8). It will not only affect local residents but also the pilgrims who are traditionally sheltered in the core town private houses of narrow lanes. The loss of historic architectural character is another very grave danger which is almost forgotten in the hurry to resolve the complexity of the issue. The east-west spine and the inner and outer circum-ambulatory paths where the widening had been carried out in 1983 have already lost some very beautiful historic facades and damaged the integrity of historic wada houses which is prominent building typology in Pandharpur.

#### 4.3II b. Outer circumambulatory path - Nagar Pradakshina Marg

This is a major town road, the boundary of the original core town and the extent of Pandharpur town till mid-19th CE. The road is lined with shops of clothes, provisions, special goods such as statues of deities, organic blankets, decorative items for cattle, musical instruments, puja and prasad goods. Many temples, mathas, wadas are lined on the road, many smaller lanes meet the road from inner and outer city. This is a major shopping street for core town residents and pilgrims and also a major transport artery for the core town.



Figure 9: Outer circumambulation road at various points (Source: Sagar Sawant)

Culturally this road is used for circumambulation of the Pandharpur town by devotees and the palanquins and rathas of various saints and sectarian groups on auspicious days. It is believed that this act earns good merit as the entire town is inhabited by Shri Vitthal and many other deities. While going round this gently curving road encircling the core town all the temples and mathas lined on this road are visited by the pilgrims, taking Darshan and Prasad at every place. They do this individually or in groups all the while doing Bhajan and Namsmaran.

Twice a year on Ashadhi and Kartiki Ekadashi, the God Shri Vitthal is taken around in a ratha for circumambulation. In pre-independence days the so-called untouchables were forbidden from entering the temple. This event was probably beginning to enable all devotees to view and bow to the god irrespective of caste, class and occupation. When in May 1947, Sane Guruji, a prominent Marathi writer, poet, teacher and social activist agitated with 'fast unto death' for opening the temple to untouchables resulting in opening the temple for all. Even then the rathayatra has continued and is the most popular event. This enables many pilgrims to take darshan on the two most crowded days in Pandharpur. It also has an emotional appeal as the god himself comes on the streets to meet his devotees.

During the rathayatra the outer circumambulatory road is overflowing with pilgrims for the entire duration of the procession which is about 5-6 hours depending on the crowd. The shops are closed for the time when the ratha is expected in a particular part of street. Devotees climb the platform in front of shops, the galleries and terraces of commercial and public buildings to catch a glimpse of the god and shower flowers, churmure and battase (puffed rice and sugar candies), dried dates and pieces of dry coconut. Even coins and notes of various

denomination are showered. The priests and attendants on the ratha have a right to collect these and redistribute as prasad. There are shouts hailing the god and asking for his favour. The entire spectacle is of devotional fervour, emotional bonding and communal unity.

The road is closed for vehicles during the auspicious days and residents of core town face many difficulties reaching their houses or carrying their vehicles across. Most of them prefer to stay at home and engage in their daily routine without venturing out. Food items are stocked to last for 3-4 days. During normal days the road is used for vehicular and pedestrian travel within the core town and extended town, and shopping.

Small informal roadside shops encroach on the roads especially near temples and mathas. There are no dividers to segregate two sides of the traffic. Illegally parked vehicles obstruct the road. Debris of old dilapidated structures or material piling of construction sites on road reduce the effective road-width. Most of the buildings on both sides of the road have been restored, rebuilt after the road widening in 1983. This has drastically changed the original historic character of the street and turned the streetscape similar to any other medium sized town. The street has steadily lost its historic architectural fabric and has increasingly adopted modern quickly built faceless R C C construction. Some historic mathas are still retained, but are in a dire need of restoration. The increased number of vehicles on the street have reduced the space previously used for socio-cultural activities. The street is unsafe for pedestrians and there are no dedicated footpaths for them (see, figure 9).

#### **4.4Place III – Chandrabhaga Dry Riverbed – *Valvant*:**

The dry riverbed – *valvant* is an integral part of the pilgrimage experience. The pilgrimage is not complete until one visits the river, bows to it and bathes or washes one's feet. The word for pilgrimage centre in Sanskrit and local language is 'Teerth-kshetra' meaning the religious centre situated on 'flowing water'. There are many temples and memorials to saintly figures who were cremated here. The most important temple is of Pundalik- the original devotee who made Lord Shrikrishna to become Vitthal and wait here in Pandharpur for the devotees' welfare. There are 18 ghat - the flight of steps leading to water from the higher ground on which the town is situated to the lower ground of the riverbed. Most of the ghat were developed in 17th, 18th and 19th CE.

All around the year devotees and local residents access the river for bathing, and washing feet as an act earning good merit. The visitors and tourist also perform daily chores such as sleeping, cooking, washing and drying clothes, washing cattle and vehicles. Some people live in tents or under umbrellas, recreational activities such as boating are available for pilgrims and tourists. During the 125 auspicious days *valvant* is used for religious group activities such as Darshan, Namsmaran, Parayan, Bhajan, Kirtan, Pravachan etc., large tents or pandals are used for religious discourse and feasts (see, figure 10 A, B).

Devotees, pilgrims, local residents, sellers and buyers of small goods and other materials, service givers and takers, beggars and homeless, police and private security personnel, drivers of numerous private vehicles all use the dry riverbed in many ways. Common temporary toilets are set up in large numbers during the *wari* days. There are also many permanent toilets built in the *valvant* at many places. Many illegal commercial stalls are set-up in the dry riverbed, the PNP is unable to control these. When the PNP squads visit the stall holders wrap their wares and move, when the squad is gone, they come back and reset the stalls<sup>5</sup>. Due to huge crowd the *valvant* is packed to full and any type of management is almost impossible. The scale and magnitude of the crowd is manifest in the *valvant* like no other place in town. Conducting the *wari* without any mishap is a huge responsibility faced by the police department. The politicians are very keen to attend the puja on the auspicious days due to popularity of the *wari*. This adds more burden of VIP security on the police. The district collector and police commissioner stay in Pandharpur for few days during *wari* to manage it in peaceful manner.



Figure 10: A multifarious pilgrim activity in dry riverbed- Chandrabhaga Valvant (Source: Sagar Sawant)

Many people migrate to Pandharpur in search of work, these migrants feed themselves by running petty businesses or offering various services for the benefit of pilgrims. Informal establishments are scattered around the entire length of the riverbed. Many aging- ailing seniors, physically challenged and mentally unbalanced are wilfully left in crowded areas to fend for themselves, turning them to beggars. Great number of beggars are present on the entire route from the temple to the riverbed. The *wari* event is a congregation of human devotion and nobleness, at the same time it is a display of social evil and human degradation.

The historic character of the riverbed imparted by the numerous temples, memorials and ghat is fast disappearing and is replaced by garish structures built in modern materials for smaller businesses. Cattle, dogs and cats are wandering everywhere seeking food. Left out food, garbage and old clothes keep lying about in the entire riverbed. Illegal sand mining has already created large pits in the dry riverbed which are potential sites for accidents. Vehicles parked in haphazard manner complicate the pedestrian nature of the riverbed.

The quality of water flowing in the river is questionable as the cities, towns, villages and industries upstream leave their untreated sewage in the river. The level of water in the river faces major fluctuations. Special provisions have to be made to keep water in the river during *wari* days. The overall effect of the riverbed is not that of auspicious religious place but of undisciplined, filthy and chaotic space. The pleasant and serene environment of the riverfront as described in devotional poetry of the saints is a thing of past. The burgeoning number of visitors and disproportionate investment in maintenance and upkeep have robbed the natural environment of its ability to self-ameliorate.





Figure 10: B multifarious pilgrim activities in dry riverbed- Chandrabhaga Valvant (Source: Sagar Sawant)

## 5. Conflicts and Negotiations:

The pilgrims, warkaris obviously expect a semblance of order in the city during their visit. Their expectations are few in terms of physical space and amenities provided. They wish to get some comfort while waiting in long queues for the Darshan, they expect clean toilets, clean and free drinking water and sleeping place. They need safe places to keep their belongings and they wish to be treated as guests rather than as a miniscule part of the crowd. They are ready to spend for food and Prasad. They expect to do some shopping for their families and friends at reasonable prices without getting their pockets picked or getting choked in the crowd. They expect medical aid if needed and dialogue with fellow visitors about common concerns. They are ready to accept some inconveniences but they wish to participate in religious group activities and lose themselves in the devotional environment of the wari<sup>6</sup>.

On the other hand, the local residents expect a normal life without the ever-hanging threat of evacuation in the name of redevelopment of core town. They don't wish to be driven out from the place of their ancestors for facilitating the nameless, faceless unknown crowd. They draw their sustenance from the visiting pilgrims by

servicing them in various ways, and they think it's a fair give and take. They bear many inconveniences during wari without complaint. They don't want to be punished for their traditions and rootedness in the core town<sup>7</sup>.

The PNP can hardly keep up pace with the ever-increasing flow of pilgrims and their basic requirements. It is helpless in terms of funds and personnel even after receiving substantial financial aid from the state every year. The aid is always spent in temporary measures for health and sanitation. Their major challenge is to develop better urban infrastructure and maintain it after the wari is over. Even for implementing master plan substantial fund needs to be raised just for the compensation money which PNP is unable to do in last 12 years. They need a major bail-out grant from the state if they ever wish to undertake it<sup>8</sup>.

*(<sup>6</sup> Discussion with Namdev Vithoba Retharekar (60), a regular visitor during Ashadhi wari.)*

*(<sup>7</sup> Discussion with Charudatta Bhausheb Badave (58), local resident and house owner, home stay provider.)*

*(<sup>8</sup> Discussion with Mr Kendre, Asst Town Planner, Pandharpur Nagar Palika regarding implementation of development plan.)*

## 6. Observations and Conclusions:

- The changing nature of space and their cultural implications are quite clear from this study. The town which was organically developed around a temple with a specific religious philosophy and its manifestation through a set of religious ritual is only capable of welcoming a certain number of additional visiting pilgrims. Rapidly expanding number of pilgrims in last two decades have necessitated a major re-haul of the urban infrastructure.
- Some negotiations must be made with memory of the historic town and its cultural environment. The expectations of visiting pilgrims are modest, but even they are difficult to fulfil considering the extremely large number of visitors at one time.
- There have to be two different sets of planning measures, one for normal 240 days and the other for crowded 125 days of the annual ritual calendar, as the users and their needs are totally different in these two time periods.
- Any planning for core town of Pandharpur and temple surroundings must take into consideration the residents of core town, the built heritage, culture and traditions of core town and its integral role in the religious atmosphere of Pandharpur.
- It would be sensible for any planning authority to involve multidisciplinary experts such as conservation architects, urban historians, architects, planners, structural engineers, transportation planners and environmentalists, sociologists, archaeologists and psychologists, religious experts and financial experts to derive a common program. The program should lead to a vision plan which satisfies most of the stakeholders by finding suitable solution within the traditional framework of nature, mythology, religion, culture and practicality.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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02

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**TRACK 2:  
ARTS AND  
HUMANITIES**

BNCA Conference Proceedings 2023



# Architectural Pedagogy – Tracing a Process-based Approach in Basic Design Studio

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## Abstract:

*The Basic Design Studio plays a role of the most pivotal character in the matrix of architectural curriculum as it goes beyond the aspects of critical and creative thinking, incorporating elements from other disciplines as well, which helps students understand the broader context in which architecture operates. This paper attempts to outline a methodology carried out by the basic design team that corroborates to a specific brief intended to trigger an understanding and development of an ideology and vocabulary that stimulates a multi-layered design process.*

*The aim of the brief was to assess and explore the term 'anomaly' in the context of design due to its very inherent nature to deviate from the expected or conventional principles. The design and methodology of this brief was visualized as a departure from the typical approach, and a step towards building a process that evokes a sense of intrigue, apprehension or even disruption. It was also to investigate the term anomaly as a conscious design possibility instead of an abnormality or inconsistency. The purpose was also to strategically engage with anomalies to instigate and challenge existing behaviours, patterns, and responses that exist within the realm of Architecture Design.*

*The consequent outcomes were a process-based journey of continuously engaging the students to understand, observe and analyse the anomalies introduced in the exercise. The paper would showcase the possibilities and analogies that were a resultant of the process and also create a framework that could be explored in Basic Design Studios. It would also highlight that a process-based pedagogical approach in Basic Design cultivates a transformative learning playground, empowering students to inculcate a design ethos that would encourage an architectural built space.*

**Keywords:** *basic design; process; anomaly; pedagogy; critical thinking*

## 1. Introduction:

Over the years, architectural education has witnessed a vast realm of pedagogical approaches aimed at instilling foundational design principles in students. These principles, with their diversity, serve as the critical substructure, guiding students in shaping their unique perspectives, approaches, and visions for the built environment (Pasin, 2017). The authors feel that at times, traditional architectural pedagogy may appear mired in outdated practices and bureaucratic structures, there are avenues that hold promise and embody innovation. Within this panorama, the Basic Design Studio has emerged as a multi-layered and levelled platform that helps gain a design vocabulary where students can manifest their ideas, thoughts, and curiosities into spatial and volumetric expressions. Undoubtedly, the pedagogical approach of the Basic Design Studio gives the best opportunity for intervening in the learning of architecture and design. This paper delves into an innovative exercise focused on the term 'anomaly', shedding light on its potential to transform students' design ethos and approach. It will journey through the objectives, methodology, and implications of the architectural pedagogy adopted in the exercise.

The subject of Basic Design, an integral subject of the foundation year, serves as a transition space that helps absorb foundational design knowledge while challenging stereotypical perceptions ingrained from earlier years. The Studio equips students with a broad spectrum of architectural expressions, merging aesthetics with pragmatic skills like drawing, model-making, material exploration, time management, and presentation. It also opens up a liberal space of creative exploration where the students and faculty members create a crucible to confront, question and redefine their understanding of design. The pedagogical approach by the authors aims to transcend traditional boundaries, deliberately challenge students' visual, graphical, and model-making prowess, immersing them in a tapestry of themes from the intricacies of nature to ethereal play of light to the tangibility of product design and installations. It further aspires to unravel and rethink the essence of design and as the course steadily progresses, it gradually assumes a character that fosters an aesthetic discipline, empowering students to transition from mere observers to creators of tangible artefacts.

While Mumbai University provides a broad canvas by suggesting areas such as Visual Studies, Basic Design, Graphic Design, Product Design, Furniture Design, and Design of Outdoor Spaces, it entrusts individual colleges with the responsibility and freedom to sculpt the course based on their unique pedagogical perspectives. The Basic Design Studio, while foundational, does not exist in isolation (Vaz, 2022). It's also closely linked to other subjects in architecture, intertwining with other design disciplines, technical nuances, and theoretical constructs. This intricate network of knowledge-sharing ensures that our students, while rooted in the basics, are also attuned to the larger dialogue of architecture, appreciating the symbiotic relationship between.

### **1.1 Pedagogical Intent:**

Basic Design Studio has been a platform to impart various facets of design education where students are nudged towards adopting a new spatial language, bolstering their skills in communication, visualization, and representation, that open avenues of architectural design exploration (Ghom, 2020). It has also become a space of inquiry where students are constantly challenged to break away from usual ways of thinking, especially when it comes to design and graphics. Through a series of esquisse or smaller exercise, students are nudged to push their creative boundaries through deeper observation, reflection, and representation techniques. Alongside this, students learn the core principles of design and importantly, they explore the connections between basic design concepts and the wider world of architecture, looking at materials, shapes, light, and colour.

Over the past half-decade, the studio's journey has been anything but linear. Exercises, regardless of their outcomes, have always been enlightening bridges to the next exploration. Whether they yielded expected reactions, deviated due to unforeseen student interpretations, or even encountered errors in design or execution; each step, each stumble, has fuelled our evolution. Some exercises saw a success, while others ventured into unexpected avenues. Yet, each one became a lesson, a stepping-stone, refining and reshaping the studio's trajectory.

### **1.2 Pedagogical Exploration:**

The evolution of a pedagogy in Basic Design has been through continuous learnings, explorations, inquiries, critical discussions and identifying the core thought process relevant to any exercise/ problem. However, it can be derived, that the studio pedagogy has developed around the core concept of learning domains: Cognitive, Affective and Psychomotor (Hoque, 2017). These were not only crucial for tackling problems but also for crafting exercises and assessing both the results of learning and the process methodology (Attia, 2020). The diagram above (Fig. 2. Pedagogical Exploration), indicates in detail, the extension of core aspects through Think/ Analyse, React/ Act, and Respond and how each of these again, are deconstructed for an analysis and execution of the problem. In our studio, we've consistently experimented with various methodologies to deconstruct a design brief. Two distinct yet somewhat opposing methods have emerged. The first involves

interpreting the introduced brief through a series of discussions or readings, subsequently represented via drawings, sketches, photographs, films, or models. In contrast, the second method engages in extensive charrettes, debates, and group discussions on a broader topic first, setting the stage for a deeper understanding of the brief introduced later. The formulation of a brief has been stimulating, at times cryptic, and an analytical exploration. From the onset, the backbone of our praxis is rooted in a process-driven approach. For our studio, it is paramount that the execution unfolds in a progressive, conscious, and explorative manner. The ultimate design is shaped by the key elements of this process, namely: Light, Materiality, Structure, and ultimately, Form.

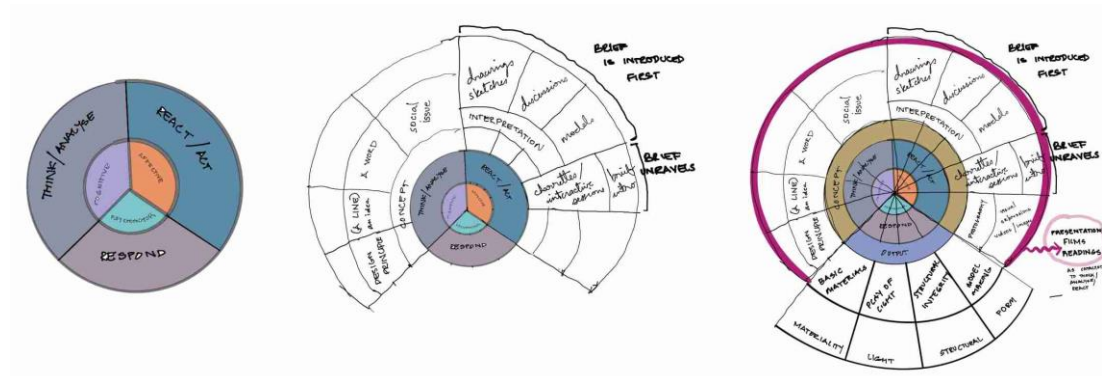


Figure 1: Evolution of the pedagogical scheme for Basic Design Studio (Source: Author)

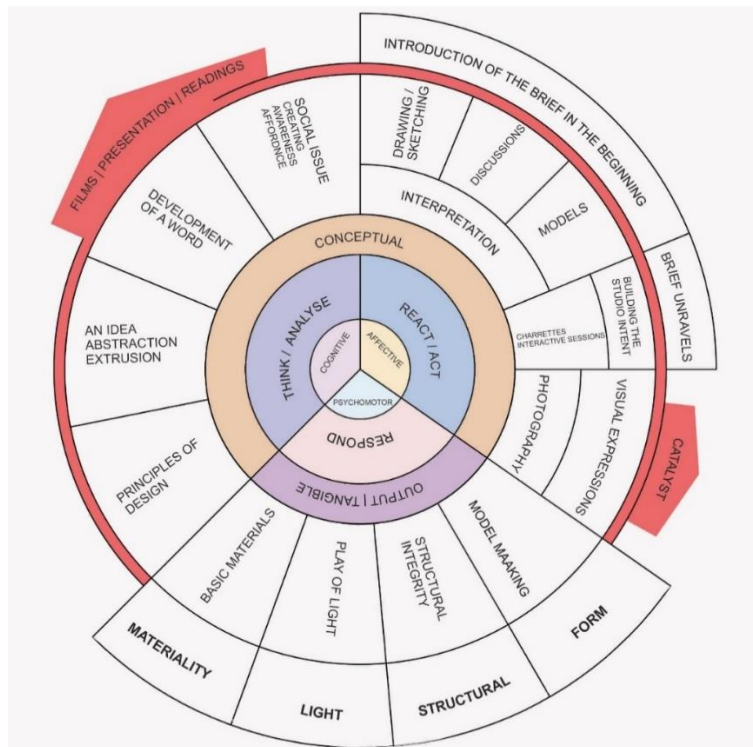


Figure 2: Pedagogical exploration scheme for Basic Design studio (Source: Author)

“I am very glad that Hussain mentioned, the process is very important... how will you enjoy the food if you didn’t know where it was coming from and how it was cooked.” - BV Doshi (<https://www.stirworld.com/think-books-and-movies-doshi-chapter-5-the-end-result-is-not-as-exciting-as-the-process>)

## 2. ‘Anomaly’:





These observations were discussed in the studio where the experiments were carried out ‘live’ for all to see and note the changes in the system. A larger session was held towards the end where students narrated their thoughts on functional, contextual and aesthetic metamorphosis of the cube.

This exercise, rooted in the concept of 'anomaly', was meticulously designed to challenge traditional pedagogical practices, prompting both educators and students to step outside their comfort zones. By introducing unpredictability and encouraging experimental approaches, the exercise sought not just to teach architectural principles, but also create a subtle shift in the very dynamics of learning. The hands-on, process-driven methodology facilitated deep engagement with the subject, fostering an environment of collaborative discovery. As students navigated through each phase, they did not just acquire knowledge; they actively constructed it, intertwining theory and practice. This exercise led to invigorating sessions, learning for one another and most importantly, instilled a sense of curiosity – a crucial element in architectural pedagogy.

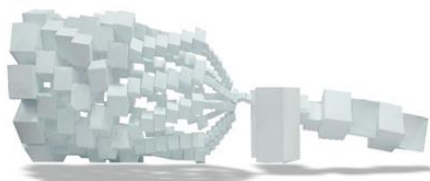



Figure 4: A collage of students works (Source: Author)

### 3. Students works & Survey:

Student perspective on the working of the studio becomes imperative in such process driven exercises. Each work indicated a unique outlook on the way the instigators, as per instructions affected the volume.

Table 1: Student work and their interpretation during the studio (Source: Author)

Student name	Student interpretation	Model / output
Fahad Dalvi	Change in medium can affect volume and its motion. An introduction of a catalyst that accelerates a linear movement. A rhythmic deviation from the straight line.	
Bhushan Bhoir	Impact/ force on a volume. A visual representation of how an impact from top affects a volume.	

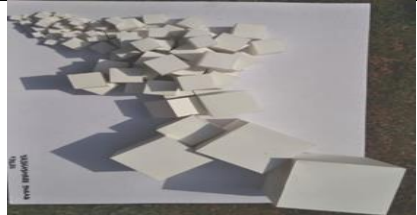
Yashashree Parab	Asymmetry that exists in volumes. The introduction of an anomaly in asymmetry creates a disruption in the understanding of form	
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Table 2: Student interpretations of 'Anomaly'

Sr. No.	Name	Student interpretations of 'Anomaly'
1	Atharva G	Anomaly is a sudden change. It is not forced by human interference but naturally.
2	Sanskriti Lad	Was able to identify and understand different meanings of an 'anomaly'
3	Bhavesh Patere	We were given a word termed Anomaly and while studying about the term we were introduced to the term catalyst and were asked to use these two terms together to make an expression that could represent both the term with each other.
4	Disha Dabke	Good learning opportunity and experimenting with forms
6	Harshita Mayekar	Of how a space can be modified with the use of various forms and actions and how the impact develops the process.
7	Fahad Kagdi	Anomaly is the deviation from the rule or what is regarded as normal, a blip in the pattern followed. Catalyst is something that accelerates the process. In layman terms, catalyst is something that brings change in a particular system. The program was to introduce anomaly through a catalyst in a volume of cube.
11	Ekta	Understanding on various behaviour of lines and points and its relationship with each other. Overlap of cubes and volumes with various movements.
12	Yashashree	A process of something which is earlier slow and when a catalyst as a parameter is introduced the process starts getting faster. Here the process was shown with different sizes of cubes.
13	Shubhangi	Deviation from normal state
15	Namrata	To understand what needs to be done in the design. To understand the context.
16	Jaidutta	Anomalies often push the boundaries of creativity, functionality, and sustainability, leading to unique and thought-provoking structures that contribute to the diversity of the built environment.
17	Garima	Anomalies in architecture can take various forms and can be intentional or unintentional.
18	Deven	Helped to understand better and in detail
20	Prajakta	Studio interaction helps in better understanding
21	Jagruti	After discussing the brief and listening to different perspectives interpretation became more stronger and clearer
23	Pushkar	Anomaly is something that is different from one can anticipate it to be. If I put in theatre terms, you could call it as the plot twist, an unpredictable storyline.



Figure 5: Demonstration of play of light in models (Source: Author)

The survey allowed us to understand student responses and shed light on the intended pedagogical explorations. The students were sent a set of questionnaires that were focused on the exercise on ‘anomaly’.

Were you able to understand the instructions given in the Basic Design studio?

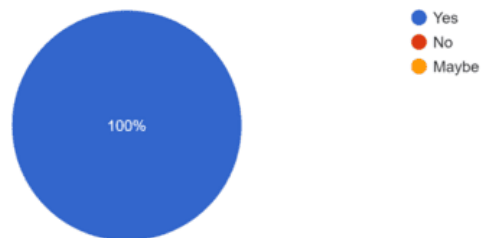


Figure 6: Understanding the brief (Source: Author)

As per (Graph 1) the survey all the students agreed to understanding of the instructions given in the studio.

Where you able to understand the word Anomaly?

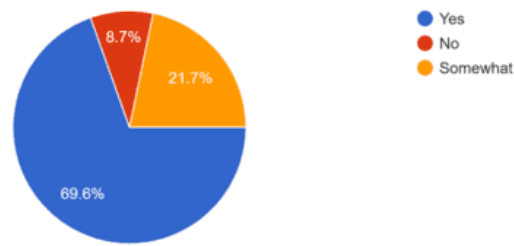


Figure 7: Understanding anomaly (Source: Author)

The introduction of the word and the discussions that followed to create a strong understanding of the brief was well received by almost 70% of the class, whereas 21% understood it to some extent. Other students, however, were able to derive more out of continuous interactions in the further stages.

Did the studio interaction allow for interpretation of the brief?

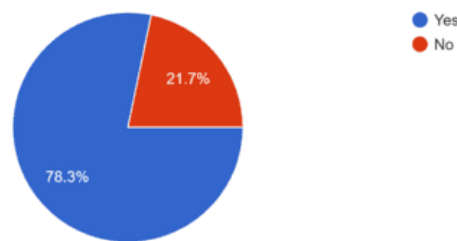


Figure 8: Interpretation of the brief (Source: Author)

Given the complexity of the design brief, studio interactions became invaluable spaces to exchange information and thoughts. The response in the graph above indicates the higher probability of this leading to a clearer interpretation.

Where your interpretations received positively?

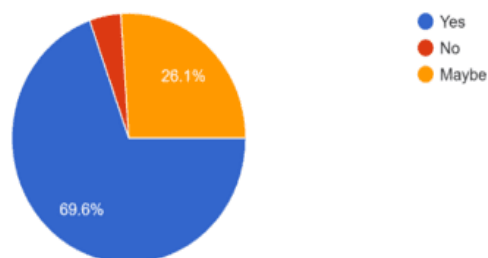


Figure 9: Allowing interpretations (Source: Author)

Results from the above graph indicate the positive side of the studio strategy; however, it gives an indication to the faculty members about evolving discussions, further to help accommodate and articulate student interpretations.

Do you think the exercise was able to bring new perspectives in your design thinking or interpretation of the built environment.

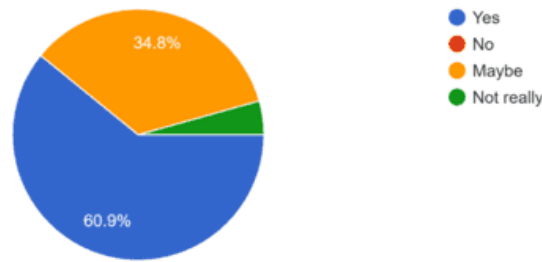


Figure 10: Design thinking and bringing in new perspectives through the exercise (Source: Author)

More than half the class responded to being able to bring in new perspectives and an evolved approach in design thinking in their understanding of the built form (Graph 5)

If yes, then how?

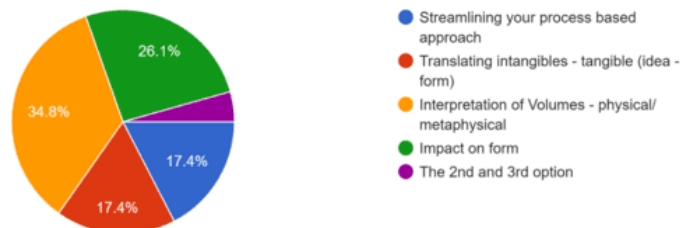


Figure 11: Understanding and interpretation (Source: Author)

We received mixed response from students on their understanding. 34% of the students responded that the exercise has aided them in comprehending volumes, physical and metaphysical. 17% of the students feel that the exercise allowed them in streamlining their process-based approach. The above graph 6 gives an overview of the studio takeaways allowing the faculty members to articulate and create exercises.

#### 4. Conclusion:

Focusing on the process rather than the outcome is something that takes two very distinct and equally important things: *discipline and focus*

Architectural education, like design itself, thrives on both introspection and experimentation. Rooted deeply within this ethos, the 'Anomaly' exercise in the Basic Design Studio offered an insightful perspective on the strength of innovative pedagogies to reshape how students perceive and practice their craft. The exercise, positioned as an anomaly itself within an existing educational system, highlights the value of process-driven learning over rigid outcome-centric approaches.

Drawing from the survey findings and reflective observations, that were taken five years after the exercise was executed, it's evident that interventions such as these, leave an indelible mark on students. Notably, even half a decade posts the exercise's execution, its resonance with the students remains profound. Such enduring engagements with foundational principles reinforce that while Basic Design exercises form the bedrock of architectural education, it's the anomalies or deviations from the norm that create the most memorable, transformative experiences.

It has been emphasised that the design process, which encompasses numerous concepts and choices, demands creativity and the capability to both formulate and appraise ideas (Cross, 2011). Therefore, an educational approach that fosters design thinking, coupled with meticulous guidance throughout the design journey, is pivotal for budding architects in their ideation processes (Asefi & Imani, 2018).

Reflection on the broader spectrum of architectural design education, it becomes evident that the promise of the future lies in a multi-disciplinary approach. This, as highlighted by (Pasin, 2017), facilitates a rupture of traditional knowledge boundaries, propelling students towards a more holistic, flexible, and adaptive design mind-set.

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# The Broken Link between Urban Development and Humanity – A Theoretical Perspective

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## **Abstract:**

*In the race for urban and infrastructural development perhaps the greatest casualty is the humanity of design. As Jane Jacobs writes in the context of North America, a growing number of people think of cities as problems in organized complexity. This point of view isn't appreciated by the planning bodies and schools. This paper aims to contextualize and theorize the broken link between humanity and development in the practice of urban design in India. The stakeholders of the city and cultural context are lenses through which this paper has been written. Pointing out the causes of insufficient urban development being the lack of human approaches, this paper is scrutinized through a literary and theoretical lens. The resultant observations shall be essential primarily towards pedagogical approaches.*

**Keywords:** *humanity; pedagogy; urban development; cities; theory*

## **1. Introduction:**

The urban population in India (as per 2011 census) was about 377.10 million, accounting for 31.16% of the population. It is projected to grow to 534.80 million or 38.21% by 2026 (Ramachandran, 2014). Urban design should be a product of a region's unique culture and heritage. The city form is neutral until impressed upon by specific cultural intent (Kostoff, 1991). Planning itself derives from an interactive relationship between people and local natural forces (Dobbins, 2009). Yet the trend in India appears to be one based on utilizing western ideas which may not necessarily be suited to the Indian context. Western urban development has primarily relied upon the philosophies of Ebenezer Howard and his "Garden City", Le Corbusier and his "Radiant City". And FL Wright and his "Broadacres" (Fishman, 2002). None of them accommodate history and humanity in their approaches. This has caused a broken link between humanity and urban development.

Indian cities cannot be planned on these principles. Our cities are ancient; culture and heritage being deeply imbibed in the city. In Gujarat, Chhabutras to feed birds and tolerance for strays is common – a result of Jain influence. In Maharashtra, many cities revolve around places of devotion. Indian cities often have such cultural aspects to their development, which makes our situation unique.

## **2. The City as a Palimpsest:**

New spaces are created through reconfiguring of body, memory, and space and time in cities (Srinivas, 2004). Planning a new space is inherently involves erasure, and most urban space is a palimpsest. It is easier to design cities anew than build upon existing settlements. India being an ancient civilization is a different situation – most of our cities are palimpsests on older settlements. Infrastructural interventions and satellite towns change the flow of the city, eventually changing memory of the city itself (Srinivas, 2004).

America stands in contrast to Europe and Asia; it does not have as extensive a history of major settlements, and land availability seldom caused problems. Yet, the problems of displacement, people uprooted, small

businesses destroyed, and communities torn apart are observed in America too. (Jacobs, 1961). Understanding a city as a palimpsest is crucial, since a city is never static. A city, though envisioned perfectly, is never complete, never at rest (Kostoff, 1991). It is a living, dynamic organism that is always evolving. As designers, we must design reflecting the people who were once there, the people who are there now, and the people who will be. People make the space, and space makes the memory. Solutionist approaches should be avoided; cities can never have a fixed solution (Dobbins, 2009).

Ahmedabad is an example of such a palimpsest city. Founded by Sultan Ahmad Shah in 1411, it was close to an already existing trading town (Asaval, or Karnavati) With Hindu, Jain, and Islamic influence, visionaries like Rancchodlal Chhotalal, mill owners, Gandhian influence, and patronage provided to famed architects like Corbusier, Correa, Kahn, and Doshi among others (Gillion, 1969), it has expanded beyond the old walls and consists of multiple layers; yet it remains grounded in tradition. Heritage is anchored in memory, and the memory that preserved the fabric of the city is rooted in human approaches. Each layer of the palimpsest is preserved in memory, resulting in sensitive planning approaches. Integrated community planning involving multiple stakeholders is evident in older neighbourhoods (pols and old city), and thus the link between humanity and development has not yet been severed to an irreparable degree in Ahmedabad.

### **3. The Politics of Planning:**

The origin of Indian town planning methodology is rooted in the Town and Country Planning act of the UK (1947), visualizing a road map towards an “Ideal” state (Ahluwalia & Mohanty, 2014). Master plans and recommendations often focus on efficiency, with land acquisition remaining a primary concern due to the layers of history in the palimpsest city (Buch, Hussain, & Dhar, 1981). However, these recommendations are not always tenable due to political influence, or lack thereof.

The planning of a modern city is inherently political. In America, the liberal tradition (This prioritizes private ownership and individual rights and minimal government interference.) is dominant. A drawback is manifest in societies where distribution of wealth and power is unequal; those who are weak economically are least able to make changes to urban policy and thus planning (Fainstein & Fainstein, 2002). India, regrettably, has frequently looked to such western notions of planning. The homeless, the poor without property documentation, even stray animals are sidelined as stakeholders. Politics results in othering, thus ignoring, of entire demographics be it on basis of caste, religion, even nationality and marital status. Sensitive political leadership and urban planners well versed in the humanities are necessary.

Squatter settlements develop due to stigmas of society, lack of attention by urban planners, and inadequate public investment towards affordable housing (Jagmohan, 1981). Solving homelessness should be prioritized. Schemes such as MHADA are undoubtedly beneficial; they are also underfunded and undervalued. The walkability of cities also begs attention. Walkability results in citizens reclaiming urban space, making it safer and friendlier. Several metropolitan cities in India are not particularly walkable, although exceptions exist. With a growing network of public transport such as metro, BRTS systems, and ring roads, private vehicular burden on the urban infrastructure can reduce, increasing the walkability of cities. Universal design is also essential. Progress is being made towards making public spaces more accessible, such as through the rights accorded by the RPwD Act 2016. Such approaches must be rooted in humanity and sensitivity, with stakeholder participation being paramount. These changes, major and often dramatic, are a result of politics, for better or for worse.



#### **4. Approaches to planning:**

Several approaches to planning are studied and written about, including but not limited to economic, pluralist, traditional, and Marxist (Kloisterman, 2002). Of these, the pluralist approach has most potential in India as it finds a middle ground between the economic incentives and traditional approaches focused on collective goods. It (while nuanced) requires planners to serve as advocates for the neediest members of society, the generally excluded.

Strong cases for public participation have been made and explored, these being foundational to a pluralist approach. This is a four-step process consisting of informing, listening to, engaging, and developing agreements with the public to solve problems (Creighton, 2005). However, not every decision can be taken by the public, and they can (and have been) misguided against their own good. An expert mediator and decision maker is required, this being the planner. The involvement of agencies in conducting initial stages of public participation is necessary. Planners need to be part of public participation and decision making. This is where the importance of empathy and humanities come in the picture, since if the human link between the user – the public – and the planners is broken, development will inevitably be mechanical and solutionist, an unfeasible approach.

#### **5. Pedagogy:**

Practice starts from pedagogy itself. How the new generations of planners are trained directly impacts their output. Not enough emphasis is laid on the humanities in architectural and urban development pedagogies. The subjects dealing with these aspects are often relegated to electives. Educators are expected to be knowledgeable in this aspect, and in good schools it is emphasized through the design process itself. Faculty development programs develop sensitivity in educators. Detaching oneself from this intimate humanity of the field is reminiscent of “making love like an intellectual” (A phrase coined by Milan Kundera, in the book titled “The Book of Laughter and Forgetting”, expressing the inability to immerse oneself into one’s surroundings.). Similarly, design detaches itself from space-making and focuses on “concepts” (McCann, 2005). Extrapolating this to urban design, we may understand it as the inability of the planner to involve themselves in the surroundings. Pedagogy focuses on solutionism – the design is a problem that needs a solution – thus neglecting theory. This has resulted in an inability to empathize and has caused the broken link spoken about. The pedagogy is in stasis – both in architecture and urban design. Radical making is often confused with radical thinking, and an attempt to hide it through guest lectures, “real world” briefs, and focusing on empirical data are made. The world isn’t a dynamic social system to engaged with, but a static abstraction in these schools (Till, 2009). The same old project, in new packaging, is passed on to the student, leaving little scope for innovative thinking. Sometimes, new ideas are shot down under the exegesis of feasibility and practicality. The way ahead will require substantial faculty development. A static pedagogy will invariably create static planners devoid of empathy and humanity, their souls being sucked dry through the grind of solutionist education. A revamp of the way educators think of design education is required. Empathy building, theoretical, and humanities-oriented subjects need to be focused upon to a greater degree in pedagogy.

#### **6. Conclusions:**

The type of work faced by an urban planner requires knowledge on contemporary philosophy, social work, law, social sciences, and civic design (Davidoff, 2002). Laws mandating universal design as part of urban and architectural decisions are a change in the right direction yet implementing it merely as law without creating empathy, without humanizing the approach itself, is futile. Palimpsest cities as we have in India require a strong humane approach, where memories are preserved and understood. All the stakeholders – not limited to landowners but also the users of public space – hawkers, the homeless, even animals are to be considered. It

is therefore necessary to study the social sciences as part of the curriculum, and it is equally important to have sociologists involved in policy and planning. There is progress in this direction, as NGOs are more involved with policy making. Dealing with Indian cities, heritage and culture should be at the forefront instead of imitating the concepts dictated by the west, be it through the process of globalization or the process of colonization.

The primary approach to repairing the broken link thus lies not just in practice but in pedagogy. Through pedagogy it is possible to create sensitive designers, thus repairing the broken link between humanity and urban design. The framing of curriculum should involve sociologists instead of relying primarily on engineers and planners. Public participation programs and workshops as part of pedagogy is crucial to the cognitive development of future designers and planners. Sociology and humanities as core subjects should be included from the first or second year in bachelors' courses, and at all levels in masters courses. In these courses, mandatory readings should include both architectural and non-architectural texts dealing with humanities and philosophies that guide design. Design itself must not be thought of as a "problem" but an exercise in evolution of thought, with a grading criterion dedicated to new thought and innovation instead of focusing on "pretty drawings". A sensitive designer, architectural or urban, must be trained in multiple aspects.

As long as city planners, leaders, businessmen, and legislators cling to the assumption that they are dealing with physical science, city planning cannot possibly progress (Jacobs, 1961). India must develop a system of urban development delinked from the mechanical concepts of the West and grounded in our own uniqueness. There is scope for further exploration in developing a unique style that respects the palimpsest cities, the politics of space, and humane approaches, as well as framing of pedagogy.

Urban development is evocative of Keats' poem "La Belle Dame Sans Merci"; in that the idea of development is enticing yet ensnaring. Without humanities to guide us, we too like the poet shall end up on a cold hill side, where no birds sing. A barren, concrete wasteland devoid of what makes us human.

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Sociological Perspectives in Architecture and Methods to Introduce or Reinforce them in the Curriculum

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## **Abstract:**

*Since architecture is the study and modulation of the built environment, it draws influences and learnings from other allied fields such as sociology, anthropology etc. Sociology is the scientific study of society, including patterns of social relationships, social interaction, and culture. In the context of architecture and urban planning, sociology determines different aspects such as building use or type at urban or neighbourhood level, structure and flow of communication and hence organization of spaces within the building; and use and nature of spaces not dedicated to a particular function.*

*The reverse is also true as architecture has dictated the way in which social relationships are established or work. Though intangible or indirect, human relationships and resulting culture are an important determinant of architectural design as they provide a sense of identity to the built form in an increasingly homogenized world. A holistic understanding of this relationship between the two fields of architecture and sociology will definitely help the architectural community design more sensitive and user – appropriate buildings.*

*The research paper traces the nuances of this inter – dependent relationship and demonstrates how sociology can be introduced as an allied subject in the Architectural Curriculum. It also discusses how architecture students can be oriented to the meaning and expression of socially – responsive architecture. The curriculum under consideration is that of the B.Arch. and M.Arch degree courses under the Savitribai Phule Pune University. Currently, the syllabi for these courses acknowledge social patterns and culture as a determinant of Architectural Design, and provide scope to study sociology and its relationship with architecture as an elective subject. Hence, the relationship has been demonstrated through documentation of the subject content and pedagogical processes adopted for allied elective subjects and study tours. Different study modules are described; along with their learning objectives, conduct methodology, possible student outcome and relevance in the different sub – fields of architecture such as history, urban design, conservation, design of public or institutional buildings, research etc. Possible avenues for further study and research have also been discussed.*

**Keywords:** *sociology; architectural pedagogy; vernacular architecture*

## **1. Introduction:**

Sociology is the scientific study of society, including patterns of social relationships, social interaction, and culture. The traditional foci of sociology include social stratification (caste system, racial discrimination), social class (divisions of rich – poor, urban – rural, servant – served etc.), social mobility (causes and patterns of urban – rural migration or migration due to lack of natural resources or war), religion, secularization (inter – relationship between different communities and religions), law, sexuality (male – female differences, transgender) and deviance (crimes and malpractices in society). In the context of architecture, sociology is used as a proxy for a critical approach to the connections between the architectural field, political power, and the construction, maintenance and mobilization of collective identities (Jonas, 2011).

Architecture or the built environment has many determinants - climate, geographical and geological considerations of the site, function, technological advancements of the time etc. One of the major determinants are social institutions (the pattern of relationships between individuals or groups) and the resulting culture. These dictate different architectural aspects such as building use or type at urban or neighbourhood level, structure and flow of communication and hence organization of spaces within the building; and use and nature of spaces not dedicated to a particular function e.g. Courtyards, lobbies, gardens etc. At the urban level,

sociology dictates how a city and its spaces segregate, develop and decline. Hence, architecture has a role in codifying and reproducing social identities (Jonas, 2011).

In ancient times, every major discovery or social phenomenon such as discovery of fire, farming, warfare, industrial revolution etc. has changed the way people live and work and hence the architecture of the society. In historic cities and old cores, the struggle for wealth, power and prestige has influenced the layout of the city and scale of its constituent-built form. In traditional architecture, architecture ‘expressed’ the structure and principles of a given society (Figure ). The wisdom of traditional architecture incorporated local social and cultural systems, ethics and traditions into the planning, hierarchy and articulation of spaces. Space was often defined by the role or occupation of the person and vice – versa, along with aspects of symbolic interaction – behaviour and familiarity, level of visibility and monitoring (Figure ). In the later centuries, architecture around the world has been very often shaped by sweeping world events and ideologies such as world wars, imperialism and colonization, capitalism and discovery of new worlds, revolution and socialism. These movements brought about social conflict and change, which led to the evolutionary adaptation of societies to their surroundings, discontinuation of various components or practices of the social system and a major shift in the value orientations and normative systems of various societies.

In the 20th Century, Modernism, along with major advancements in science and technology, brought about a change in the working patterns; and hence changes in the family and social structure of most population groups around the world. In today’s world of overlapping cultures and homogeneity, the influence on architecture has been no different, leading to singularity in architectural expression and language. New social phenomena such as globalization, information technology and digital services modulate the way we live, work and socialize; and hence the design of the spaces we occupy. New trends such as increasing thematization, role and importance of artificial simulation, spectacle and theatre, along with the advent of social media and artificial intelligence have also affected the design of architectural space.

The reverse is also true as architecture (spatial planning patterns and sequencing of thresholds and built – open spaces) has dictated the way in which social relationships are established or work. A marker of good architecture is often seen in the form of increased interaction and bonding between different people and communities, whereas dysfunctional planning and derelict built spaces have been proved to affect the safety and security of its occupants and contribute to an increase in crime and social malpractices.



*Figure 1: Pol Houses in Ahmedabad depict the social and economic standing of the owner (Source: Author)*



*Figure 2: Market Street at Siddhpur - the facades are reflective of the influences of the various communities which settled and traded here (Source: Author)*

## 2. Aim and objectives:

Sociology and architecture are hence interlinked. Social patterns and practices influence architecture and architecture can be used as a tool for social rejuvenation and change. A central task of a sociology of architecture should include situating architecture practice, and the objectified results of that practice, within the political – economic conditions that give rise to it (Jonas, 2011).

Hence, the research paper is aimed at demonstrating how sociology can be introduced as an allied subject in the Architectural Curriculum and how architecture students can be oriented to the meaning and expression of socially – responsive architecture i.e. how architecture is shaped by the social ideologies, systems, codes and traditions in force at the time. The paper also explores how sociology can be used as an aspect of study in subjects such as architectural history, research etc.

## 3. Scope and methodology:

The paper documents allied elective subjects and study tours conducted for 2nd - 4th Year B.Arch. students, and demonstrates the above through different study modules which can be adopted. Teaching objectives and methodology adopted are given, along with documentation of lecture content and student work.

Sociology as a theme or subject can be explored in architecture under the following heads:

- Observations in daily life – social interaction and how architecture shapes it;
- Social, religious and cultural systems, ethics and traditions dictating local or traditional architecture in India and different forms of expression of the above found in residential and public structures;
- How architecture was shaped by social movements such as gender and class segregation, war, imperialism and colonization, independence movements etc.; along with how modern social trends such as globalization and increasing use of social media affect architecture;
- Introduction of examples of socially relevant or responsive modern architecture in the 21st Century – buildings, precincts and urban spaces; including documentation of examples of how architecture has been used to highlight and heal prevalent social issues such as forced migration, street crime, drug addiction etc.;
- Study of the urban planning and architectural language of historic towns or old city cores; especially those in which distinct architectural patterns can be observed due to the presence of a single, distinct community or intermingling and evolution of the various cultures of different social and religious

communities. The paper describes the parameters of study and the working processes adopted on site, and documents the outcome.

### 3.1 Module 1 - Observations in daily life:

#### **Objectives**

To introduce how social relationships and dictums affect architecture and vice – versa;

To orient how architecture aids and promotes social interaction in daily life.

#### **Methodology**

Class discussion based on photographs of common group activities of daily life such as eating and spending time with friends being done in various architectural settings (Figure ). Aspects discussed included the level of formality being induced by the setting into the interaction, and how the setting dictates the contribution of the individual to the group interaction and forming of new – interpersonal relationships.

#### **Deliverables**

The students were then asked to observe such instances around the campus or public places in the city, document them in the form of photographs, and analyse the above aspects in them (Figure).

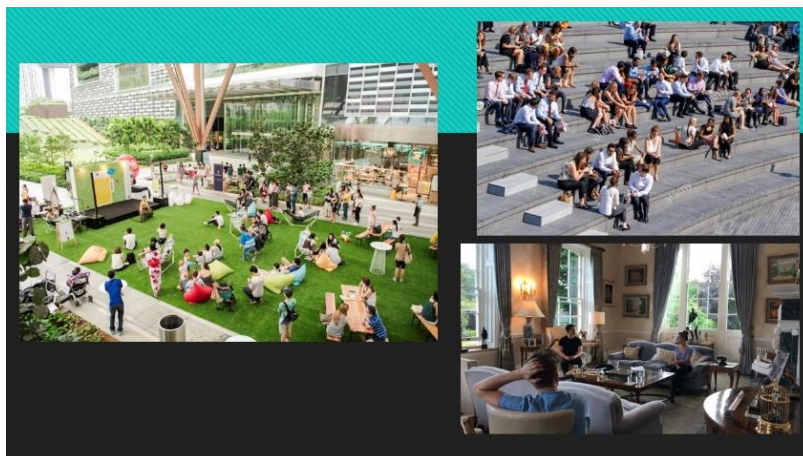


Figure 3: Comparative Photographs used for class discussion (Source: Author)

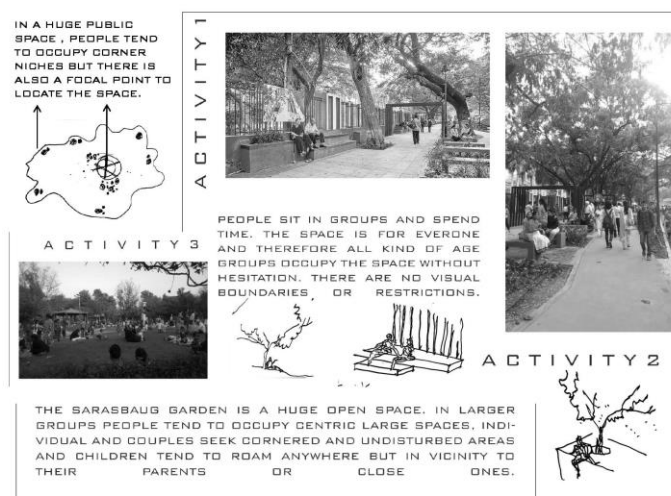


Figure 4: (Source: Sample student work - Aishwarya Dayama, 5A, A.Y. 18 - 19, ASAD, Pune)

### 3.2 Module 2 – Sociological aspects of traditional architecture:

#### *Objectives*

- To understand if and how traditional architecture is socially responsive, and what are the possible physical or architectural manifestations of a community's social practices and customs;
- To understand how cultural homogeneity and intermingling affects architecture.

#### *Methodology*

Through a lecture, the students were oriented to how various social norms, values and dynamics influenced the following in traditional architecture in India:

- **Urban layout** - proximity to a natural feature or resource; Existing land laws and social systems regarding prioritization and ownership of land; Layout of settlement based on class; nature of focal points in the settlement; class – wise construction and control of sources of water, common gathering spaces and places of worship; division of settlement into neighborhoods; and Seclusion and importance provided in the urban context to structures of death, remembrance and sacrifice.
- **House form and architectural style** - Perception of perfect forms which imitate the order of the Universe; presence of money, power, social stature and the opportunity to display it; ordering principles prescribed by ancient texts or scriptures; practiced occupation of the household; and outside influences brought by religion, trade, colonization or gender segregation.
- **Characteristics of common spaces** - Ritualistic significance of a structural member or element; location and nature of prayer rooms, presence of separate storage or sleeping areas; use of central courtyards or common spaces; accommodation of multiple functions or growing needs and family; use of murals or decorative carvings, religious symbols and scenes from daily life.
- **Social practices and rituals associated with the construction process** – Practices such as 'Shramdan' and use of the services of a 'Shapati', 'Mistry' or an Architect to design and build structures; religious ceremonies conducted on commencement and completion of construction.

#### *Deliverables*

Since the points covered were thematic or generalized in nature and not specific to any sub – culture or community, the students were asked to choose any community or tribe in India or the world, and analyse if and how their social customs and traditions have affected their architecture. They also had to document the changes in architecture modernity and irrelevance of traditional customs may have brought about in these architectural manifestations (Figure).



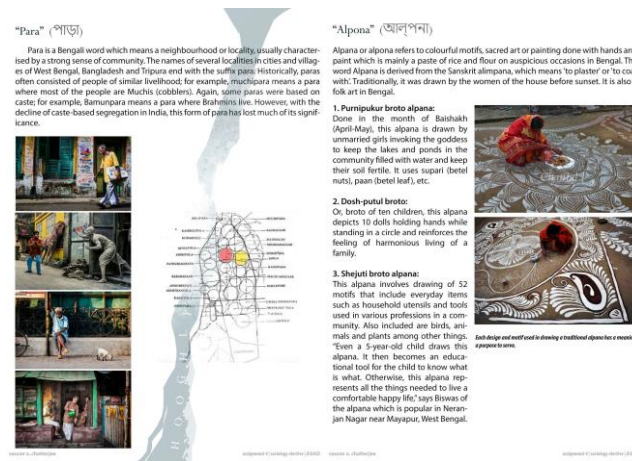


Figure 5: (Source: Sample student work - Saurav Chatterjee, 5B, A.Y. 18 - 19, ASAD, Pune)

### 3.3 Module 3 – Social movements and architecture:

#### Objectives

- To discuss various social phenomena such as changing administration and warfare, establishment of organized religion, colonization and imperialism, modernism etc. and the changes they have brought about in architecture, land use and town planning.
- To discuss current social trends and their possible effect on architecture.

#### Methodology

As a part of a lecture, various sub – themes were picked up under each phenomenon, and the same were discussed in the context of different time periods or regional contexts.

#### Deliverables

To further their understanding of the same and develop their critical thinking skills, the students were asked to choose a current social trend or issue in India or around the world E.g. Urban – Rural Migration in India’s Metropolitan Cities, Safety in Indian Cities for Women, Terrorism and Conflict regions of the world etc. They had to write a critical essay analysing the phenomena and examine if and how these issues have shaped the architecture around them.

### 3.4 Module 4 - architecture of social healing, change and participation:

#### Objectives

To raise the awareness among the students towards their role as a positive contributor towards society’s welfare and a creator of safe, hygienic, positive and socially responsive spaces.

#### Methodology

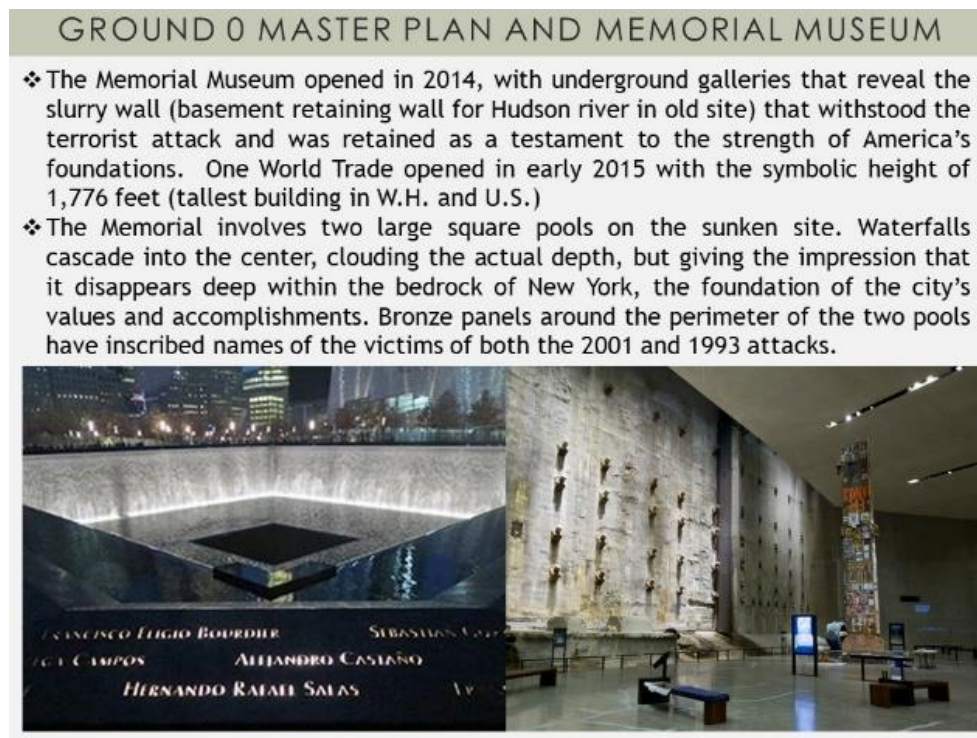
Through a lecture, the students were introduced to various architectural and urban design projects around the world that echoed the above theme (Figure). Aspects discussed included contributing event or phenomenon and how the architect has interpreted the same in the concept and planning of the building and the design of its different architectural elements. The aim of the session was to raise the awareness of the students towards their role as a positive contributor towards society’s welfare and a creator of safe, hygienic, positive and socially responsive spaces.

***Deliverables***

To further reinforce this concept, the students have to choose and study a structure or urban space whose design or re - design has influenced, highlighted or healed a prevalent social issue (Figure ).

### **3.5 Module 5: study of the urban planning and architectural language of historic towns or old city cores under theme - socio-cultural aspects – lifestyle, culture traditions and their effect on architectural design:**

This theme can be used to study historic or vernacular cities or neighbourhoods which show a continued presence of a traditional settlement pattern and architectural elements; along with an intimate and human scale of the urban fabric. Distinct variations in the same can also be seen due to the steady evolution of the town or city over time. These areas often also depict the presence and intermingling of various communities – each confined to a separate neighbourhood, and with their own religion, lifestyle, culture and traditions; which is reflected in the urban clustering and street response of the house form, along with the planning, design and construction of the individual buildings



*Figure 6: Sample slide of lecture presentation – Projects of Social Change (Source: Author)*

### Jangli Maharaj road

#### Analysis-

- Green spaces serve as buffers to segregate the two speeds of walking and cycling. Bus stops have been located so as to allow for smooth flow of pedestrians and cyclists.
- Vendors now have dedicated spaces, as do children – play areas with rubberised soft flooring have been designed at regular intervals between the green buffers. Frontage of the shops spill over to the wide footpath, adding life to the street. Better signage, street lighting and seating are other features that collectively add to revitalise JM Road.
- Streets are vital public spaces which go beyond serving as mere channels for the movement of vehicles, but are crucial to the very identity of a city. Acknowledging this fact, JM road is remodelled its streets to respond to the multitude of activities and functions they host.
- The city thus continues firmly on its course towards becoming more people-friendly by the day.



Figure 7: (Source: Sample student work - Varun Gupta, 5B, A.Y. 18 - 19, ASAD, Pune)

Based on a preliminary reconnaissance survey, different neighbourhoods can be selected. The different neighbourhoods can be studied based on a common set of parameters:

- Function, relative scale and proportion and nature of the different internal spaces of a typical house,
- Connections and inter - relationship of the different closed, semi – open and open spaces of the house – within themselves and with the abutting open space or street
- Movement or activity patterns within the house – These may vary according to gender, climate or relationship of the person with the residing family,
- Clustering profile and presence and nature of different thresholds
- Building elements such as columns, walls, doors and windows etc. – Documentation of not only the different typologies prevalent in their neighbourhood cluster, but also the different design – based attributes of each element along with associated material usage and construction technology.
- Common or community spaces formed within the cluster, along with activity patterns during different times of the day; and temporal changes happening in the space during festivals or seasonal changes

The documentation can be done in the form of drawings, sketches, photographs, analytical diagrams, videos and user interviews. Detailed discussions can also be done to analyse and understand similarities and differences between the different study areas, along with their associated culture and lifestyle patterns and derived architectural responses based on them.

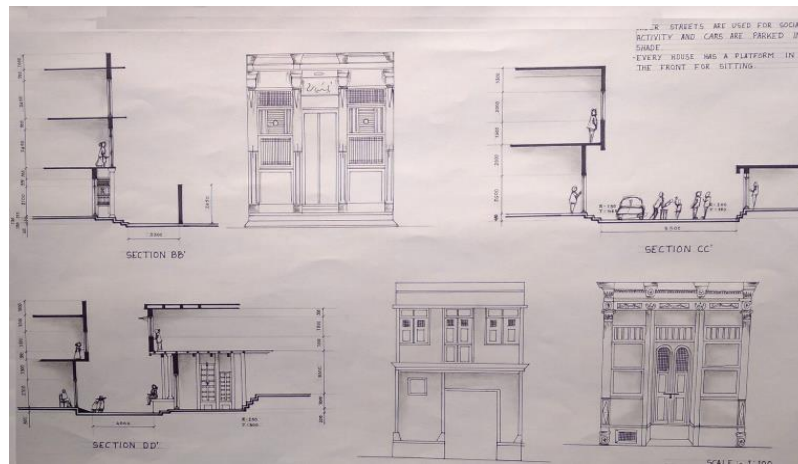


Figure 8: (Source: Street response and thresholds at Juna Bohrawad, Siddhpur, S.Y. B.Arch, 2022 – 23)



Figure 9: (Source: Documentation of different building elements, Paris Lane, Siddhpur, S.Y. B.Arch, A.Y. 2022 – 23)

#### 4. Inferences:

The table below demonstrates how the different modules are relevant in the different sub – fields of architecture

Table 1 : Applicability of different study modules in the field of Architecture (Source: Author)

Sr. No.	Subject sub – head	Sub – field or relevance
1	Observations in Daily Life	Interior Design, Design of public or urban spaces
2	Sociological Aspects of Traditional Architecture	Architectural History, research on vernacular architecture, building conservation
3	Social Movements and Architecture	Architectural History, theory and criticism, architectural research
4	Architecture of Social Healing, Change and Participation	Urban renewal, Design of public and institutional buildings
5	Study of historic towns or old city cores	Research on vernacular architecture, Urban Conservation, designing in a heritage context

## **5. Conclusion:**

Though intangible or indirect, human relationships and resulting culture are an important determinant of architectural design as they provide a sense of identity to the built form in an increasingly homogenized world. The inter – dependent relationship of sociology and architecture can be interpreted and explored in many ways in the architectural curriculum as shown above. These modules can also contribute the building of different skills such as live observation, reading, writing, verbal and graphical presentation, data collection and analysis, critical thinking etc.

The goal of the above courses was to introduce the allied field of sociology to the students and emphasize its role as a determinant of design. Hence, they provide only an overview of the different themes of exploration. Detailed research can be conducted on any of the sub – themes to go beyond mere documentation and understand the reasons behind these influences. Additional case studies can also be done and compared to understand the same sub – theme and its variations in detail.

A holistic understanding of this relationship between the two fields of architecture and sociology will definitely help the architectural community design more sensitive and user – appropriate buildings.

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Music and Architecture: Relationship through History

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## **Abstract:**

*Every country possesses their own ideals manifested in their culture. Through their lifestyle they develop systems of moral codes and norms, which are enriched with activities and customs. There are many forms of Art and these can be considered as one of the defining characteristics of Human being. Of all the arts music, architecture and literature have been major integral components of the culture. Vitruvius suggests that Architecture is characterized by three essential qualities 'firmitas, utilitas, venustas' which can be referred as 'firmness, use and beauty'. Architecture has been considered as a type of Art from the inception of the history of architectural theory and Venustas means beauty that inspire emotion of love which is a visual quality of architecture. Architecture and music come from particular country, region, and area which play a key role as a product of the culture where it belongs to. Architecture is referred to as frozen music. Many buildings and structures were conceptualized on the basis of musical parameter which substantiates that music is a source of inspiration for architectural development. India is the country with a diverse mixture of tradition and culture. Temples, churches and mosques as well as forts a part of Indian Classical architecture and different art forms like sculpture, painting, literature and music and dance form constitute this tradition and culture. This research aims to establish relationship of music and architecture as true art forms having shared common concepts and principles. It uses archival resources to find out this relationship based on historical precedents. It presents manifestation of music in architectural production chronologically in Indian and Western context. The analysis is likely to highlight various aesthetical concepts shared by both the art forms which can play an instrumental role in architectural design practices.*

**Key words :** music ;western ; architecture ; Indian ; relationship

## **1. Introduction:**

Every culture develops through the beliefs and traditions evident in different parts of the world. Architecture and Music as art forms are integral part of a particular country, region and area and also represent culture. There are many forms of Art and these can be considered as one of the defining characteristics of human being (Morris-Kay, 2010). The main objective of art is expression in the form of audio, video and performance which has inherent qualities. These have effect on human mind resulting in enjoying its values. Gaquin identified thirteen categories of art forms which include architecture and music which exist in every community, every culture and play an integral part in social life (Gaquin,2008). Architecture is characterized by three essential qualities as suggested by Vitruvius viz. 'firmitas, utilitas, venustas' which can be referred as 'firmness, use and beauty'. Architecture has been considered as a type of Art from the inception of the history of architectural theory and Venustas means beauty that inspire emotion of love which is a visual quality of architecture . Architecture is referred as frozen music where its interrelation with music is multiple (Johann Wolfgang von GoetheThe link and shared terms between music and architecture were explained by Iannis Xenakis a composer and architect (Tayyebi, 2013). Many buildings and structures were conceptualized on the basis of

musical parameter which substantiates that music is a source of inspiration for architectural development. (Xenakis, 1971).

India is the country with a diverse mixture of tradition and culture. Temples, churches and mosques as well as forts a part of Indian Classical architecture and different art forms like sculpture, painting, literature (style) and music and dance form constitute this tradition and culture. Every medium has developed its rules and regulations sharing same religious beliefs. The association of spiritual states and symbols and its process was worked out in detail (Vatsyayan K., 1991). Indian classical music referred as “Shastriya Sangeet” the Sanskrit word for music is Sangeeta which represents song (geeta) instrument (vadya) and dance (nritya) characterized by a rich stylized structure containing many musical forms. Raga is the main musical form which is pleasing to listen because of its adornment and beautification by notes (swara) and order of movement (varna) (Mahajan, 2001). Musical pillars in Vithala temple (1422 AD) at Hampi, the world heritage site, are made of granite stone when struck with a finger sound similar to the sound produced by various musical instruments.

This research aims to establish relationship of music and architecture as true art forms having shared common concepts and principles. It uses archival resources to find out this relationship based on historical precedents. It presents manifestation of music in architectural production chronologically in Indian and Western context. The analysis is likely to highlight various aesthetical concepts shared by both the art forms which can play an instrumental role in architectural design practices.

## **2. Architecture and Music as an Art Form:**

As per the traditions in the ancient past and the Middle Ages there was a term ‘artes liberales’ which included seven subjects. These seven subjects were grouped into four named ‘quadrivium’ wherein arithmetic, geometry as well as music and astronomy were the four subjects included and in ‘trivium’ there were three subject’s rhetoric, grammar and logic. Every person was expected to have knowledge of all these subjects so that they could participate in the city life. The in-depth study of the link in the two subject’s music and geometry was initiated in this period. ‘Artes mechanicae’ means practical arts wherein architecture subject was included. In this for any design the concepts of proportion and harmony were taken into consideration. The development and application of the link between music and architecture was influenced by the proposition of harmony and proportion by the great Mathematician Pythagoras. The development of form and intervention of the association of music and architecture was achieved with the help of geometrical forms and principles. Along with the seven artesliberales there was artes mechanicae which was prevalent in the Middle Ages. Dominicus Gundissalinus in the 12 century in Europe proposed applied geometry to be included in Artes Mechanicae. Today what is said as engineering in the 19th century was mechanical arts in the Middle Ages. This was done to differentiate it from fine arts and performing arts.

### **2.1 Interrelationship of Music and Architecture through History:**

The two subjects’ music and architecture have a complementary association in the built form, spatial organization and detailing. Application of concepts from music is seen in the works of great masters of architecture. All the arts in common are inspiring toward the principle of music as per Arthur Schopenhauer which largely affects the quality of an art (Tayyebi, 2013). There are some terms for design shared by both the arts. These terms encompass theme, composition, form, structure, shape, organization, cluster, articulation, development, transformation, transition, proportion, contrast, repetition, rhythm, colour, texture, contour, linear, variation, scale, meter, pitch, harmony, tactus, nuance, accent, triad, interval, tonality, detailing (Imaah N., 2004). The concept of tactus as an emphatic beat or strong accent at the beginning and the end of a musical composition appears in architecture. Tactus is the stroke in beat-time, a successive motion in singing that directs the equality of the measure. This idea is comparable to the concept of rhythm in architectural

composition, where the elements of rhythm or meter are equivalent to form, but not the same as interval, which is the equivalent of space in architecture (Imaah N., 2004).

## 2.2 Mathematics, Music and Architecture:

For many centuries the formation processes in music and architecture were influenced by Pythagoras ideas on harmony and proportion. The role of intervention and giving a definite form to the relations between music and architecture was assigned to geometry (Leopold C. E.-1., 2005).

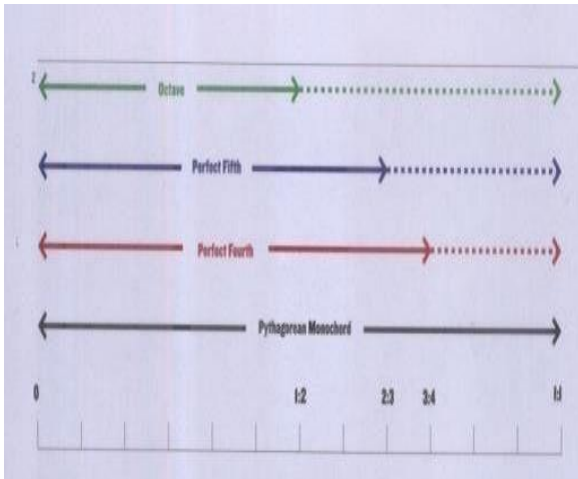


Figure 1: Pythagoras Monochord (Source: Jencks, 2013)

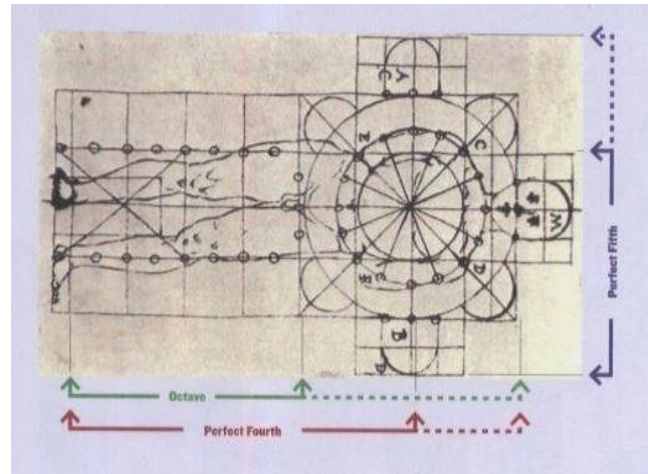


Figure 2: Diagram Showing Proportion of Human Body (Source: Jencks, 2013)

There is a connection between harmonic sound, whole numbers, perfect proportion and geometry. These ratios are demonstrated by cello the Pythagoras monochord which is said that it is tuned by God (Jencks, 2013) (see, figure 1).

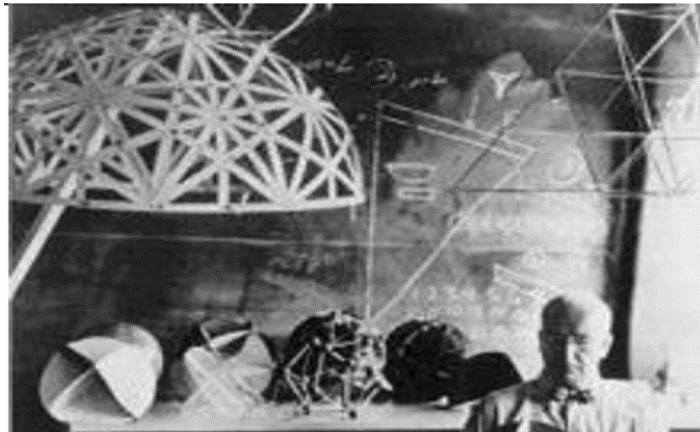


Figure 3: Diagram Showing Diapason and Diapente (Source: Jencks, 2013)

These ratios and proportions are the same as human body proportion. The same ratios were used to design the cathedral (Jencks, 2013) (Figure 2). The perfect octave (diapason), the perfect fifth (diapente) (Figure 3). Geometry helps in the process with the aid of geometrical figures, its angles, their proportions and interrelation. A structure is a composition of elements having a scientific approach for its connections, order and disposition. The name is derived from Latin word ‘structura’. The foundation of composing is built by structures. In various scientific disciplines structures indicate general systems of order, which means join together in order and is derived from the Latin notion “structura”. The definition of Mathematics is stated as general science of structures considering systems of elements and their relations or operations, Richard Buckminster Fuller for the innovative approach to composition had this above-mentioned concept at the background. “Mathematics is the science of structure and pattern in general” (Leopold, 2006). Leopold also mentions that some rules were



formulated based on geometry through the history of architecture and geometry. There were developed some rules based on geometry through history of geometry and architecture and these rules formed the principles of architectural composition.



*Figure 4: R. B. Fuller with Models, 1949 (Source: Leopold, 2006)*

Buckminster Fuller studied the arrangement of platonic solids. Then he derived the method of subdividing a sphere. All this in-depth study led to the formation of geodesic grids and geodesic domes (Leopold, 2006) (Figure 4)

As per Greek philosopher Aristotle music is a branch of Mathematics. Architecture has been described by Goethe in various ways where he considered architecture as “Frozen Music”, or “Silent Music”. Schopenhauer believed that during their creation both the arts traverse through the same places and passages and lead to abstraction ultimately. The impact of Music and architecture on each other is invariable creative and promoting which enrich the creators. Music has direct relevance with mathematics as music theorists had used mathematics in music theory for development, expression and communication of the ideas. Many composers widely used mathematical techniques in composing music from historic times. Music was also used for religious a purpose which is evident in many compositions having religious connotation and message (Bhat, Wani, Nusrat, & Anees, 2015).

The public could watch the performances of Greek comedy, tragedy, and satyr plays in built open-air theatres by the ancient Greeks. Throughout the Aegean they spread this idea to the colonies so that theatres became a typical feature of the urban landscape in all Greek cities. This concept was taken further and expanded by the Romans wherein a monumental backstage is added and made the structure more grandiose. At many archaeological sites the large semi-circular structures, still with their excellent acoustics, are visible today. A number of them remain in use not only for modern concerts and performances but also for festivals of ancient Greek drama. On the south slope of the acropolis of Athens the oldest theatre is that of Dionysos Eleuthereus which was first built in the 6th century BCE. The theatre would host the Great Dionysia, held each year in March/April, during the month of Elaphebolion, where the most famous playwrights such as Euripides, Sophocles, and Aristophanes presented their plays in competition. Its evolution was typical of most Greek theatres in other cities. At the end of the 5th century BCE a rectangular stage building was added with wings on each side. Still, only the front seats were made of stone and the rest of wood. Monumental entrances were built at the sides of the stage for the public to enter (Figure 5)

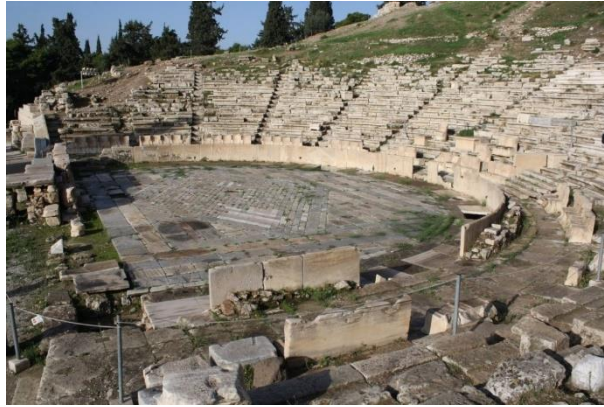


Figure 5: Theatre of Dionysos Eleuthereus, Athens ( Source : [World History Encyclopaedia](#))

### 2.3 Middle ages:

Despite complete differences in environmental situation in medieval period the traces of society and privilege of cultural issues dominated both architecture and music. In this era, the churches designed based on Vitruvius theory his description of temple and theatre design. The principles of design and consonant distance between the columns were based on acoustical science. The spacing of columns in temples was to be in accordance with the intervals between the tones of music. These principles were applied in both internal and external architectural design (Tayyebi, 2013).

The musician's space in a church had an elliptical roof the design of which was based on acoustical science (see, figure 6). The church is tented to show its honour based on the idea and privilege spirit of the age (Bruno, 1974) .The same is reflected in music wherein a single performer is substituted by chore music in churches i.e. A group of singers performing together as a group substitute with singer performances (Tayyebi, 2013).



Figure 6: Milan Cathedral, Italy (Source: Tayyebi, 2013)

The manifestation of privilege cultural issues and interaction of Music and Architecture is seen in huge scale of churches and group of singers the design of which is based on acoustical science.

### 2.4 Gothic period:

In Gothic period the composer Perotin and his group developed harmonies of three and four melodies placed one above the other.

These melodies moved in blocks creating harmonic chords which were very melodious and soothing to the ear. In the evolution of Gothic cathedrals and architectural design of Gothic cathedrals the use of this rhythmic

concept is evident as there were three or four levels one above the other like arcade, triforium, gallery and clear storey.

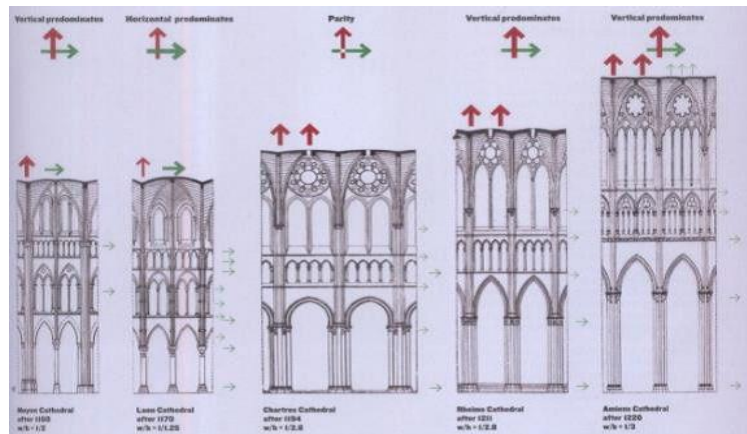


Figure 7: Evolutionary Series of Gothic Cathedrals (Source : Jencks, 2013)

In the Noyon and Laon cathedrals there are four levels which are combined into classic three at Chartes cathedral. This is further squeezed and stretched upwards in Reims and Amiens cathedral. On the horizontal part of the elevation are small mouldings which are the melodic lines. The colonnades move up in vertical direction highlighting the harmonies (Figure 7) (Jencks, 2013).

## 2.5 Renaissance period:

Renaissance the era of rebirth so called as a result of going back to ancient Greek rationalism and naturalism. After the middle-ages the society had one sided tendency towards churches, the behaviour of privileged society changed in many aspects and were more focused on secular themes. The huge scale of middle-age changed into more pleasant proportion in Architecture.

The principles of being can be defined by integers says Pythagoras the great Mathematician. He expressed that all harmonic proportions can be expressed by the integers 1, 2, 3 and 4, the numbers of "Tetraktys". There is simple instrument called "monochord" with one string tightened over a resonance box explained Pythagoras harmonic proportion, related with music. The four discovered harmonic proportion are developed to seven pleasant harmonic proportions in this era (Leopold C. E.-1., 2005). The rules of harmonic proportions in music are based on numbers (Tayyebi, 2013).

Alberti explained the importance of using these rules and applying them in architecture (Alberti, 1992). Despite more secular idea of the society, the churches remained as the most important buildings since public spaces are concerning with the generalization of individual and accordingly geometrical perfection required to reflect the musical harmony in the church buildings (Tayyebi, 2013).



*Figure 8: Santa Maria Novella Church, Alberti, 1456, Florence, Italy (Source: Tayyebi, 2013)*

The vertical, unpleasant, terrified proportion of Gothic churches changed into more pleasant and horizontal proportionate form, very welcoming in the Renaissance (period having a comparative brief look of these churches. But the harmonic proportion of music also developed both for musical and architectural usage (Tayyebi, 2013) (see figure 8).

## **2.6 The Baroque Period:**

The development in music and architecture reached its climax in the Baroque period seen more in detailing and ornamentation. Parallely cultural enhancement was also taking place. In this era a major portion of classical music improved its quality. Various complicated rhythms wherein there was development of tonality and lot of creation found in this time. Excessive decoration with their long and fluent melody was achieved by means of new playing techniques and new types of music. In a narrower view, range of musical tone, size and complexity of combination of notes were expanded in this time when opera, oratorio, concerto, and sonata as instrumental performance was initiated additionally. The two original influential composer of the time who come different tonality range in music true with their fabulous music were George Frideric Handel (1685-1759) and Johann Sebastian Bach (1685-1750) (Tayyebi, 2013).

In theatres as artistic place of art performances there is a lot of ornamentation. In musical realm there is lot of enhancement in structures and details (Figure 9). The identifiable character of this era in architecture is harmony in detail of music interpreted in architecture, and accordingly harmonic decoration (Tayyebi, 2013).



*Figure 9: Pannini, Giovanni Paolo (Source: Tayyebi, 2013)*

Utilizing curved lines and surfaces illustrating motion that is enriched by rhythm of light is the dominate characteristic of Baroque period architecture not just the in facades but the floor plans as well. Finally, under the influence of cultural advancement Extravagant decorations that are based on mathematical and geometric proportions are mentioned as the main feature of interrelation between music and architecture in this era that some of them are still in use today (Tayyebi, 2013). Architecture is referred as frozen music where its interrelation with music is multiple (Johann Wolfgang von Goethe). Iannis Xenakis, the composer explained the great linkage and identified shared terms between music and architecture.

Vincenzo Galilei, one of those who experimented first with an equally tempered scale, introduced dissonance in Baroque music. Vincenzo Galilei modulated sound into distinctive and equal musical order. Later Baroque composers evolved and progressed in the work and Johann Sebastian Bach was one of famous composers who made the change. Research indicated there is a similarity in Baroque architecture which is intricate and complicated and the intricacy in the music composed by musician Sebastian Bach. In the tempered scale there are all keys, all tones and semitones which are there in minor and major modes. This freedom of tempered scale gave a unique feature to all his compositions.



Figure 10: The church of San Carlo alle, Rome ( Source: Kilicaslan, 2012)

One of the major features of Baroque period was the use of tempered scale and the distinguishing characteristics of the compositions show a natural parallel in Baroque architecture (Tayyebi, 2013).

## 2.7 Relation of Music and Architecture in Regional Context:

In the regional context the relationship between music and architecture has been examined. Exploration is carried out to find in how many different ways is there a link between Egyptian/ Arab architecture and Egyptian/ Arab music. To achieve this method is used called defamiliarization. In this method the respondents are given a direction to observe the common things around in an uncommon way which helps to further improve the quality of the interpretation of the common things (Riad, 2009).

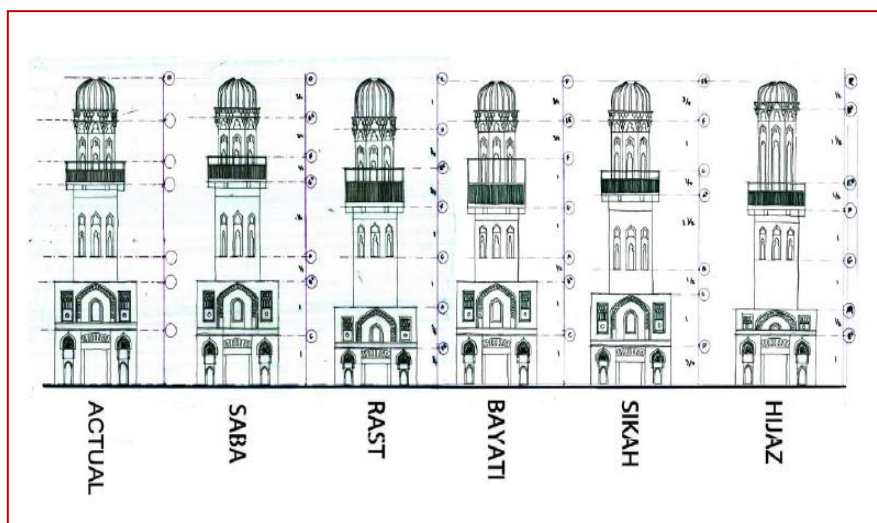


Figure 11: Minaret of Al Najm al Deen Ayoub Mosque with Maqam analysis (Source: Riad, 2009)

There are number of minarets situated along al Mui'zz el Din Street in Cairo. Riad in his research mentions that the visual proportion system of Maqam shows the application of the proportion of the maqam (a set of notes). The intervals of the proportions of all the maqams approximately match with the proportions of the minaret. “*This example demonstrated that these maqam intervals were explicitly used in the design process, and such proportionate systems exist beyond the realm of Arabic music, and could be manifest in other aspects within the Arab culture*”(refer Figure 2-15 ) (Riad, 2009).

## 2.8 Relationship of music and architecture in Indian context:

With millions of people, thousands of languages and hundreds of cities and villages, India is a land with many interesting aspects which come together to create a country that is vast and diverse but one. Having been ruled by the Mughals, followed by the British and in parts by the French and Portuguese, India has a rich and colorful cultural history. Architecture, dance, visual arts, music all form a part of the intricate tapestry of Indian life. It is a land of architectural wonders like the Tajmahal and the place where classical music has emerged and evolved. There are various forms of music and also different styles in which it is sung.

Rao R in her research has explained the demonstration of sound in the Mandala of Virabhadra Temple, Keladi in Shimoga district of Karnataka state.

The innermost point of the mandala is called the sacred bindu. The mandala has five consecutive layers of concentric circles formed of petals called Valaya. No. of petals in each layer are in mathematical progression of 16, they are of varying size and length and have particular design (see, figure 12) (see, table 1).

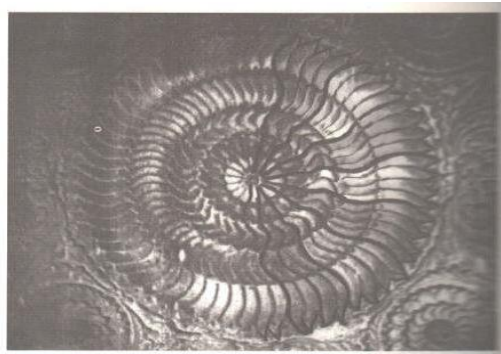


Figure 12: Fractal art (Source: Rao R., 2011)

It looks like a twisted band of design which is much embellished and decorative (Rao R., 2011).

Table 1: Description of Valaya (Source: Author)

Valaya	No. of petals	Description
First valaya encircling the bindu	16	The petals are radiating from center, have rounded tips.
Second valaya	16	They are in continuation with the first valaya but petals are bigger size, convex structure, have a hump in the middle and rounded tip.
Third valaya	32	Petals have high crest in the middle oriented in the clockwise direction and bigger in size than previous valaya.
Fourth valaya	64	Petals are long, have pointed tips, in anticlockwise direction with a hump in middle of each petal.
Fifth valaya	64	Petals have long pointed tips, clockwise direction and have a crest in the middle.

Sixteen is a sacred number of the visuddhacakra of kundalinicakras, which is associated with the element [tattva] of ether [sky], which is considered as a zone of purity and non-pollution.

Rao has mentioned that frequency, wavelength, period amplitude and speed are the properties of sound which give quality to the sound. An attempt was made by earliest Hindu atheist to provide theories on the nature of light and sound. Sound pitches [shrutis] were seen as caused by the frequency of vibrations. The mandala is a pictorial depiction of a sound wave. Artist has tried to portray a two-dimensional representation of a sound wave. The sound waves are uniformly distributed and radiate from a single point.

Like in any stationary wave pattern sound waves too have alternating patterns of nodes and antinodes. The point of no displacement is a node and a point that undergoes displacement is an antinode.

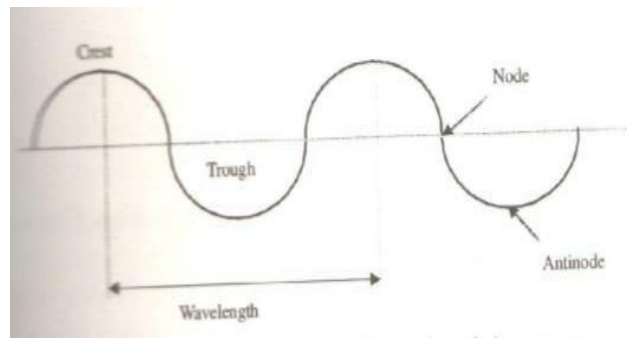


Figure 13: Figure of crest, trough and wavelength in a wave (Source: Rao R., 2011)

The parts of a stationary wave are nodes and antinodes. The midpoint of the trough is the antinodal region and the region between two consecutive bands is the nodal region in the mandala (see, figure 13).

The sound which was good to hear is called shruti and it has an association with magnitude, momentum and frequency of vibration (Figure 14).

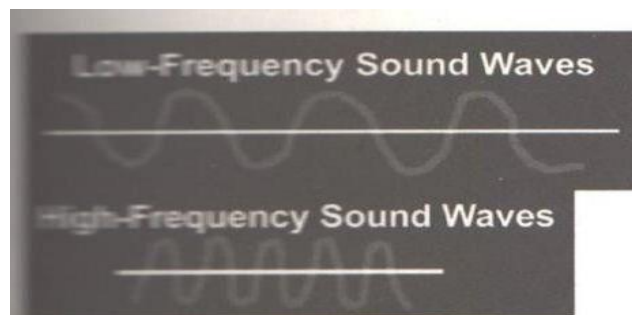


Figure 14: Associated wave curves of low and high frequency sound waves (Source: Rao R., 2011)

The ratio of a note to its octave in respect of pitch was given as 1:2. The same ratio is reflected in the mathematical progression of petal divisions as 16-32-64 (Rao R., 2011).

Dhaky in his research in the book *Concept of Space: Ancient and Modern* mentioned that Indian classical music an ancient and medieval regional art is a well-established form of music and classified into two major ones the Northern or Hindustani and the Southern or Carnatic. Evidences from the old Sanskrit texts on music suggest that the two schools preserve several essential ancient elements as well as essential parts.

“The features of both musical systems show close correspondence with the structural concepts and obvious aspects of the ancient sacred and historical buildings existing in their respective areas of origin”. Dhaky also explains that the conspicuous similarity between the characteristics of both the music systems and Northern and Southern Indian architectural styles is seen in the temple super structure. In the North Indian music style there is ornamentation in the form of mind which has a curvilinear profile, solid stances and patterns at a particular speed which finds similarity with curvilinear shikharas of the North Indian temples (refer Figure 2-24) likewise in the South Indian or Carnatic music style the movement of melodies is very structural, geometric

and have definite stages which finds similarity in the shikharas of South Indian temples which have progression like a stepped pyramid (refer Figure 2-23) (Vatsyayan K., 1991).



Figure 15: South Indian Temple Shikhara (Source: <https://www.google.com/search?q=shore+temple&tbm=isch&ved=2ah>)



Figure 16: North Indian temple Shikhara (Source: <https://www.google.com/search?q=north+indian+temple+shikhara&tbm=isch&ved>)

### 3. Conclusion:

It has been established that architecture and music are two inherently different art forms which rely on inherently different character. The strong relationship between historic designs of architectural forms is evident in large number of monumental buildings. Music and architecture are mutually influencing art forms which share a common language in terminology with architecture. Music has been a source of creativity for architecture from historic times. It has been found that musical concepts and symbols like architectural forms and spaces can convey physical meaning. Many similarities in terms of lexicon as well as semiotics were found primarily in context of Western music and architecture.

The relationship between both the art forms was established by many great masters like Pythagoras in Europe and thereafter during modern architecture movement by Jencks. These concepts of the relationship of music and architecture with an in-depth study and analysis could be applied in today's context of Architectural design.

### Conflict of Interest:

The authors have no conflict of interest to declare.



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# 03

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## **TRACK 3: TECHNOLOGY AND ALLIED DISCIPLINES**

BNCA Conference Proceedings 2023



# Investigating the Relevance of Use of Vastu Shastra in Interior Designing of Residential Spaces.

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## **Abstract:**

*Vastu shastra is a traditional Indian system which is also known as “science of architecture and a bridge between man and nature.” (Barodia, 2019) we stay in a quick developing world of human settlement and urbanization which leads to socioecological instability which generates an extreme problem of adverse local weather change and natural disaster. (Soni, 2019) Although vastu shastra is a traditional machine having a base of Vedic beginning which has an awesome affect in planning of residential spaces in accordance to nature which is high-quality for everyone, surroundings and local weather are the extra dominant elements for today’s planning. Behind each vastu guideline, there is a scientific motive that ambitions at offering a prepared and handy existence to each person. (Batra, 2018) The purpose of this research is, among other things, to hear from a wide range of people how they perceive the term "vastu shastra," its usefulness for planning, as well as user experience and generate cognizance about to carry the tradition in advance by following the strategies of planning in accordance with vastu shastra. Goal of the research is to understand how people see the application of vastu shastra science, as well as how many individuals across various demographics believe in it and recommend designing a home on its principles. A questionnaire survey examines to comprehend the perceptions of humans about use of the science of vastu shastra. Outcome of the research inferred via evaluation of quantity of people prefer to have a domestic with a perfect know-how of vastu shastra to be included in their livelihood. The research will help to know the scope of vastu shastra in nowadays lifestyles and additionally with this type of information one can generate cognizance to have a residence with a notion procedure about designing spaces and will assist people who are unfamiliar with the term "vastu shastra".*

**Keywords:** *vastu shastra, spatial science, vastu purusha mandala, environmental factors, positivity.*

## **1. Introduction:**

“Vastu shastra” has a broad range of definitions. Each one has adapted principles of vastu shastra in a different way. The term Vastu Shastra originates from the Sanskrit words 'Vastu' and 'Shastra'. Vastu means nature, surrounding or environment and Shastra signifies system. (Batra, 2018) Vastu Shastra is the result of the culture, religion and natural phenomena of India that are responsible for the welfare of human beings. (Yadav N. K., 2021) Vastu shastra a regular Indian gadget of architectural which also translate to “science of architecture”. (Barodia, 2019) according to the author Vastu shastra is a regular Indian historical science

originated from Vedas that affords guidelines and keep a harmonious condition in the constructions and enhances health, wealth, prosperity, and happiness in an enlightened environment. According to the Vastu Shastra, everything which is living in this universe holds high quality and terrible energies. And it influences nature as well as who is living in it. So Vastu Shastra is the principle that stabilizes the standard forces. There are four 'Vedas'- Rig Veda which underlines the course of 'Gyan' or Knowledge, the 'Yajur' Veda indicates the course of 'Karma' or Action, and 'Saama' Veda which illuminates the way of 'Bhakti' or Devotion. 'Atharva' Veda represents a synthesis of the above three. (Yadav N. K., 2021) Vastu shastra depends on a variety of energies that originate from surroundings like photo voltaic electricity from sun, cosmic electricity, lunar energy, thermal power, magnetic energy, mild energy, wind electricity. These energies can be adjusted to upgrade peace, prosperity, and achievements. (Batra, 2018)

Aim of the research is to look at the quantity of people knowing the term vastu shastra, its utility into planning, User experiences after redesigning or having a residential area according to standards of vastu shastra and scope for the indoors designing. the research will generate cognizance about to lift the culture ahead through following the strategies of planning according to vastu shastra. At current stage Vaastu shastra emerges again as a new fashion and fashion in Indian Architecture. As the home is the first basic need of a human being it's a want to be graph such a way that a character will feel healthy, joyful, and sparkling which one can be executed by means of perfect planning of areas with help of principles of vastu shastra. This is exploratory research, and it included a questionnaire survey conducted in online format as a methodology tool.

### **1.1 Brief history of vastu shastra:**

Vastu Vidya or the know-how of historic architecture belongs to the period of 1000-1500 B.C its traces can be viewed from the Rig-Veda where we have the proof of (Vastupati) protector of home invoked. Vastu Shastra is the part of Sthapatya Veda and subordinate to Atharva Veda. Vastu shastra evolved throughout at least 2500 years and have several texts like Kashyapa Shilpa Shastra, Brihat Samhita, Brihad Vaastumala, Vaastu vidya, Rajavallabha of Mandana Sutradhara, Viswakarma Vaastu Shastra, Samarangana Sutradhara, Vishu Dharmodhare, Purana Manjari, Manasara, Mayamata, Aparajitapccha, Silparatna Vaastu Shastra, etc. Brahma, Narada, Brihaspati, Bhrigu, Vasistha, Vishwakarma, Maya, Kumara, Anirudha, Bhoja, and Sukra are some great sages, scholar, and preachers of Vaastu Shastra. (Yadav N. K., 2021) Vaastu-Shastra deals with town-planning, the laying out of gardens, setting up marketplaces, roads, bridges, gateways, ports, harbors, wells, tanks, dams, etc. (Patra R. T., 2017)

### **1.2 Vastu Purusha Mandala:**

Vastu Purusha Mandala is the oldest model for architectural layout and planning. After choice of the land a constructing blueprint is prepared on the foundation of grids of Vastu Purusha Mandala. It truly divides the place in accordance with their activity. Vastu Purusha skill the man of universe who hold the pure energy, soul, or consciousness. (Yadav N. K., 2021) Mandala is the format which relates the orientation of the building according to the sunrises and sunset. (Patra R., 2008). The Vastu Purusha Mandala is a square plan having 9x9 grid, which mechanically helps to keep panchabhutaas in harmony, which helps to provoke the planning of a given plot of land. (Soni, 2019)



Objectives of the research are.

- To study the number of people knowing about Vastu shastra.
- To analyse how many people having houses planned according to the Vastu shastra.
- To know perceptions of people about science of Vastu shastra.
- To generate awareness among people to have a house with a proper knowledge of Vastu shastra.

### 2.3 Methodology:

This research is exploratory research and will need a mixed type of research methodology that generates a questionnaire to get information as well as structured interview (face to face) to gather different perspectives of people. By collecting responses from the questionnaire Analysis and findings would be generated.

### 2.4. Expected outcome:

Outcome of the research inferred by analysis of quantity / number of people prefer to and home with a proper knowledge of vastu shastra to be incorporated in their livelihood and also will know the scope of vastu shastra in nowadays life and also with this type of information one can generate awareness to have a house with a thought process about designing spaces and for ppl not knowing the term “vastu shastra”.

## 3. Methodology:

This is exploratory research and the methodology adopted involved an online questionnaire survey aimed to know the number of people knowing the term vastu shastra and to investigate the relevance of use of vastu shastra in interior designing of residential spaces. Respondents were students of different streams, Architects, professors, self-employees, professional workers. A sample of 100 people is considered for analysis and valid responses obtained included both male and female of different age groups. The survey instrument consisted of 13 questions and circulate in both languages “English” and “Marathi” (Local language) i.e., multiple choice questions and short answer questions focused to find out the respective outcome. The data is statically and graphically analyzed.

## 4. Analysis and Findings:

Analysis indicated perceptions of people about the use of vastu shastra in residential space. The questions circulated in online questionnaire and their responses were shared.

### a) Collège Name:

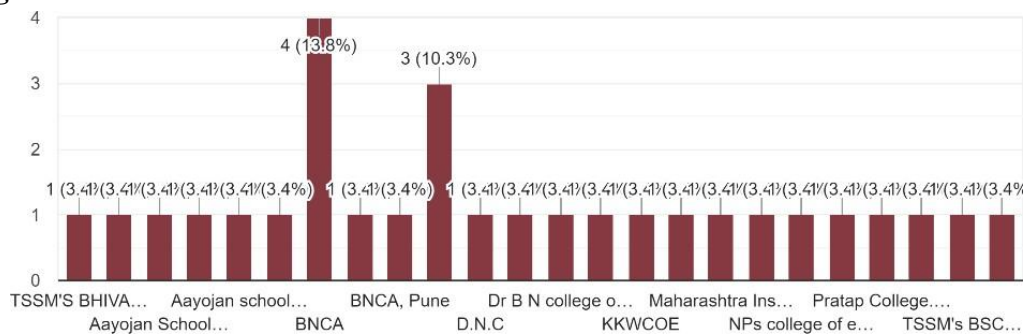


Figure 2: Graphs showing college name (Source: Authors)

Responses from various colleges are obtained. Responses are as per Fig.2

**b) Profession:**

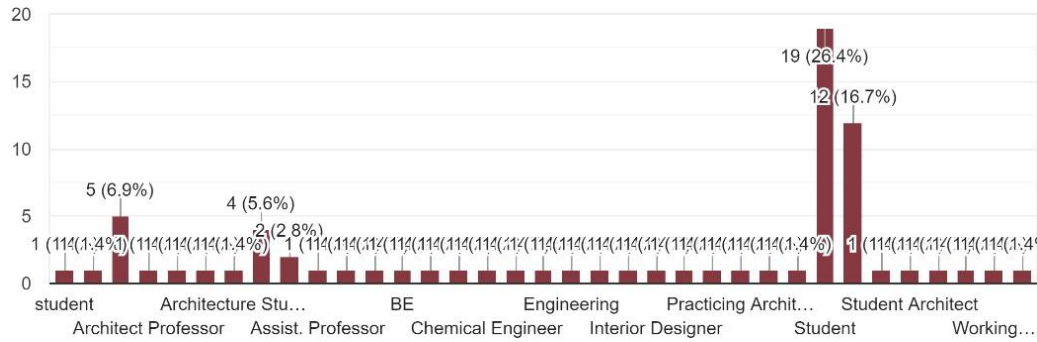


Figure 3: Graph showing profession of Respondent (Source: Authors)

Responses from people having variations in profession were collected. Analysis indicated Respondents were students of different streams, Architects, professors, self-employees, professional workers. Responses are as per Fig.3

**c) Gender:**

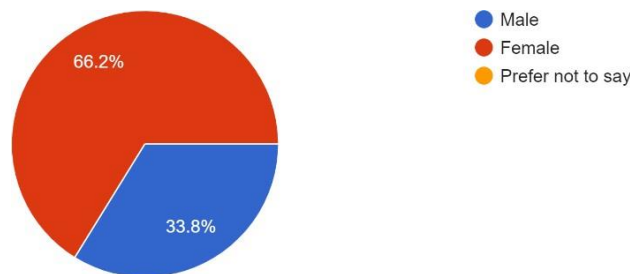


Figure 4: Gender of Respondent (Source: Authors)

**d) Age Group:**

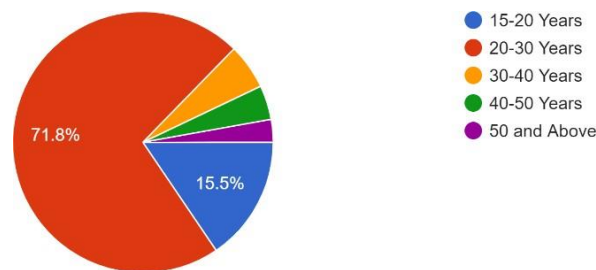


Figure 5: Age group of Respondent (Source: Authors)

The sample of 100 respondents was considered for analysis that included 65 females and 35 males belonging to different age groups as presented in fig.4 and fig.5 respectively.

**e) Do you know the term “vastu shastra”?**

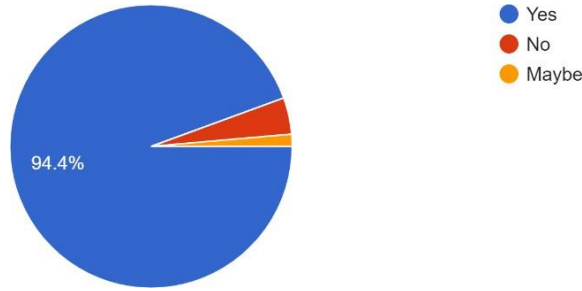


Figure 6: Responses got from people for questions above respectively (Source: Authors)

**f) Do you believe in “vastu shastra”?**

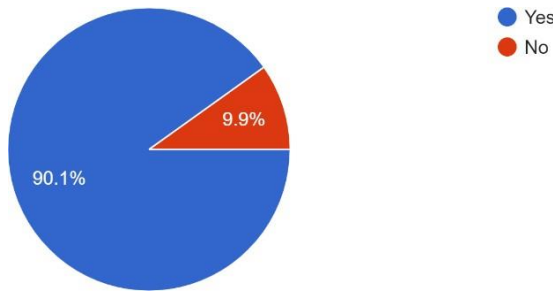


Figure 7: Responses got from people for questions above respectively (Source: Authors)

Both the questions have a major response as “yes”.94.4 % people know the term vastu shastra and 90.3 % people believe in vastu shastra. Analysis shows that a good number of people know about vastu shastra and its use. Results are as per Fig.6 and Fig.7

**g) Have you followed vastu shastra principles in your house?**

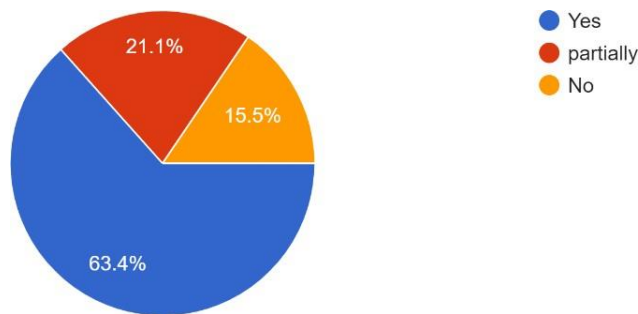


Figure 8: Respondents followed vastu shastra principles in house. (Source: Authors)

Above discern Fig. 8 suggested that a good range of number of people is aware of about vastu shastra and also, they have followed principles of vastu shastra in their houses, whilst some of them answered that they had houses designed partially in accordance to the standards of vastu shastra. Very few responses confirmed that people don't have houses according to the standards accompanied.



**h) Reason behind following vastu shastra principles?**

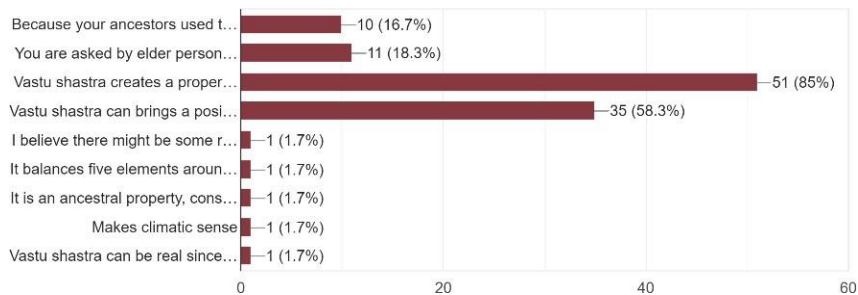


Figure 9: graph showing reasons to follow vastu shastra (Source: Authors)

According to the above fig.9 primary reason to comply with vastu shastra principles used to be people agree with that Vastu shastra creates a suited balance in the environment to make the residence a home the place one can locate mental solace. The second most important purpose was once their concept procedure stated that vastu shastra can brings a positivity. Some of them seem to be forced by using elder people in the house to observe it. And very few people followed vastu shastra due to the fact their ancestors used to observe the principles. Following diagram proves that most of the people are aware about the valid scientific purpose and good outcomes by means of having a residence according to principles of vastu shastra. Architects suggested that another reason was makes climatic sense.

**i) Do you live in house designed according to Vaastu principles?**

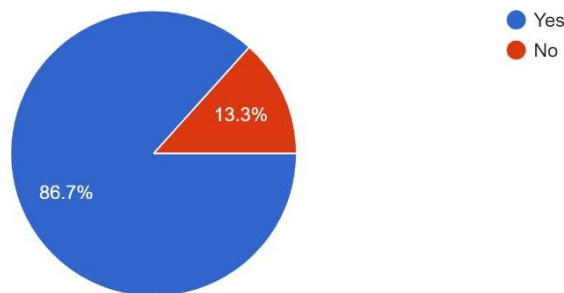


Figure 10: Respondents having house according to vastu shastra (Source: Authors)

**j) Does the concept of “vastu shastra” relate Emotions?**

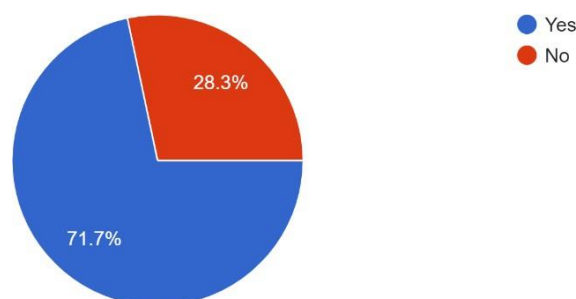


Figure 11: Response for the above question. (Source: Authors)

**k) Are you satisfied with the planning of your own house?**

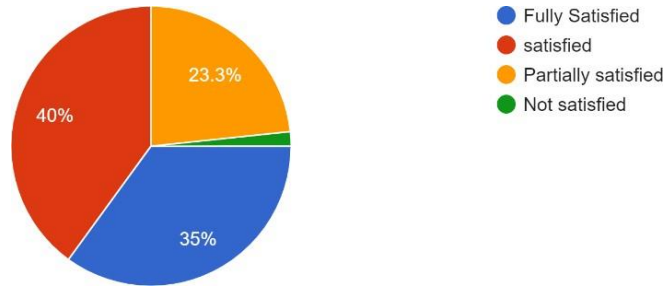


Figure 12: Satisfaction of respondents (Source: Authors)

Analysis from Fig.10 and Fig 11 indicated that people give importance to format their homes with the use of vastu ideas and it is mentioned that the thought is directly associated with their emotions .35 % people said that they were happy and fully satisfied with the planning of their houses ,while 40 % people are satisfied,23.3 % people were partially satisfied as they had only some areas design according to the vastu shastra principles, Results are as per Fig.12

**l) If vastu shastra principles are followed while designing your house, which spaces according to you are planned according to vastu shastra?**

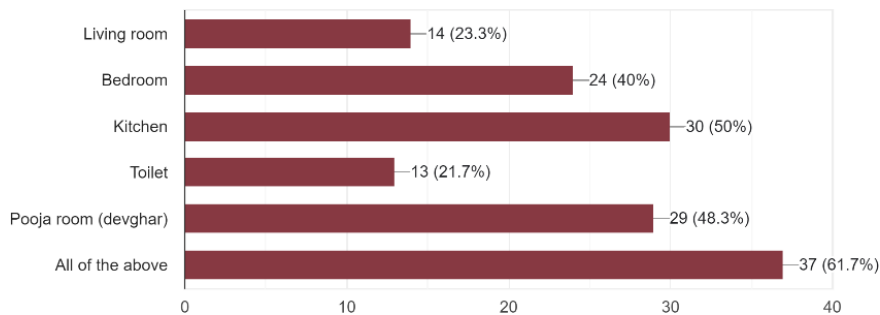


Figure 13: Showing the spaces planned according to vastu shastra. (Source: Authors)

Above fig.13 shows that according to the respondents majorly all the spaces mentioned had been planned with reference to Vastu Shastra principles. Were some respondents answered that Bedroom, Kitchen, and devghar were planned according to Vastu. Last but not least some respondents answered that the living room and kitchen were planned according to the principles of vastu.

**m) What effects do you get with having a house designed according to principles of vastu shastra?**

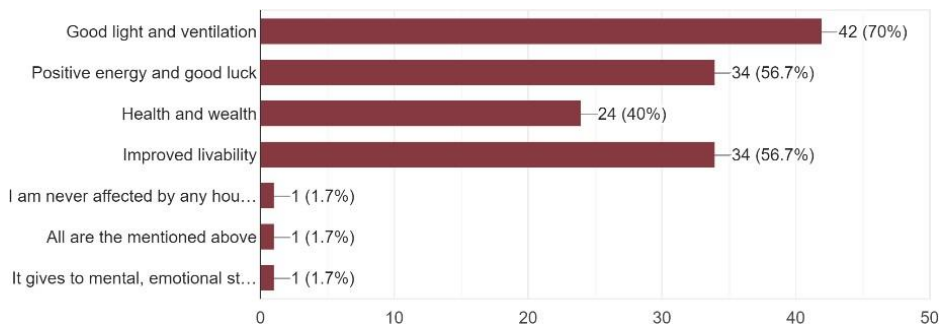


Figure 14: Showing the effects got by following vastu shastra. (Source: Authors)

Above Figure.14 indicated that the important impact got by using following vastu shastra ideas in a residence was once top light and ventilation other results acquired have been wonderful strength and right luck, accelerated livability. some of the responses had been it offers a mental, emotional stability to take right choices in life. by no means affected by way of any residence just wanted a peaceable place to continue to be with exact light and ventilation. Doesn't have to be a hundred percent vastu complaint house. from these responses we can conclude that vastu shastra is associated with emotions.

**n) According to you which living space should be planned according to the vastu shastra principles?**

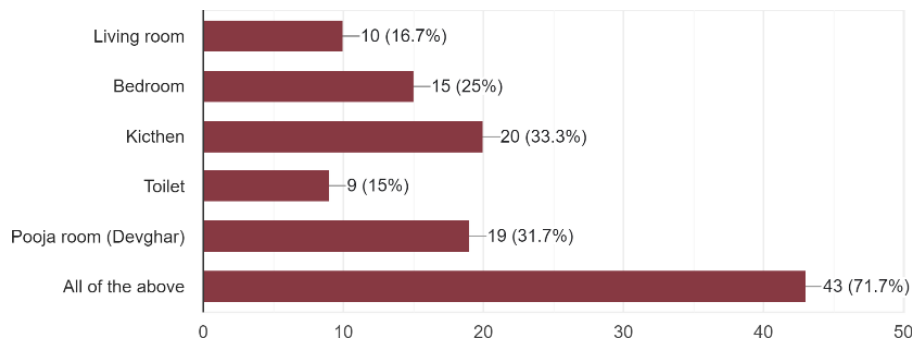


Figure 15: Showing the spaces should be planned according to vastu shastra. (Source: Authors)

Analysis from fig.15 indicated that majorly people had a whole house designed with the use of vastu shastra principles whereas bedroom area, kitchen area, and devghar had given a priority to design according to vastu shastra and living room and toilet were at second priority. Fig .12 suggested that people believe that all the areas in a residential space should be planned according to vastu shastra principles.

**o) What are the driving factors of vastu shastra do you think?**

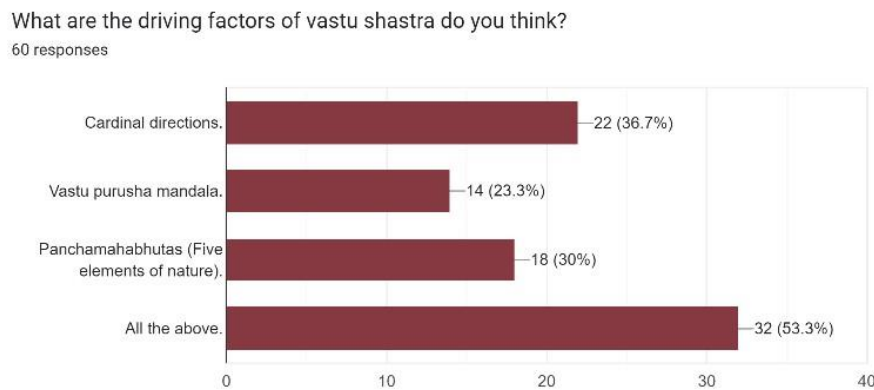


Figure.16: Driving factors of vastu shastra. Source: Authors)

Analysis indicated that cardinal directions, Vastu purusha Mandala, Panchamahabhutas (Five factors of nature) have been equally vital and had been the using elements of vastu shastra. Whereas some of the people cited that if no longer all the factors of vastu shastra are to be followed then at least cardinal directions ought to be given a thought to. Results are as per fig.16

**p) Do you have any good or bad experiences which are due to following or not following vastu shastra principles?**

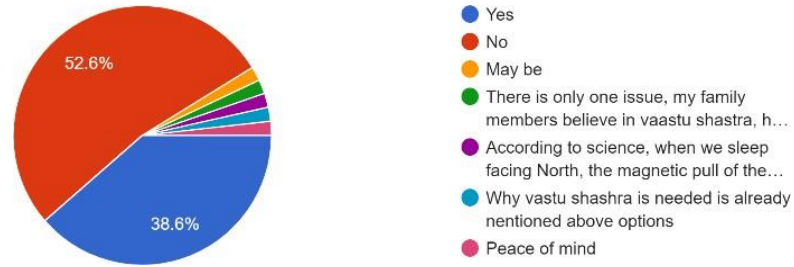


Figure 17: Showcasing information about good or bad experiences mentioned in question. (Source: Authors)

Analysis from Fig 17 indicated that 52.6 % people did not have such good or bad experiences, whereas people who had experienced stated that They got good effects and peace of mind by following cardinal directions, one respondent stated that they got forced to follow vastu shastra because their family members believe in vastu shastra.

**q) Do you recommend that people should design as per VASTU ONLY?**

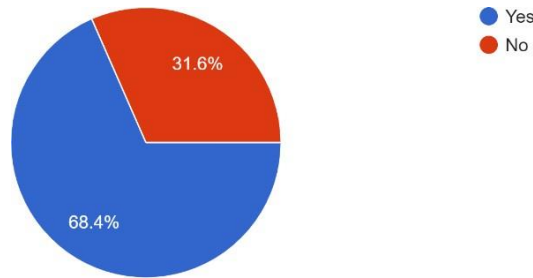


Figure 18: Vastu shastra recommendations (Source: Authors)

Analysis indicated that 68.4 % of people recommended having a house as per vastu only. These included responses from students, professors, and self-employees. some architects declared that they haven't followed vastu principles whereas some declared that they have partially followed the principles of vastu shastra and yet it is not necessary to have a house that is 100% designed according to vastu shastra principles. Results are as per Fig.18

**5. Discussion:**

Vastu shastra performs a substantial position in our life. Vastu shastra has a scientific base to its ideas and has logical and scientific brilliant results in our life. Responses got from people with exclusive age corporations it is located that by means of following vastu shastra ideas in designing we can have a residential space with desirable mild and ventilation, expanded liveability, exquisite strength, and positivity. Also, evaluation indicated that to follow vastu shastra is now not a fable it has logical and scientific reasons which performs an integral position in everyone's lifestyles and emotions.in some instances disliking to use vastu concepts is observed every now and then it is pressured to be accompanied via family members and elder person in a family.

Analysis indicated that there is recognition among people about the information of Vastu shastra, and a right wide variety of people had trust in it. Many respondents answered that they had followed the ideas of Vastu shastra in their house completely, whereas some of them have utilized it partially. According to the respondent's major cause to comply with Vastu shastra have been Vastu shastra creates a perfect stability in environment to make the house a domestic, second reason was they accept as true with that Vastu shastra brings positivity,

very few people answered that they had been compelled to follow the standards of Vastu shastra. People provide significance to structure their homes with the use of Vastu shastra principles and majority of them are happy and cosy via following it. Many people recommended that all the areas, i.e. Room areas, ought to be designed according to basic information of Vastu principles. It's been

Found that Vastu principles quicken liveability, improves mild and ventilation conditions. Brings health, wealth, and positivity. Respective evaluation inferred that it is not indispensable to have a house which is a hundred percentage designed in accordance with Vastu shastra ideas but if there is use of some information of Vastu shastra whilst designing a residential space surely it will result positively.

## **6. Conclusion:**

This research established that use of vastu shastra concepts mostly which include knowledge of cardinal directions, Vastu Purusha Mandala, Panchmahabhutas in designing of residential areas will furnish a residence with ideal health, wealth, joy, and positivity. From the above analysis and discussion, it acquired to recognize that a good variety of people had been aware about the terminology of “vastu shastra” and they had used in designing their personal residential spaces with a satisfaction. It clears that there no need at that extinct to generate recognition among people about it. Also, from discussion it bought to be aware of that the cause in the back of following vastu shastra ideas is now not solely that it is a mythology or to observe because any individual has suggested, however additionally people know about the logical and scientific desirable consequences in the back of following Vastu shastra. To conclude from the combined responses acquired from people with assorted professions it indicated that it is not necessary to have a Vastu complaint house, it is simply that to have some experience of elements of Vastu shastra principles to get superb effects and to accelerate liveability of a residential space.

## **7. Future Scope:**

The established research will help to know different perceptions of people about to follow vastu shastra concept and will be helpful to a common man to understand the basic ideology of Vastu shastra principles. Also, the research will provide opportunities to the students willing to explore the Vastu shastra as the research topic.

## **Acknowledgement:**

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## **Conflict of Interest:**

Conflicts of interest in research are situations where professional objectivity may be compromised, or perceived to be compromised, because of competing financial, personal, or professional connections or personal values and stands. In case no conflict, mention ‘The authors have no conflicts of interest to declare’.

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# Passive Design Strategies for Residential Buildings in Cold and Dry Climates

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## **Abstract:**

*As the study shows that, buildings emit 6% of the greenhouse gases and consumes more energy. And many of the researches shows that there will be energy crises in future and for the energy crises the contribution of residential sector is more. Buildings in cold climates consumes more energy and more amount of gas emission takes place because of heating required in winter season. So, improvising the thermal comfort of the residents and no use or reducing the use of fossil fuel-based system in the building is a challenge. Because of the fast development and urbanization, there is rise in using of heating and cooling system in the individual buildings. Hence studying the passive strategies and its impact on the building energy consumption in cold and dry climates is important. The results shows that different types of passive strategies and building materials for wall assembly which can be recommended integrated for the residential buildings at the time of designing itself in the similar type of climatic conditions.*

**Keywords:** *passive strategies energy consumption; human body comfort; heating systems; construction techniques.*

## **1. Introduction:**

Consumption of domestic energy in India has increased tremendously. In 2012 the It is increased from 80 TWh to 180 TWh, which equals to around 22% of total energy consumed. Buildings total floor area is expected to rise 400 percent and till 2030 it is estimated to be around by 20-billion-meter square. By 2050, it is predicted that energy consumption will increase more than eight times. So, to develop India, energy efficient strategies or the passive design strategies should be studied and should apply to the buildings to reduce the current energy demand. Passive design is design that takes advantage of the Natural Energy Sources available, climate to maintain a comfortable temperature range in the house.

## **Characteristics of Cold and Dry climate:**

The area which has cold and dry climate is in the mountainous region and has less vegetation. Solar radiation is extreme with low percentage of diffused radiation. Relative humidity is consistently low at 10-50 percent. Precipitation is also very low and it is generally less than 200mm per year. Wind is occasionally extreme. Sky is clear throughout the year; cloud cover is less than 50 percent and the temperature vary from 25 degree to -25 degree Celsius.

### **The main expectations from the Design in this climate**

- a) Resist Heat Loss from the building
- b) Promote heat gain in the building.
  - a. **To resist heat loss, below following steps can be taken**
    - Decreasing exposed surface area of the building.
    - Using appropriate material which can gain heat faster and release very slowly or it can store heat for longer duration and release heat when it is needed.
    - Decreasing the air flow or air exchange in the building.
  - b. **To Promote Heat gain below following steps can be taken**
    - By excluding shading devices or excessive shading.
    - By trapping the heat which is coming from the sun.

## **2. Case studies:**

### **2.1 LEDeG (Ladakh Ecological development Group), Leh:**

- External wall construction
- Rubble masonry with mud mortar on ground floor.
- Thick mass of earth on the wall and roof provides insulation and mass on the first floor and it is framed with timber.

#### **Passive Design Features**

- Orientation: Longer face of the building is facing north and south.
- Trombe wall is on South façade
- South wall is painted black to provide better heating.
- Cork-based weather-strips are used to seal tight all the openings
- Properly lighted with natural light in the day
- Photovoltaic cells to provide most of the night lighting.

### **2.2 Sarai for Tabo Gompa, Spiti:**

#### External wall construction

- 600mm thick rammed earth wall.
- Trombe wall is on South façade. Passive Design Features
- Minimum opening and sizes are on the South, East and West.
- Thermally massive construction.
- Centrally located courtyards covered by glass for heating of inner rooms and daylighting.

### **2.3 Airport and Staff Housing colony, Kargil External wall construction:**

- 500mm thick composite walls (300mm stone +50mm insulation +150mm cement concrete hollow block.
- Passive Design Features
- Large double-glazed surfaces on south face
- Earth beaming on the east face acts as insulation.
- Clerestory maximizes solar heat gain and daylight to all inner spaces.
- Clustered around central open spaces with maximum southern exposure.



- Terraces and glazing on the longer side have southern orientation for direct solar gain.
- Minimum opening on north prevents heat loss.
- North-side entrances provided with double air lock.

### 3. Passive Design Strategies:

#### 3.1 Orientation of the building:

The orientation of the building plays an important role in this climate. To have maximum solar exposure longer axis should be facing East towards West which will help for both heating in winter and cooling in summer. Long façade of the building is available to collect solar radiation i.e., this orientation allows for maximum glazing (windows) on the south side to capture solar energy.

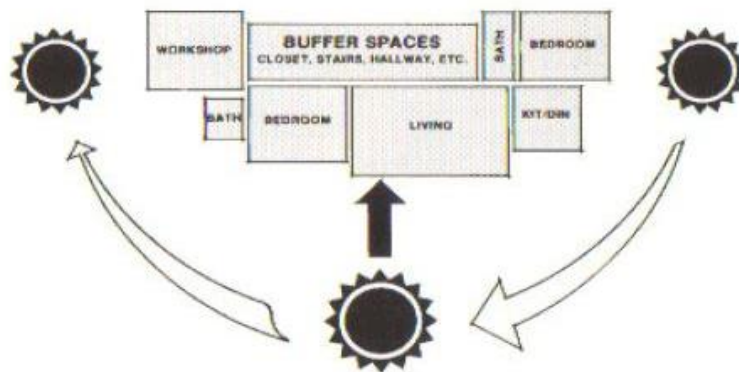


Figure 1: Orientation of the building (Source: Authors)

#### 3.2 Building Materials and Construction Techniques:

- Walls play a major role in receiving the amount of solar radiation. Building material used for the construction should be with low embodied energy and the chosen building material helps in lowering the energy levels in the building and it also maximizes thermal comfort of the occupant.
- The exhaustion of conventional energy can be lowered by using energy efficient materials, efficient building technologies. i.e. we should use locally available material.
- Heat loss control can be achieved by compact building form, high level of thermal insulation, air tightness, and earth sheltering and earth air heat exchangers.
- When Building needs Mechanical heating or cooling then building should be provided with good thermal insulation •An airtight construction with controllable means of ventilation to minimize infiltration and heat recovery from outgoing indoor air to reduce heat loss, are the options.
- Windows should be orientated in south direction, East & West direction.
- Careful consideration to joint and frame materials to minimize thermal bridges and cold air infiltration and warm air exfiltration.
- Windows should be orientated in south direction, East & West direction.
- Penetration and absorption of solar radiation into the building will depend on the colour of the external surface.
- White washed surfaces absorb 15%
- Light colours (cream or light grey) absorb 40 to 50 %
- Dark shades (dark grey, green, red etc) absorb 60 to 70 %
- Black surfaces absorb 80 to 90 %

- The air and surface temperatures of the buildings depends on the type of shading present in the building and the composition of glass is used in the windows.
- The indoor temperature of the building is 10 degree Celsius more than outdoor temperature when the external wall is thin, less resistant and when walls, externally with dark colours ,with big unshaded windows, without ventilation ,the indoor temperature may rise above 20 degree Celsius above the outdoor temperature .

### 3.3 Trombe wall construction:

Glazed outer side of external wall helps trapping solar radiation. Glazed wall also prevents convective and radiative losses, which results in higher wall surface temperatures. Eventually, it maintains air cavity between glazing and wall, above outside temperature. The warmed air tends to rise up, the warmed-up air can be endowed from cavity to adjoining room through the opening at the top of the wall and a controllable loop to withdraw air from the room can be established via openings at the bottom part. Through this process by conduction additional solar radiation is absorbed by the external wall.

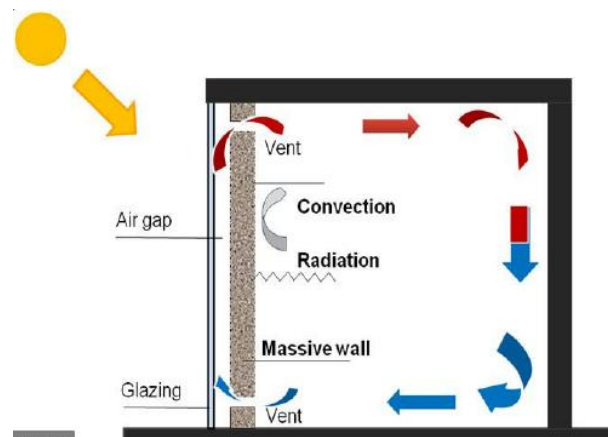


Figure 2: Trombe wall section (Source: Authors)

### 3.4 Roof Space Collectors:

Roof space collectors replace the roof cover on a south facing slopes, which we glazed to trap solar radiation. This solar radiation is then collected and absorbed inside the loft to heat air, heated air then passes to the rooms with the help of ducting and fan located inside the duct.

#### Advantages of Roof space collector over Trombe wall.

- Roof space collector has better exposure to sun than Trombe wall.
- Roof space collector does not interfere with building elevation.
- Roof space collector has low maintenance and has low capital cost as compare to Trombe wall.
- Roof space collector better suited for day time occupation.

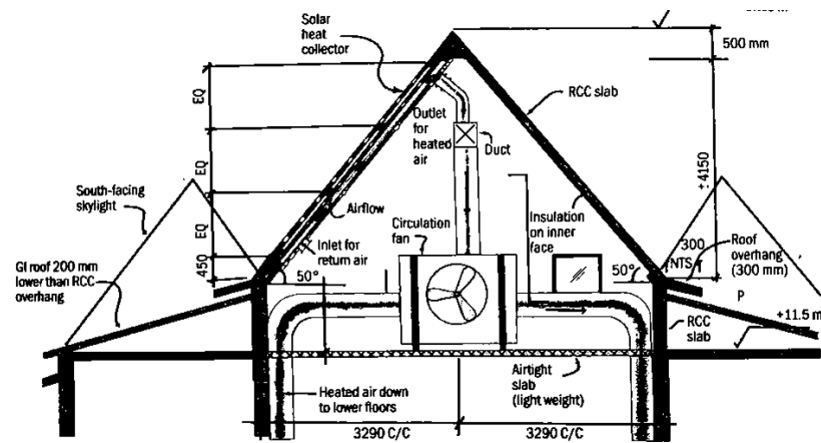


Figure 3: Roof space collector (Source: Energy Efficient Building in India)

### 3.5 Transitional Spaces:

Transition spaces are the fully surrounded space located at the centre or circumference of a building. Which are rarely in use for constant occupation and are not heated by conventional means, the glass house as a form of extended house should include a wide range of forms and sizes. Conservatory or a glass house is different from glazed walls (Trombe) and roof. It is an architectural design which is more commonly practiced as space that is veranda, essentially in a cool climate. Conservatory should be design in a way to attain and maintain temperatures suitable for occupation in maximum time in a year. Moreover, in addition to providing pleasant space and habitability, good design also implies on the parent building meaningful thermal buffering effect, without creating more exposure to unneeded excess heat in warm period. The exposed sunspaces collect the solar energy, store it and distribute it all over rooms. Sunspace heats the wind before entering the building. A sunspace different than direct gain and also Trombe wall adds a room to the buildings

**Winter season section:** A wall divides sunspace and a wall; two openings are provided on this wall. Air inside the sunspace rises upwards when heated by sunrays and endowed into the room. At the same time the cold air in the room at the lower-level moves into the sunspace which forms a cycle of hot airflow, which goes on and on.

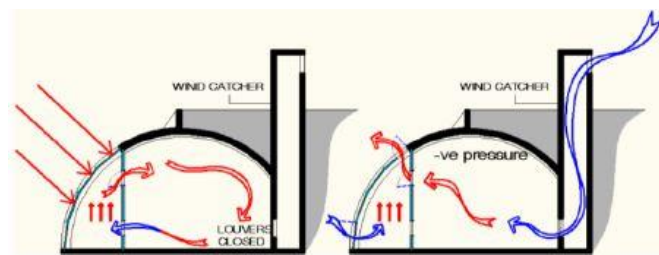


Figure 4: Section for Winter season (left) section for summer season (Right) (Source: Author)

**Summer section:** Lower-level inlets and outlets at higher levels can be used in a stacks effect in wind catcher's form. As warm air rises upwards, an open-mouthed wind catcher placed in the prevailing direction of wind draws the air inside and simultaneously the warm air created is drawn out of the room due to negative pressure. Sunspace can be ventilated in the outward direction to minimize excess heating if required. A proper, vented sunspace can function as a screened in porch, which make it open to the elements regardless of the time of year.

- To take use of the prevailing wind in summer, operable windows and vents should be kept for effective cross ventilation.
- With Sunspace we can combine earth berm and rock bed. Combination of sunspace with earth berm or rock bed can give optimum result.

### 3.6 Rock Bed:

Rock bed can be used to enlarge the thermal mass of the building and thereby it also increases the ability of building to store energy. In rock beds air is drawn from the sunspace and through the bed of rocks. Heat is given in the direction to the rocks and air is circulated in repetitive manner to a location in the hot space to collect more and more heat. At night time when the heated air is needed, Available air from the stored space is released to rooms direction coming through the rock bed, where its pickups heat and distributed back to occupied space.

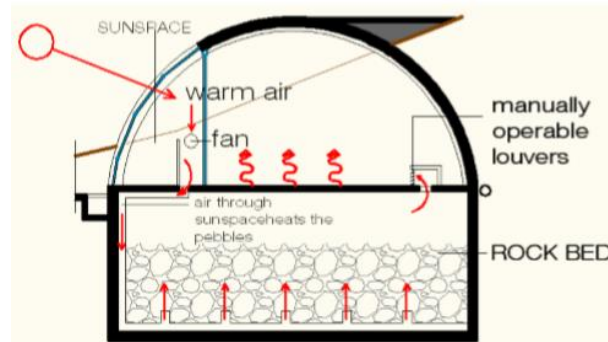


Figure 5: Rock Bed (Source: Author)

### 3.7 Earth Berms:

Earth berm is the sheltering under earth. Here for external thermal mass earth is used. It reduces heat loss, and by this indoor air temperature is maintained. Earth Berms restricts the heat loss in two ways:

- 1) By providing the resistance to heat flow of the walls, roof, and floor and
- 2) by lowering the difference between indoor and outdoor temperatures. Daily temperature fluctuations are negligible at a depth greater than (0.6m) below the earth's surface.

### 3.8 Air Lock at the entrance:

To reduce the heat losses the recessed entry or the air locks should be provided. The air lock is a small chamber consist of the two airtight doors.

External wall assemblies

#### South wall:

As per different case studies, south wall should be treated with Trombe wall

Option-01: 25mm thick Glazing + 100mm Cavity +230mm thick Brick wall plastered on both sides.

Option-02: 25mm thick Glazing + 100mm Cavity +300mm thick Stone wall.

#### North, East and West wall

Option-01: 500mm thick composite walls (300mm stone +50mm insulation +150mm cement concrete hollow block) Option-02: 600mm thick rammed earth wall

#### U- value calculation of external wall assemblies

As per the base case:

U value ( $w/m^2 \cdot K$ ) of the Opaque wall assembly should be

For ECBC compliant building: 0.34

For ECBC + and Super ECBC compliant building: 0.22

#### For South Wall construction, Considering

**Option -01:** 25mm thick Glazing + 100mm Cavity +230mm thick Brick wall plastered on both side

Table 1: U-Value of wall Assembly (Source: Author)

<b>"U" value of Opaque Skin</b>				
No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-Internal			0.123
2	Glass	0.96	25	0.026
4	cavity	0.026	100	3.846
6	12mm plaster	0.201	12	0.060
5	Brickwork dense	1.47	230	0.156
6	12mm plaster	0.201	12	0.060
7	Air film external			0.076
Total 'R' value			379	4.35
<b>"U" Value</b>		0.230 w/sqmk		

To comply With ECBC U-value needed id 0.34 So the above assembly is complying with Base case ECBC.

**Option-02:** 25mm thick Glazing + 100mm Cavity +300mm thick Stone wall.

Table 2: U-Value of wall Assembly (Source: Author)

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-Internal			0.123
2	Glass	0.96	25	0.026
4	cavity	0.026	150	5.769
6	Stone	2.92	300	0.103
7	Air film external			0.076
Total 'R' value			475	6.10
<b>"U" Value</b>		0.164 w/sqmk		
As per ECBC the U- value of wall in Cold climate should be 0.34w/sqmk as it is 24 hr used building				

To comply With ECBC U-value needed id 0.34 So the above assembly is complying with Base case ECBC  
And it is also complying with the Super ECBC.

**For North, East and West wall construction:**

**Option-01:** 500mm thick composite walls (300mm stone +50mm insulation +150mm cement concrete hollow block)

Table 3: U-Value of wall Assembly (Source: Author)

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-Internal			0.123
2	Cement concrete hollow	0.52	150	0.288
4	Glasswool insulation	0.034	50	1.471
6	Stone	2.92	300	0.103
7	Air film external			0.076
Total 'R' value			500	2.06
<b>"U" Value</b>		0.485 w/sqmk		

The wall assembly does not comply with base case ECBC

**Option-02:** 500mm thick composite walls. (350mm stone +100mm insulation +150mm cement concrete hollow block)

Table 4: U-Value of wall Assembly (Source: Author)

No.	Skin Components	K Value W/m degC	Thickness (mm)	R Value for Given Thickness
1	Air film-Internal			0.123
2	Cement concrete hollow	0.52	150	0.288
4	Glasswool insulation	0.034	100	2.941
6	Stone	2.92	350	0.120
7	Air film external			0.076
Total 'R' value			600	3.55
<b>"U" Value</b>		0.282 w/sqmk		

By increasing the insulation by 50mm, assembly is complying with Base case ECBC.

**Sunspace:**

Double glazing is used with 20mm space and the U-Value is 2.50 W/m<sup>2</sup> deg c. And it does not comply with base case ECBC.

**4. Conclusion:**

The idea of passive solar heating is simple, but applying it effectively requires attention to the details of strategic design, analytic techniques and method of construction.

Passive solar heating, also known as sun tempering, can help to reduce auxiliary heating requirements of the building around 5%- 25%.

**Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Understanding the Present State of Traditional Rajasthani Palaces with Respect to Economy Generation

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## **Abstract:**

*Rajasthan is famous for its climate responsive architectural marvels, such as forts, palaces, havelis and temples that were constructed by Rajput's. Rajasthan architecture is based on combination of Hindu & Islamic architecture. Most of these structures are under government custody or converted into heritage hotels while few have been preserved as private homes for the royal families. The objective of this research was to study Rajasthan palaces, its architectural elements in context of function, material & aesthetical elements with the understanding of the present state of traditional Rajasthani Palaces, this is to fulfil the aim of studying 'Understanding the present state of Traditional Rajasthani Palaces with respect to Economy generation'. The research is based upon the analysis of the secondary data i.e. case study and research papers. The research lists down four different types of traditional palaces i.e. GADH or FORT, MAHAL OR PALACE, BAAG or GARDEN, HAVELI. Goenka haveli is an example of utilizing locally sourced materials, traditional construction methods and passive design strategies. These are designed to create comfort in the indoors from the extreme external environmental conditions. The fresco paintings describing mythological and historical themes are well known in the havelis of the Shekhawati region. INDIA HERITAGE HOTEL ASSOCIATION (IHHA), is the association working for the conservation and preservation of these traditional palaces. Adaptive reuse of the palace as a heritage hotel is the contemporary interpretation of those traditional palaces playing vital role in the economy generations.*

**Keywords:** *Rajasthani palaces, material, elements, traditional techniques, contemporary role*

## **1. Introduction:**

A palace is a grand structure that serves as the royal residence or the home to the leader/ruler of a state. Rajasthan is widely known for its climate responsive architectural marvels, such as forts, palaces, havelis and temples that were constructed by Rajput's. Rajasthani architecture is a blend of Mughal architecture and vernacular building elements. Most of these structures are under government custody or converted into heritage hotels while few have been preserved as private homes for the royal families.

Rajasthan, the largest state in India is famous for its historically significant structures. Rajasthan was previously known as Rajputana and was a royal state ruled by Rajputs. Rajasthani architecture flourished during the sixth century. Rajasthan is a home to an incredible number of forts, palaces, and temples that are scattered throughout the state, arising from the desert, hill tops, overlooking lakes. The early Hindu way of

living is reflected in the rich culture of Rajasthan. The architecture of Palaces in Rajasthan has enhanced due to its climate, lifestyle, & available materials.

## **2. Literature Review:**

Ar. Vibha Upadhyaya (2017) discusses the four main types of traditional palaces in detail i.e. GADH, MAHAL, BAAG & HAVELI. "The architectural built form of these havelis has evolved in response to the climate, lifestyle and availability of material. These havelis are the example of sustainability in the hot and dry climate of Rajasthan. But at present due to increase in population, increasing commercial activities and changing lifestyle of people lot of transformation is taking place". Madhavi Chulet (2018) mentions about the "Shekhawati haveli in Shekhawat region of Rajasthan, those are known for their fresco paintings depicting mythological and historical themes". Her paper focuses on the climatic analysis of the havelis of the Shekhawati region; such as light, heat & dust control; courtyards; small openings; material and construction techniques to make the building energy efficient. Ar. Vibha Upadhyaya (2015) her research is all about traditional walled cities of Rajasthan, it focuses on "present condition of Rajasthan's heritage and emphasizes on protection and need of conservation to save the heritage". Manmeet Singh and Harleen Kaur (2019) their paper focuses on "the various Rajasthan structures like havelis, palaces etc. that how do they tackle the harsh hot & dry climate. It tells about the various techniques, styles and elements applied in these buildings, that can be used in modern architecture". Silpakorn university (2016) their paper observes "the different trajectories of the heritage hotel movements in India". It mentions about the concept of heritage havelis, castles, forts, palaces converted into hotels, museums, banquet hall etc. under Indian Heritage Hotel Association (IHHA).

## **3. Methodology:**

The research is based on analytical methodology comprises of secondary data study from existing sources and analysis. The research begins with search of papers related to Contemporary role of traditional palaces in Rajasthan. The secondary data is accessed from research papers and online method.

## **4. Results & Discussion:**

### **4.1 Background:**

Rajasthani architecture flourished during the sixth century. Rajasthan is considered as one of the most beautiful and bright state in India. It is home to a few of magnificent palaces and forts in the whole world. Architectural heritage of Rajasthan has been characterized by the observation of magnificent havelis, intricately carved temples and huge forts. The Rajput way of architecture is seen in cities like Jaisalmer, Udaipur, Jaipur and Jodhpur.

Mainly Bhils, Rajputs, Yadavs, Jats, Gujjars and various other communities contributed in building Rajasthan state. Presently, Rajasthan is home to various kingdoms, including Jat kingdoms, Rajput kingdoms and even Mughal Kingdom. The influence of Jain & Muslim architecture can be seen in the decoration of forts & palaces of Rajasthan.

Marwaris built huge buildings in Narwar and Shekhawati region in the between the year 1830 and 1930. The mansions are commonly referred to as Havelis. The Havelis in Rajasthan are influenced by Mughal architecture and its style.



## 4.2 About Rajasthan Palaces:

In Rajasthan, four types of traditional buildings are found:

- *Gadh or Fort*- palace standing tall on hilltops
- *Mahal or Palace* – palace that is placed on the ground level
- *Baag or Garden* - a place with landscape for recreation purposes
- *Haveli*- traditional house

### i. Gadh Or Fort:

The fort or Gadh is a palace standing tall on hilltops. The walls are fortified all around the forts. Hills, deserts, rivers, and dense forests provide natural defence for the forts. The forts in Rajasthan includes Amber fort, Nahargarh, Jaigarh fort in Jaipur, Mehrangarh in Jodhpur, Junagadh in Bikaner and Jaisalmer & Bharatpur fort etc.



Figure 15: Gadh or Fort (Source: <https://hindi.nativeplanet.com> )

### ii. Mahal Or Palace:

Alike forts, palace also exhibits the elegant architecture of the royal Rajput fortified palaces, with huge entry gates. The unique difference about palaces in Rajasthan is that they are constructed on the ground level and serve as private residences for the royal families, such as City palace, Rambagh palace Jaipur, Umaid Bhavan palace Jodhpur, Udai vilas palace Dungarpur, City palace & Lake palace Udaipur, and Lalgarh palace Bikaner etc. The Palaces and havelis of Rajasthan truly depict the rich historical background and heritage. Some palaces in Rajasthan are still occupied by the royal families as their residences.



Figure 16: Mahal or Palace (Source: <https://www.jaipurstuff.com>)

### iii. Baag:

It is a place with landscape for recreation purposes. Sisodiya Rani ka baag & Ramniwas baag Jaipur, Mandor Udyan Jodhpur, Rani Padmini Garden Chittorgarh, Sahelion Ki Bari Udaipur etc. are indeed few examples of Baags. Various areas in Rajasthan, where the previous rulers have built stunning green gardens to contrast the harsh terrain and climate of the region. Baag used to have a building compounds, water bodies, fountains, garden spaces and other landscape elements.

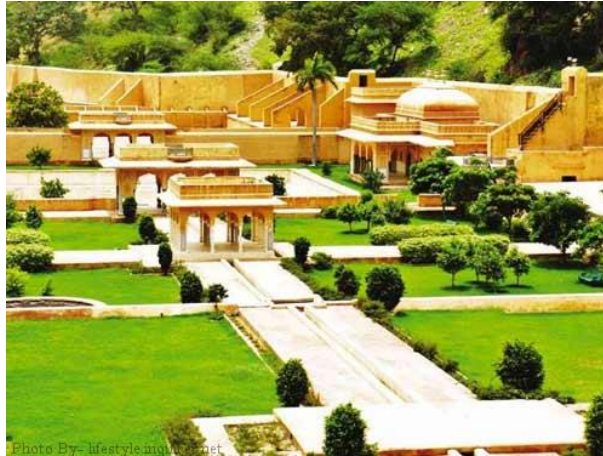


Figure 3: Baag or Garden (Source: <https://www.rajasthandirect.com>)

### iv. Haveli:

This traditional courtyard house commonly referred to as Haveli serve as large family residence for employees and public. The size and aesthetics of these havelis vary depending on the status and wealth of the family. They are designed around one or more courtyards, allowing for ample natural light and air circulation. Havelis were indeed built during medieval period in response to the demands of conservative society. Few cases are Dhabai ji ki havelis, Munshi ji ki havelis, Samode Jaipur, and Patwa havelis Jaisalmer etc. (Upadhyaya, Transformation in Traditional Havelis: A case of walled city Jaipur, Rajasthan , 2017)



Figure 4: Haveli (Source: <https://www.royalquestresorts.com>)

## 4.3 Case Study - Goenka Haveli:



Figure 5: Map of Shekhawati region (Source: <https://www.indiaunbound.com.au>)

- **Location-**

Fatehpur, Shekhawati region in Rajasthan

- **Introduction-**

The fresco paintings describing mythological and historical themes are well known in the havelis of the Shekhawati region. The built form of haveli is based upon the size of family.

- **Zoning-**

The zoning of haveli is as per the need of the user. Private, semi private and the public spaces are divided. It is designed in a way that separates business related activities from household activities.

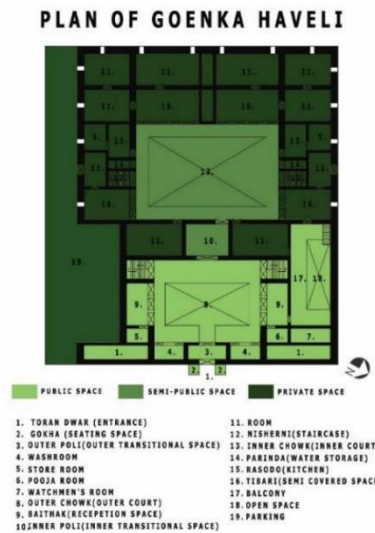


Figure 6: Zoning of the haveli (Source: Climatic Analysis of a Haveli in Shekhaw.pdf)



Figure 7: Entry and Exit (Source: <https://pixelvoyages.com>)

- **Entry & Exits**

The haveli has one common entry & exit to secure the it. Service entries are also provided for the private courtyard.



Figure 8: Walls (Source: <https://culturallyyours.com>)

- **Walls**

An internal courtyard is designed with built mass surrounding it, providing direct sunlight, induced ventilation, and temperature reduction by evaporative cooling. The surrounding walls are up to a height of 600 mm, and four of the sides have overhangs that shield that side from direct sunlight.



Figure 9 Fenestrations (Source: <https://postlmg.cc>)

- **Fenestrations**

Use of air conditioner is reduced by windows overhangs or sunshades devices. Conventional passive design methods used in haveli such as courtyards surrounded by shading projections, with some fountains to reduce the impact of wind and create a microclimate that is more favourable for human comfort. The small, recessed shaded openings in the heavily massed haveli can be opened at night for night time ventilation and cooling of the structure.



Figure 10: Roof (Source: <https://sadanandsafar.blogspot.com>)

- **Roof**

Flat roofs with light colours help in keeping the house cool by reflecting the sunlight. Orienting windows towards prevailing breezes and providing shade can enhance the airflow. Opting for lighter coloured building materials and incorporating cool roofs is a best way to minimize heat gain.



Figure 11: Courtyard (Source: <https://timesofindia.indiatimes.com/travel/destinations/shekhawati-the-painted-wonderland/articleshow/53537943.cms>)

- **Courtyard**

Courtyard are sustainable and they offer a direct connection to the natural world, allowing sunlight, fresh air, and water to enter the living space. Courtyard is oriented in a se – nw direction. Courtyard is designed with the idea of bringing people together. The courtyard serves as natural barrier against dust in the hot and dry climate. The openings of rooms are strategically positioned to prevent dust from entering the living spaces. The havelis are designed with colonnades and semi open outside the rooms to ensure that the courtyard receives sufficient light and fresh air.



Figure 12: Fresco paintings (Source: <https://www.thesocialitefamily.com/en/blog/india-shekhawati-fatehpur-le-prince-haveli/>)

**Art Forms-**

- Fresco paintings
- Mural painting
- Wood carving
- Patra work
- Stone carving



Figure 13: Hessian (Source: <https://www.poulmart.com/product/shed-nets>)

- **Construction Techniques**

450 mm thick locally available stone plastered with lime is used in construction. The columns are often made using either laterite stone or constructed as monolithic with timber like joints. Flat roofs have an insulating layer, a double-layered, 450 mm-thick stone veneer layer, and lime mortar is applied to the veneer layer. A mixture of lime, jaggery, and hesian is used to make roofing plaster.

- **Materials**

Stone is often combined with lime mortar; lime mortar is great in keeping temperature low inside the building and stone plays a crucial role in creating a time lag due to its thermal capacities. The haveli is a result of a perfect blend of available materials and skilled labour. High thermal capacity and low conductivity materials are commonly used in the construction. The three major building materials used in the walls are brick made from locally produced red clay, stone fragments and Dhandhala which is a greyish hardpan lump. (Chulet, 2018)

### **Contemporary Role of Rajasthani Palaces - Tourism & Economy Generation:**

Rajasthan truly stepped up in generating a heritage business venture by turning their ancestral homes into hotels, museums, banquet halls, art galleries etc. Ajit Bhawan palace in Jodhpur is the first heritage hotel in India. Some historic structures such as forts, palaces, haveli had been transformed into heritage hotels. Established in 1990, the Indian Heritage Hotels Association (IHHA) aims to unite all heritage hotels in the country and unite them in a common bond. In addition, IHHA has worked to prevent the deterioration of havelis, forts, palaces, and other historic buildings while offering visitors unique, cultural experiences that distinguish India as a "heritage destination of international heritage tourism." The idea of heritage hotels was accepted by the Indian government as a way to increase the number of rooms in havelis, castles, forts, and palaces while simultaneously conserving the heritage and culture of the region. These palaces are indeed used for tourism and play a prominent role in generating revenue for the state's economy. The tourism industry surrounding these palaces contributes greatly to the local economy, providing employment opportunities and boosting overall economic growth.

In Rajasthan, these palaces play a vital role in the growth of tourism industry. Few existing examples are Rambagh palace, Jaipur; Raj palace Jaipur; Umaid Bhawan palace Jodhpur. Similarly, small scale palaces/havelis such as Goanka Haveli can undergo adaptive reuse, where they can be repurposed for different functions while preserving their historical significance.



Figure 14: Umaid Bhawan (Source: <https://www.tatler.com/article/umaid-bhawan-palace-hotel-review-jodhpur-rajasthan-india> )



Figure 17: Rambagh Palace (Source: <https://www.tajhotels.com/en-in/taj/rambagh-palace-jaipur>)

## 5. Conclusion:

The research mentions that there are various types of palaces, which differ on the bases of land form, climate, structure etc. Rajasthani Palaces are the combination of Mughal architecture and vernacular building elements. One such case of GOENKA HAVELI situated in Shekhawati region of Rajasthan has been chosen. The research discusses about the architectural elements of the haveli in context of aesthetics, material & function. It also focuses on the passive cooling techniques used in haveli. These havelis are well known for fresco paintings all over the walls. At present havelis such as Umaid Bhawan are conserved by INDIA HERITAGE HOTEL ASSOCIATION (IHHA), they had converted these palaces in heritage hotels, tourist attractions, banquet halls, museums etc. Adaptive reuse of these palaces can provide luxurious experience for the tourists while ensuring historical and sustainable significance of these structures. Adaptive reuse of the havelis such as Goanka Haveli creates job opportunities, boosts tourism and generates revenue for the region. This helps in both preserving heritage and supporting economic growth. The research based on reusing structures from Rajasthani historical context can help in the conservation process for structures in Maharashtra as well as other states.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Approach for Conservation and Development of Heritage Campuses for Sustainable Futures - Case of BORI, Pune

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## **Abstract:**

*This paper focuses on an integrated approach for conserving and developing heritage campuses, using the case of BORI in Pune, India. BORI, spanning 12 acres, holds architectural, natural, and cultural significance. It emphasizes balancing preservation with sustainable development.*

*The study examines BORI's heritage value, cultural context, and potential adaptive reuse of existing structures. It also explores incorporating natural elements and landscape design for sustainability and aesthetics.*

*This research provides insights into creating sustainable heritage campuses, using BORI as a model. It advocates transforming heritage sites into functional spaces while respecting their history. The paper discusses alternative design solutions and promotes Cultural Resource Management Plans (CRMPs) that preserve both built and natural heritage.*

*CRMPs for BORI will prioritize conserving built heritage while maintaining its natural ambiance through thoughtful landscape design. In summary, this paper offers a holistic approach to heritage campus conservation and development, emphasizing sustainability and cultural preservation. CRMPs play a crucial role in achieving this vision and warrant further research for refining amenity introduction criteria. The integration of cultural and natural heritage in such plans promises a vibrant and sustainable future for heritage sites.*

**Keywords:** *heritage conservation, heritage development sustainable development, adaptive reuse, landscape design, cultural context, natural heritage, cultural resource management plans, built heritage, preservation strategies*

## **1. Introduction:**

Preserving heritage sites within architecture is of paramount importance, as they embody cultural and architectural legacies for future generations. This paper centers on the Bhandarkar Oriental Research Institute (BORI) campus in Pune, India, as a poignant case study for academic pedagogy and sharing the learning's with architectural fraternity. BORI, spanning 12 acres, encapsulates not only built heritage but also landscapes, nature, and cultural heritage. The research paper aims to formulate an integrated approach to the conservation and development of such heritage campuses. It seeks to harmonize historical preservation with contemporary needs by analyzing BORI's heritage value, cultural context, and potential for adaptive reuse. Ultimately, the paper endeavors to contribute insights into creating sustainable and culturally resonant heritage spaces.

The Ramkrishna Gopal Bhandarkar Oriental Research Institute, located in Pune, was established on July 6, 1917, to honor his name and contributions to the field of Orientology in India. The Institute focuses on Orientology research with the goal of educating the world about the all-encompassing knowledge created in the East, particularly in India. With more than 1, 25,000 books and more than 28,000 manuscripts amassed



over a 90-year period, the institute possesses one of the biggest collections of rare books and manuscripts, encompassing virtually every area of Orientalology. ( World Architecture News, 2020)



Figure 1: BORI Main Building Source: [www.bori.ac.in](http://www.bori.ac.in)

The architectural style of the Bhandarkar Oriental Research Institute (BORI) building in Pune, India, is primarily influenced by the Indo-Saracenic architectural style, with a strong Neo-Gothic component. Indo-Saracenic architecture emerged during the British colonial period in India and sought to blend Indian architectural traditions with elements from various Islamic and European styles. In the context of the BORI building, the Neo-Gothic features, such as pointed arches and intricate carvings, are integrated with Indo-Saracenic elements like domes, minarets, and jalis (intricately perforated screens). This fusion creates a unique architectural identity that symbolizes the cultural amalgamation of the era.

The BORI campus, with its Indo-Saracenic and Neo-Gothic architectural influences, serves as a significant case study for understanding the complexities of architectural styles during colonial times and their impact on heritage preservation and conservation. This blending of architectural traditions speaks to the historical context and the multi-layered history of the region. As the research paper aims to develop a comprehensive approach to conserving and developing such heritage campuses, the analysis of the Indo-Saracenic and Neo-Gothic architectural elements within the BORI building underscores the importance of acknowledging the diverse influences that shape a site's character.

## **2. Sustainable Framework for Heritage Campus Conservation:**

In the realm of sustainable architectural design, a holistic approach that considers architectural, cultural, and environmental factors has emerged as a fundamental paradigm. (A, 2018) This approach acknowledges the interconnectedness of these factors and underscores the importance of addressing them collectively in the design process (Brown C. , 2019) Architectural factors encompass the structural and functional aspects of a building, while cultural factors recognize the significance of contextual and societal elements in shaping architectural choices (Jones, 2017) Moreover, environmental factors emphasize the need to minimize the ecological footprint of architectural projects, fostering sustainability and resilience (Gupta, 2016) By synthesizing these dimensions, architects can create designs that not only respond to local cultural values but also promote environmental stewardship, ultimately yielding more inclusive and sustainable built environments (Doe, 2018)

### 3. Approach to Redevelopment of heritage campuses:

The research methodology for the academic partnership between BNCA and BORI (Bhandarkar Oriental Research Institute) involved a multifaceted approach. First, stakeholder interviews were conducted to gather insights and perspectives from individuals directly involved in the partnership. This qualitative data helped in understanding the motivations, expectations, and challenges faced. Next, discussions with experts from both academia and the field of sustainability were conducted. These expert opinions provided valuable insights into the academic partnership's potential impact and feasibility.

The approach to Redevelopment of heritage campuses often involves preserving the historical significance of the site while adapting it to modern needs. There are various approaches, with adaptive reuse being one of the most common and widely accepted methods.

**Adaptive Reuse:** This approach involves repurposing historic buildings for new functions while preserving their architectural and cultural value. Adaptive reuse can include converting old factories into loft apartments, turning churches into community centers, or transforming industrial sites into cultural hubs.

**Historical Restoration:** This approach focuses on restoring heritage buildings to their original appearance and function. It often requires extensive research and attention to detail to ensure historical accuracy.

**Reconstruction:** In cases where heritage buildings are severely damaged or lost, reconstruction can be considered. This approach involves recreating historic structures based on historical records, photographs, and archaeological findings.

**Conservation and Preservation:** These approaches prioritize the protection and maintenance of heritage sites in their existing state, preventing further deterioration. Conservation aims to stabilize and protect the site's integrity, while preservation aims to maintain it in its current condition.

**Heritage Interpretation:** This approach focuses on making heritage campuses accessible to the public through interpretation programs. It involves creating visitor centers, signage, and educational materials to help visitors understand the historical and cultural significance of the site.

**Sustainable Redevelopment:** Integrating sustainable design principles into heritage campus redevelopment can help reduce the environmental impact while preserving the historical character.

**Community Engagement:** Involving the local community in the redevelopment process is crucial. Participatory planning and community engagement strategies can help ensure that the redevelopment aligns with the community's values and needs.

### 4. Case of Adaptive Reuse:

**Bori Institute campus – Successful case of adaptive reuse of the Press Building as Auditorium. Designed by Group Phi Architects, Pune:**

The Bhandarkar Oriental Research Institute (BORI) is a Heritage Grade I structure. The campus consists of Tata Hall, Nizam's House and Press building. The Press building was built in 1933, used for storage of manuscripts & their printed volumes of Ramayana & Mahabharata. ( World Architecture News, 2020)

BORI lacks a consistent income source but possesses a prime location in the city with ample parking. Therefore, the concept of adaptively reusing the press building as a Heritage Auditorium with cutting-edge facilities emerged. This would serve as a valuable asset for Pune's residents, extending beyond preservation

and conservation. The existing structural limitations were creatively incorporated in line with heritage guidelines. To refurbish the 87-year-old building, the existing truss was reinforced to support additional HVAC ducts. The original floor level remained unchanged, allowing efficient incorporation of tiered seating for the auditorium. Sound control measures were introduced at the mezzanine level, and an AHU (Air Handling Unit) room was positioned above the green room to accommodate the new purpose without compromising structural integrity.

The design process involved local craftsmen to create paintings on canvas which are inspired from the collection of manuscripts available at the BORI. These manuscripts are from the 16th and 17th century. It reflects the institute's identity, individuality and rich heritage. Artisans are involved with expertise in traditional stone masonry techniques and timber roof construction. The project is unique and all citizens of the city are utilizing this space beautifully as heritage auditorium. Propose strategies for preserving and repurposing existing structures to meet contemporary needs while retaining their historical character.



Figure 2: BORI Auditorium Source: [www.worldarchitecturenews.com](http://www.worldarchitecturenews.com)

### Integration of Natural Elements and Landscape Design:

Within the BORI Campus, the specialty of this open-air theatre, is that an 83-year-old banyan tree will be at its center. In 1937, this tree was planted by Vajinath Kashinath Rajwade, the then executive chairperson of the institute. Just like the work of the institute, the tree has grown and expanded over the years. Approximately two years ago, the construction of the open-air theatre around this iconic tree started and now it is to be completed. The institute hoped this theatre, which will be able to accommodate 2,000 people, will be a cultural center in Pune and a revenue source. Nachiket Patwardhan, a senior architect, designed the theatre, which was inaugurated in March 2021.



Figure 3: Samavasaran – Open Air Amphitheatre Source: [www.bori.ac.in](http://www.bori.ac.in)

## 5. Sustainable Framework for Heritage Campus Conservation:

In the realm of sustainable architectural design, a holistic approach that considers architectural, cultural, and environmental factors has emerged as a fundamental paradigm. (A, 2018) This approach acknowledges the interconnectedness of these factors and underscores the importance of addressing them collectively in the design process (Brown C. , 2019) Architectural factors encompass the structural and functional aspects of a building, while cultural factors recognize the significance of contextual and societal elements in shaping architectural choices (Jones, 2017) Moreover, environmental factors emphasize the need to minimize the ecological footprint of architectural projects, fostering sustainability and resilience (Gupta, 2016) By synthesizing these dimensions, architects can create designs that not only respond to local cultural values but also promote environmental stewardship, ultimately yielding more inclusive and sustainable built environments (Doe, 2018)

Academic institutions play a pivotal role in advancing the exploration of alternative design options through student projects (Smith, 2019). These institutions serve as fertile grounds for cultivating fresh ideas and fostering creativity in budding architects and designers. Student projects within academic environments not only encourage experimentation but also provide a platform to test and refine innovative conservation and development ideas. (Brown C. &., 2020) By engaging in real-world design challenges, students can apply theoretical knowledge to practical scenarios, resulting in the generation of creative solutions (Johnson, Interdisciplinary Collaboration in Academic Environments: Fostering Innovative Design Solutions., 2018) Moreover, the multidisciplinary nature of academic settings encourages collaboration between students from various disciplines, further enriching the diversity of ideas and approaches (Gupta & Patel, 2017). As a consequence, academic institutions serve as incubators for progressive design thinking and contribute significantly to the evolution of sustainable and innovative solutions in the field of architecture and design.

## 6. Recommendations and Future Research:

The integration of cultural and natural heritage preservation in Cultural Resource Management Plans (CRMPs) is a promising approach. To ensure its effectiveness, future research should focus on refining the criteria for introducing amenities at heritage sites.

Cultural Resource Management Plans (CRMPs) will be developed with a strong focus on conserving the built heritage within the context of the natural heritage. The intention is to maintain the natural historic ambiance of these sites through thoughtful landscape design. Furthermore, the introduction of amenities such as restaurants, cafes, libraries, kiosks, exhibition spaces, information centers, and souvenir stores will be allowed

in accordance with designated criteria (DCNs). Adaptive reuse of existing structures will also be considered, based on feasibility assessments. Temporary structures made of eco-friendly materials will be permitted for events and exhibitions. Additionally, temporary public art installations will be encouraged, contributing to the dynamic cultural environment of these heritage sites. (Delhi Development Authority, 2021)

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Exploring Architecture Elements of Iskcon Temple

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## **Abstract:**

*Iskcon Temple is a spiritual and religious centre in India dedicated to the worship of Krishna. It is one of the most popular pilgrimage sites in India and has existence since 16<sup>th</sup> C.E. The Iskcon Temple has gone through stages of evolution over the years. The Temple elements and designs have been evolved with more elaborate structures and details. Generally, the Temples sites are a large complex with variety of Temples, shrines and other structures with walls and pillar added with intricate carvings.*

*The aim of the research was to understand the exploring architecture elements of Iskcon Temple. Which was achieved through the study of what is Iskcon Temple philosophy of Iskcon Temple, planning and common elements of Iskcon Temple. The research methodology adopted was analytical with secondary data from books and internet and primary data from Iskcon Temple, Pune. As the Pune was my limitation of my research*

*The research talks about the Iskcon Temple was founded in the 16<sup>th</sup> C.E. by Chaitanya Maha Prabhu a spiritual leader who propagated the worship of Krishna. He established the Temple in a Puri, a small town in the state Orissa. It was initially a simple structure with few basic rooms and a small shrine. Over the years the temple has been expanded with more elaborate detailing and planning. The Iskcon Temple known for its intricate architectural grandeur. It has been observed that the Temple styles are built in traditional Rajasthani style with walls and pillar adorned with intricate carving. It has also been evolved to match with modern trends and technologies. The Iskcon Temple is a living testament to the power of faith devotion and it is likely to continue style in future.*

**Keywords:** *Iskcon temple; intricate carvings; pilgrimage sites; elaborate structures*

## **1. Introduction:**

This research explains the exploring architecture elements of Iskcon temple and how it is expanded with elaborate detail and planning of Iskcon temple. Iskcon Temple is a spiritual and religious center in India dedicated to the worship of Lord Krishna. It is one of the most popular pilgrimage sites in India and it has been in existence since 16<sup>th</sup> C.E. This research aims to explain the planning, architectural styles, elements of Iskcon Temple. Iskcon temple was built in 1975. Iskcon temple was initially used as a place of worship and meditation. Generally, the Temple has gone through various stages of evolution over the years. Over the years temple elements and design have been evolved, with more elaborate structures detailing planning. The temple has also seen changes in its ritual and its overall purpose, becoming a center for both spiritual and cultural activities. The Iskcon temple has become popular pilgrimage site, with thousands of devotees visiting the temple each year. The temple has been home to various festivals, such as the Rath Yatra, Janmashtami etc. and has become a cultural center in India. The Iskcon temple has continued to evolve and develop over the years and today it is one of the most pilgrimage site in India. The temple is now a large complex, with variety of temples, shrines

and other structures. It has been observed that the temple built in grand structure with traditional Rajasthan style with walls and pillars intricate carvings. It has also been evolved to match with modern trends and technologies. The Iskcon Temple is a living testament to the power of faith devotion and it is likely to continue style in future.

## 2. Literature Review:

John Sahy (2018) mentions in his article ‘Vedic culture in Iskcon Mayapur’ “That Mayapur has been catalyst for dramatic social economic and urban development. It describes how recourse to Vedic culture in Mayapur and understanding what was meant by Vedic culture.” Mansbroo (2022) discusses in his paper explaining “The relationship between Iskcon and Science the article asks what the motivation for challenging Darwin what the consequences of it are for movement often taken to be a fundamentalist one.” Arjun Mukherjee, Sanghamitra Basu (2015) this research paper analysis “Architectural languages employed in designing contemporary Hindu Temple. Iskcon Temple Sri Radha Parth Sarth (1988) by Achyut Prasad Kanvinde with impressive ornamentation on the shikhara. These ornaments do not form the fabric of the structural members; thus, a degree of complexity is created double-coding of both tradition and modernity.” Nurit Zaidman (2000) this paper focused “The relationship between Indian immigrants and Iskcon in us and developed a social culture development.” Dr. Rajeshkumar Sharma, Ms. Sandhya Dixi “The environment all over the world, and particularly in India, is passing through hard times. India is facing the problem of pollution which can be noticed more or less everywhere. Iskcon is teaching its devotees about environmental crisis, and thus, to motivate others to observe cleanliness and perfect hygiene.”

## 3. Methodology:

In this research paper Descriptive Analytical method is used. The systematic literature review has been explored through research papers. The data collection is done by primary and secondary data collection. The primary data collection is collected through live case study, site visits and the temple elements are documents and collected in the architectural element’s arches, carvings, materials, is documented. Secondary data collection is collected through articles, research paper and online methods. Analysis of research paper based upon primary and secondary data collection then the whole research is concluded with whole research data.

## 4. Result and Discussion:

### 4.1 Secondary Data Collection:

#### Iskon Temple Delhi:

**Location:** Shri Radha Parthasarathy temple, complex, Sant Nagar, new Delhi.



Figure 1: Overall, View of Temple (Source-Wikipedia)

The plot area size is 3 acres approximately. The complex oriented at east west direction. It has hard and rocky soil. “The temple is situated on a sloping site and covers an area of 3 acres with slope of 8 m”

#### 4.1.2 Landscape Features:

Water bodies have been provided. Oat is available near the plantation area, as well as near water features and fountains. The trees have been grown in a landscape pockets pediments, along the circulation and foundation plantation. The plantation is done along boundary of an idol and temple. Ornamental plantation has been done in the plantation, with various flowering plants with vivid textures and colours creates a contrast to an area. There are waterbodies in an entrance. The waste water is drained along the natural slope of 8m



Figure 2: idol along fountain (Source: <https://www.expedia.co.in/ISKCON-Temple-East-of-Kailash.d6074798.Attraction>)



Figure 3: slope of land (Source: Wikimedia Commons)

#### 4.1.3 Architectural Analysis of Feature:

The temple complex is divided into two zones which includes one temple and the other involves the functions separate by landscape court in between at the intermediate levels one finds the shopping area and shoe keeping area from the central court there is main halls and a special kitchen. There are two parikramas one around the deities and the other around the temple complex as a whole. As the highest spot of the site has been allotted to the main temple deity (facing an east west direction) the hierarchy of the buildings have been so beautifully placed around it that it gives the expression of unified whole structure.



Figure 4: Landscape pocket (Source: Temple)





Figure 5 Views (Source: Isckon Temple Delhi.pdf)



Figure 18 Site plan (Source: Isckon Temple Delhi.pdf)

1. The Temple
2. The Museum of Vedic Culture
3. The Centre for Vedic Studies
4. The Vedic Centre for the Performing Arts
5. The Ashram
6. Krishna Jayanti Park

#### 4.1.4 Planning: Main Hall:

The main hall entrance of the temple is in North east direction. The main temple hall which has highest part of temple complex. The entrance is created in a such way that it has a modern version of the traditional Torana. It has 3 shrines inside a temple. “The steps near the entrance have been bifurcated to facilitate separate entry and exit during crowded hours. The material used for the flooring of the main hall is white marble and black granite.” (Himani Bhargava) The ceiling of the hall is such a way that whose periphery and the central part of a ceiling are octagonal with 64 triangles joined together and form a dome which also create a part of ventilation purpose. There are two entrance and windows towards eastward side

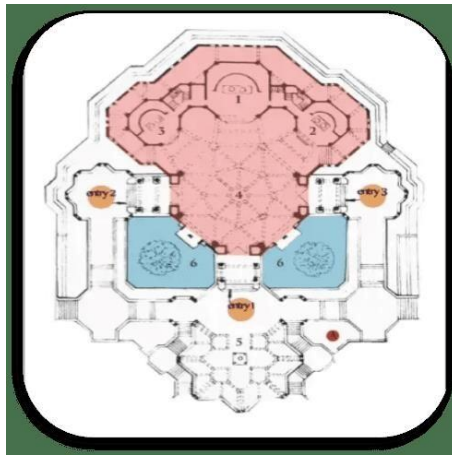


Figure 7: Main hall plan (Source: Isckon Temple Delhi.pdf)

**Restaurant block:** An area of 291sqm approx. A large hall of 150 sitting capacity approximately

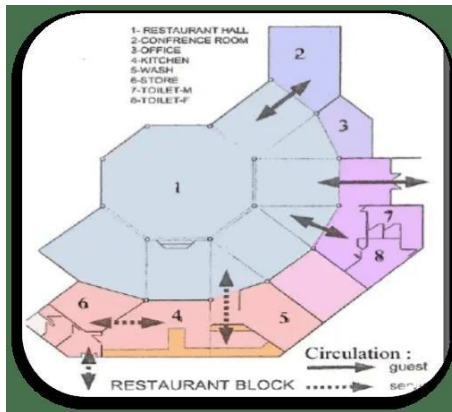


Figure 8: Restaurant plan (Source: Isckon Temple Delhi.pdf)

**Library & Auditorium block:** The museum explores the Vedic culture of India with walk through dramas and paintings the exhibition displays the dramatic life story of Chaitanya Maha Prabhu. auditorium built for 120 spectators. An Area of auditorium is 110sqm approx.

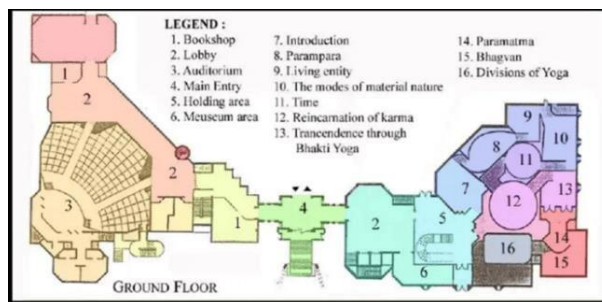


Figure 9: Library and auditorium plan (Source-Isckon Temple Delhi.pdf)



Figure 10: Key plan (Source: Iskcon Temple Delhi.pdf)

#### 4.1.5 Materials:

The building was built with a reinforced concrete frame, brick wall filling, and a red sandstone and white marble finish on its exterior face. This temple has an interesting combination of brown Dholpur stone with marble. The marble has been used only for cladding and Dholpur stone has been carved to highlight edges and carvings. The foremost requirements of a temple – a Shikhar. The Iskcon temple has three, topped with the amalakas (ribbed circular)

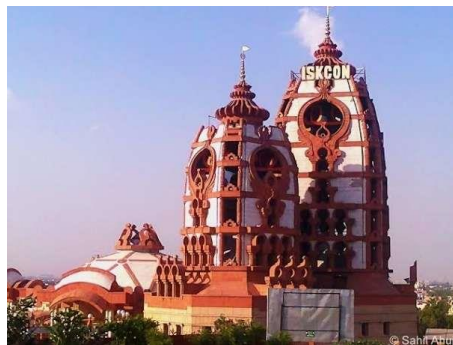


Figure 11: Materials combination (Source: I stock)

#### 4.1.6 Aesthetics:

Geometry has a significant impact on form and is rigid yet flexible, making it visually appealing. The materials used are not expanded but monotonous, yet their look is not monotonous; rather, it provides a very vivid panoramic view. Beautifully carved temple on site with levels playing an important role in it. The cream hue and grid texture of the mass don't overpower because the red stone performs as a highlight element.



Figure 12: Section (Source: Iskcon Temple Delhi.pdf)

## 4.2 Primary Data Collection:

### Iskcon:

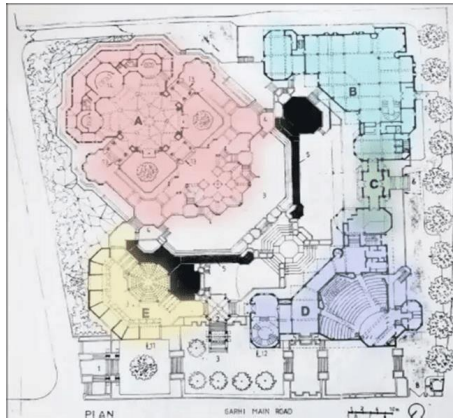


Figure 13: Plan (Source: Iskcon Temple Delhi.pdf)

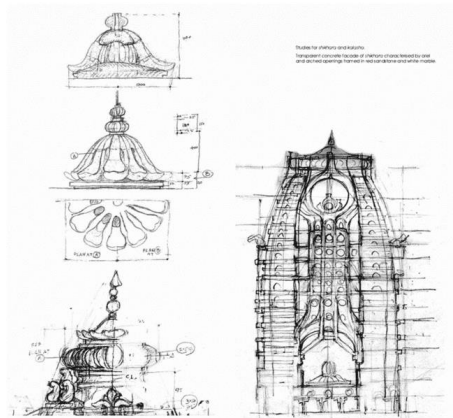


Figure 14: Details (Source: Iskcon Temple Delhi.pdf)

### Temple Katraj

**Location:** Kondhwa Road, Tilekar Nagar Pune, 411048. The plot area size is 6 acres approximately. The complex oriented at east west direction. It has hard and rocky soil



Figure 15: Overall view (Source: TripAdvisor)

#### 4.2.1 Landscape features:

Water bodies have been provided with small temple. Plant have been grown, along the circulation of an idol. Flow of plantation is done along the boundary. Small pockets of landscape with tress have been provided.



Figure 16: Small temple along water body (Source: Author)



Figure 17: Lord idol with flow of plantation (Source: Author)



Figure 18: Cattle shed (Source: Author)

#### 4.2.2 Architectural Analysis Features:

The whole complex is divided into two zones. One includes temple and the other involves the functions separated by a landscape court in between. The temple complex has 2 temples the main Radha Krishna and lord Balaji temple. Radhakrishna temple is built in Dravidian architectural style using Redstone and marble. Lord Balaji temple is built in Nagara style using Kota stone. At the intermediate levels one finds the shopping area and shoe keeping area. Below the Balaji temple there is meditation hall.



Figure 19: Information center (Source: Author)



Figure 20: Balaji temple (Source: Author)



Figure 21: Radha Krishna temple (Source: Author)

1. The temple
2. The museum of Vedic culture
3. The center for Vedic studies
4. The Vedic center for the performing arts
5. The ashram

#### 4.2.3 Planning: Main Hall:

The main entrance of the temple is in North east direction. The main temple hall which is the highest Part if temple complex. The material used for the flooring is white marble. The ceiling of the hall is such that whose periphery and the central part of dome.



Figure 22: Main hall (Source: Author)

**Book centre:** The Book center is made up of steel from south and east side glass is used

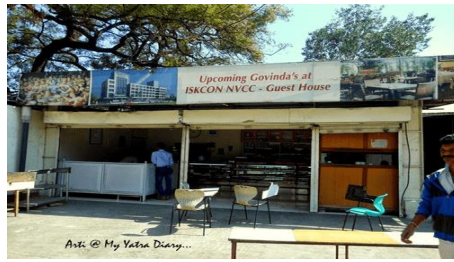


Figure 23: Book center (Source: Author)

## Balaji Temple

The Balaji temple material used Kota stone. Flooring at periphery white marble and inside Kota stone is used. The temple is built in Nagara style architecture.



Figure 24: Entrance of Balaji temple (Source: Author)

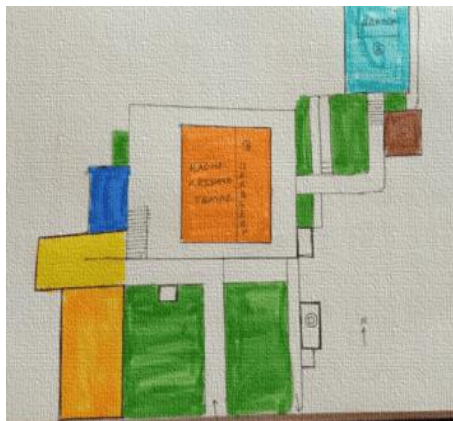


Figure 25: key plan (Source: Author)

#### 4.2.4 Architectural Elements: Jali Work



Figure 25: Jali work (Source: Author)

Materials- red stone, wooden

#### Ventilators



Figure 26: Ventilators of shrines (Left), Central dome of main hall (Right) (Source: Author)

Ventilators are provided in dome to control indoor noise

#### Ramp



Figure 27: Ramps (Source: Author)

Ramps are provided for circulation

#### Carving details



Figure 28: Carvings of Balaji temple (Source: Author)



## Flooring



Figure 29: Concrete flooring of Radha Krishna (Left) and White marble flooring of Balaji temple (Right) (Source: Author)

## 5. Comparative Analysis of Secondary and Primary Data:

Table 2: comparative analysis (Source by Author)

	PUNE	DELHI
<b>Materials</b>	Red sand stone, white marble, Kota stone, glass, steel	Red sand stone, white marble brown dholpur stone, black granite
<b>Landscape</b>	Water bodies, garden, ornamental plantation, flowers, plants along circulation of idol, fountain	Water bodies, fountain, ornamental plantation, entrance highlighted with water bodies, plants along circulation of idol
<b>Aesthetical Elements</b>	Dome, Jali work, carvings, temple has 3 shrines which are located inside a huge hall	Traditional torna, central dome, paintings, temple has 3 shrines which are located inside a huge hall

## 6. Conclusion:

In conclusion, the Iskcon temple architecture is a significant style that combines traditional and modern architectural elements. It is reflected in various aspects as in carvings, materials, openings, and planning. Also, the landscape plays an important role as there are various types of flora and water bodies based on traditional and contemporary relevance. The grandeur and appearance of Iskcon Temple becomes one of the magnets point for the visitors and devotees. The reason behind in this blending of traditional elements with modern materials technique and proportions. The research focuses and list down these elements to known their role in overall aesthetical values appearance of the structure.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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- (n.d.). Retrieved from <https://www.ravindrabhan.com/Iskcon>

# Assessing the Influence of Residential Building Modifications on Human Wellbeing

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## Abstract:

*Mental stress is one of the by-products of evolving societies, changing family structure, and housing needs. Routine stresses apart, housing issues cause more than 50% of the tensions in an urban family life. Humans spend 70% of their time in residential buildings, which are designed by experts who do not know their clients intimately. India has become the fifth largest economy due to the rising middle class. Consumer aspirations are reflected in their home transformations due to changing family needs. The aim of this paper is to study and analyze the results of a post occupancy evaluation of residential transformations in a government housing in Delhi, and its impact on occupant health. The paper has a concise literature review on human health, changing family structure, and residential modifications, & then establishes the purpose of the study which is to find solutions to the effect of modifications upon human health, along with data compilation of a field study undertaken in Vasant Kunj area of New Delhi in 2022, of 112 case studies, with on-site climatic measurements, personal interviews and a questionnaire survey. The last section presents the analysis and conclusions. The research finds that the changing home transformations effect occupants' health, by causing different types of stress due to damage to buildings.*

**Keywords:** *housing; residential transformation, changing family needs; mental stress*

## 1. Introduction:

Housing is the most valued human possession providing all round comfort which helps develop human health. Health is a state of complete physical, mental and social well-being, and not simply the lack of disease or infirmity (WHO Constitution, 1946). The positive impact of housing on human health is when the person experiences complete physical, mental, and social health. This means that he has fully functioning organs, sound mind, and social acceptance in his community circle. Negative impact of housing means that the person suffers from ill health (physical /mental/social) due to the living spaces he is in. A badly designed and poorly maintained house often results in the occupants suffering from various physical and mental diseases, also called the Sick Building Syndrome. In this, the occupants suffer from various health problems having symptoms affecting the eyes, head, respiratory tract and skin (Marmot, Stafford, Elay, Stansfield, & Warwick, 2006). More unaccounted symptoms could be fatigue, pain, memory-loss/concentration issues, mood swings and personality disorders. ((Babatsikou, 2011). This study is a post occupancy evaluation of one typology of DDA housing, built in the late eighties and showing signs of post occupancy modifications, in a rapid pictorial survey. Based on the hypothesis that these residential modifications have a significant effect on the human health; this research aims to study this in a post occupancy field survey.

## **2. Literature Review:**

### **2.1 Human Health parameters:**

Human health, an important community & society asset, and resource, in all its functioning glory; is reason for its progress and success (Sinha, 2015). It is also a measure of the social and economic development of a country; human health being a defining indicator of a well-functioning governance.

#### **2.1.1 Physical Parameters of Human Health:**

Human Health is determined by a number of measurable parameters. Temperature, Oxygen levels, Cardiovascular, eyesight & hearing, Blood pressure, Digestion, Skin issues, Neurological issues and Developmental problems are some of the health problems that indicate ill health.

Change in normal body temperatures, Irregular low oxygen levels, heart attack, heart failure, heart valve and muscle disease; very high or very low blood pressure, skin allergies and rashes, digestive problems, loss of appetite, anxiety, nervous breakdown, and delayed growth patterns, are some of the causes for concern (Pope III, 1999) (Shmerling, 2020) (Nayana Ambardekar, 2020) (Eczema, 2021) (What causes a loss of appetite?, 2018) (Debra Jaliman, 2019) (Neurological Disorders, 2020) (Healthy Buildings Healthy People, 2001)

#### **2.1.2 Mental Stress:**

Stress is defined as the change in physiological human equilibrium due to psychological reasons caused by social and emotional stressors (WHO, 2020). It is measured by verbal personal interviews, self-assessment questionnaires and physical parameters. Questionnaires are based on rating of daily hassles, happiness scale, personality trait, and perception of present. Physical measures include change in hormonal levels, elevated temperature, rise in blood pressure levels, loss of appetite, unaccounted weight loss, frequent headaches, indecisiveness, unsocial tendencies (Sood, 2013)

Housing is one of the many important factors that can cause mental stress. World Health Organization (WHO) has defined four interlinked levels in Housing that may affect health. a) Physical aspects of a home such as construction quality, presence of mould, dampness, quality of design etc., b) Safety features of a home causes feeling of possession (Dunn, 2002), c) immediate infrastructure and urban design of the location, d) quality of the housing neighbourhood and social integration (Bonney, 2004). These levels can affect the occupants directly through hard physical discomfort like dampness, water seepage, decaying structure, wall cracks, bad drainage, etc. and indirectly, in terms of area culture, neighbourhood discontent, social fragmentation, and insecurity (Shaw, 2004)

Other influences are, ontological security aspect of housing, which happens with the coming together of consistency (of physical and social paradigms), freedom of living (free from social scrutiny & rigidities), and identity formation of individuals (Neil Klepeis, 2001) (Kinnvall, 2018).

Holmes and Rahe Scale, created in 1967, by Thomas Holmes and Richard Rahe, was to establish the link between stress due to Life-changing events and human health, based on a score on the Holmes and Rahe stress scale. Life changing events are- death of a loved one, Illness of a loved one, loss of work, personal illness, child leaving home, trouble with in-laws, loan/mortgage, financial difficulties, divorce/separation etc. Scores below 150 have a low chance of any health issues due to stress, scores between 150 and 300, have a 50% chance, and scores over 300 have an 80% chance of a health issue. It was deduced that a positive correlation existed between the two (Holmes & Rahe, 1967). The author has taken inspiration from the Holmes and Rahe scale, and using the scale for the items related to the research; has come to an overall stress level of the participants. The study is limited only to study of mental stress due to living conditions.

## **2.2 Changing Family Structure and Housing:**

The basic societal unit called family can consist of many types. In India, the nuclear unit consists of Parents and children or the joint family consisting of many generations living together, requiring many overlapping and personal spaces in the home which change after the parents expire. Increase in migrant single young professionals, number of divorces etc., has changed the housing need. (Gupta, 2022) (Catherine Martel, 2008) (UNECE, 2010)

## **2.3 Residential Building Modifications:**

Mass Housing, designed for users by a professional, are usually identical housing units made for non-identical end-users, which could be of diverse backgrounds and cultures in an urban environment. Hence it is natural for the occupants to customize their place of living or working as per their needs (Modi, 2010). The post occupancy modifications may not be in sync with the structural stability, aesthetic palette or the functional spectrum hence designed by the architect.

These modifications may be of the following types, as indicated by the rapid pictorial survey done by the author:

1. Change in dwelling unit layout
2. Covering of existing terrace /balcony
3. Construction of a new balcony
4. Covering of existing courtyard with permanent roof
5. Construction of extra room outside building line
6. Construction of toilet on existing balcony/terrace

## **2.4 Research Gap:**

Dampness and mould are a few of the common reasons of poor indoor air quality causing asthma, breathlessness and lung diseases (Loftness, Adan, & Hakkinen, 2014). Surface Building temperatures, access to green spaces, water quality, infrastructure and transportation affect the human health as much as poorly designed buildings with little sunlight and ventilation (Haidari, Younger, Chandler, Gooch, & Scramm, 2016)It is also known that certain type of buildings having central air-conditioning, automated heating and ventilated systems; cause of skin rashes, headaches, nausea, breathing issues; are called as the sick building syndrome (Marmot, Stafford, Elay, Stansfield, & Warwick, 2006). Among all the research between human health and building health; the effect of residential modifications on mental stress is not known. This paper resolves to fill this research gap.

## **2.5 Need for the Study:**

Mental Health has been included in WHO's Sustainable Development Goals due to the increase in suicide and depression cases (WHO, 2022). There is a need for Mental Health Literacy; to understand, empathize and recognize mental health disorders without the stigma (Srivastava, Chatterjee, & Bhat, 2016). Stress is an everyday reaction to daily issues but can lead to severe mental problems like depression, anxiety, burnout or anger management issues. It can also lead to physical health problems like increased blood pressure, heart issues, addictions, gastrointestinal problems and headache. Among the many known causes of mental stress are work problems, family problems, financial issues, daily stressors, and living conditions (Watson, 2022). The purpose of the study is to find the impact of residential modifications on human health, to find solutions.

## 2.6 Aim:

The aim of the research is to study and analyze residential building modifications by a post occupancy evaluation (POE), and understand their impact upon human health.

### 2.6.1 Research Questions:

- 1) What are the building modifications done by occupants in residential buildings?
- 2) What are the effects of occupant building modifications upon human health particularly stress?

## 2.7 Study Area:

### Primary Field Study

The research is based on government apartment buildings in Delhi built in the eighties to study the occupant changes in housing post liberalization. The economic liberalization in 1991, caused the middle class to grow and customize their homes. A Rapid pictorial survey conducted by the author on various DDA housings, built in the late eighties; revealed that Vasant Kunj housing had the maximum modifications. Vasant Kunj was developed by DDA, over a course of time from 1985, having 2BHK, 3BHK, 3BHK duplex, 4BHK, villas, and high rise; making each sector self-sufficient, with community facilities, a retail area, gated security and major roads connectivity.

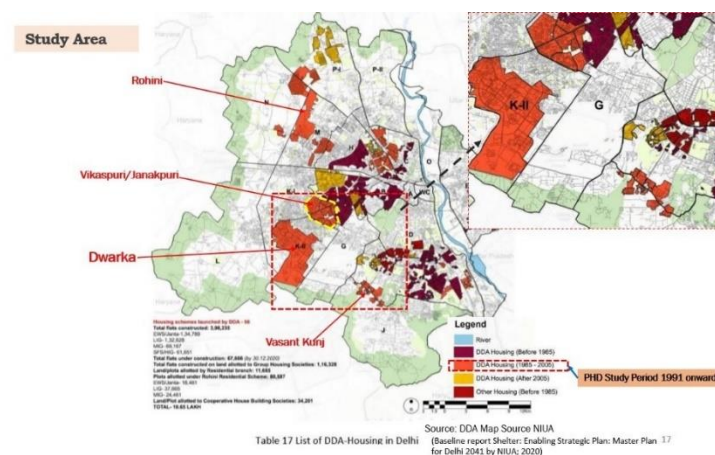


Figure 1: Map of Delhi showing the DDA flats timeline of construction (Source: NIUA)

## 3. Research Methodology:

A Rapid pictorial pre-study conducted by the author in October 2021 along with an online questionnaire, showed maximum modifications in Vasant Kunj; which led to the primary study area.

A field study was conducted between Mar to June 2022, by post occupancy evaluation (POE) of Vasant Kunj Area, sectors A, B, C and D, in New Delhi, chosen by snowball random sampling.

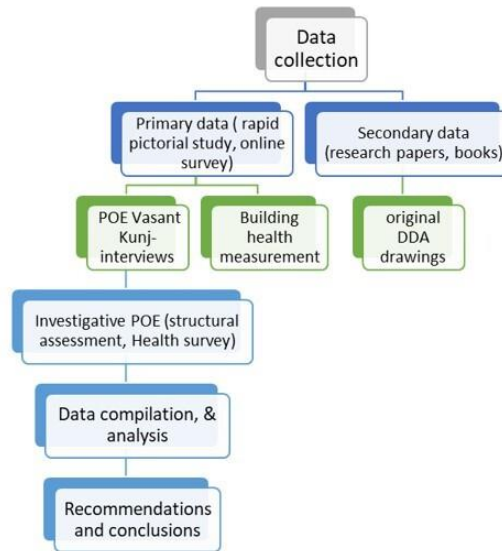


Figure 2: Research Methodology (Source: Author)

### 3.1 Field Study:

About 134 families were approached in Vasant Kunj by snow ball random sampling, out of which 112 (1% of the estimated population size) families responded and participated in the POE. Building Measurements, personal Interviews and questionnaire survey, were conducted during the POE. Pictorial record of the modifications was tallied with the original DDA drawings and on-site measurements, to compile original and modified architectural plans along with the natural light, room temperature and humidity measurements. The Instruments used were a) Infra-red digital room Thermometer gun, b) Digital Lux meter, c) Digital mini humidity measure Hygrometer (Room Indoor Thermometer Hygrometer Tool).

#### Personal Interviews

During the personal verbal interview, the following information was collected online.

Table 1: Personal Interview Questionnaire (Source: Author)

Information	Objectives (To assess...)
Age, gender	Age and gender impact on stress levels
Profession	Profession's impact on stress levels
Blood pressure/Heart/Breathing issues	Physical health
Death of a loved one/ Divorce/ Work related problems/ health issues of a loved one/ Personal illness etc.	To apply the Holmes and Rahe Scale selectively
Daily planning	Personality of the person
Anxiety from daily stressors	Anxiety levels of the person
Anger management	Nature of the person
Disagreement with Neighbours	Neighbourhood relations
Co-operation with Neighbours	Person's attitude
Neighbourhood help	Neighbourhood dynamics
Contribution to the maintenance of common neighbourhood areas	Responsibility
Supporting neighbours during renovation	Neighbourhood dynamics
1 Neighbourhood 1 Family	Basic thinking of the person

Neighbourhood support during renovation	Neighbourhood dynamics
Immediate neighbours renovating their home now	Live assessment of the number of residential modifications
Any damage to property due to renovation- rating	Role of personal damage on stress levels
Mental stress level due to neighbourhood renovation on a rating from 1 to 5	Person's real insights based on actual experience

### 3.2 Data collection:

Presenting 2 samples of the 112 case studies conducted; with the original plan and modified plans; showing the encroachments on public area, common use area, internal court and internal spaces. The natural light inside the rooms, humidity and room temperature have also been measured with a view to assess building damage by occupant modifications.

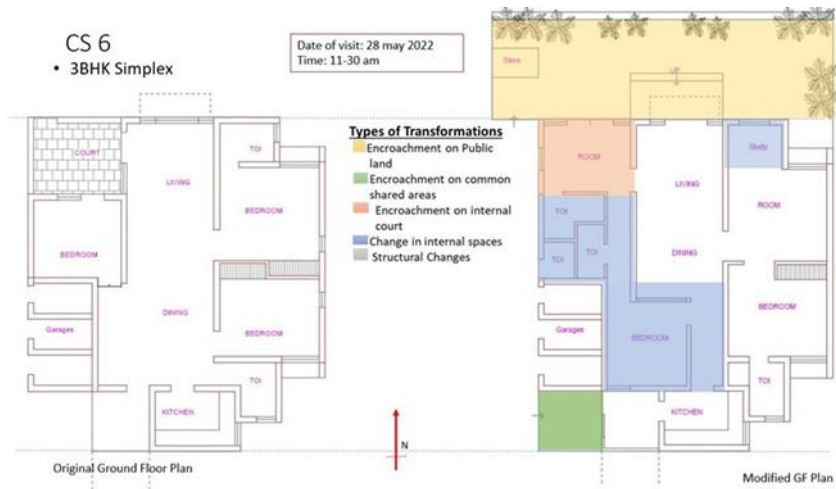


Figure 3: Sample 1- Original and Modified GF plans (Source: Author)



Figure 4: Sample 1- Natural light and Humidity (Source: Author)



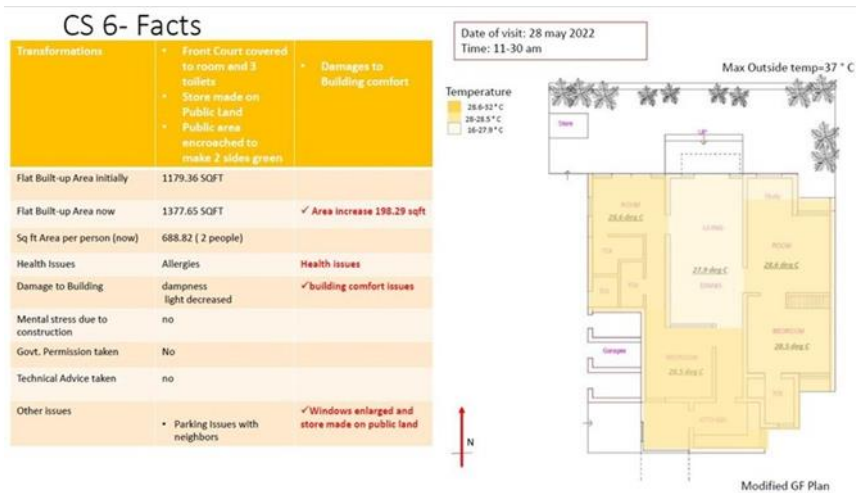


Figure 5: Sample CS6 facts and Room temperature (Source: Author)



Figure 6: Sample CS6 on-site photos (Source: Author)

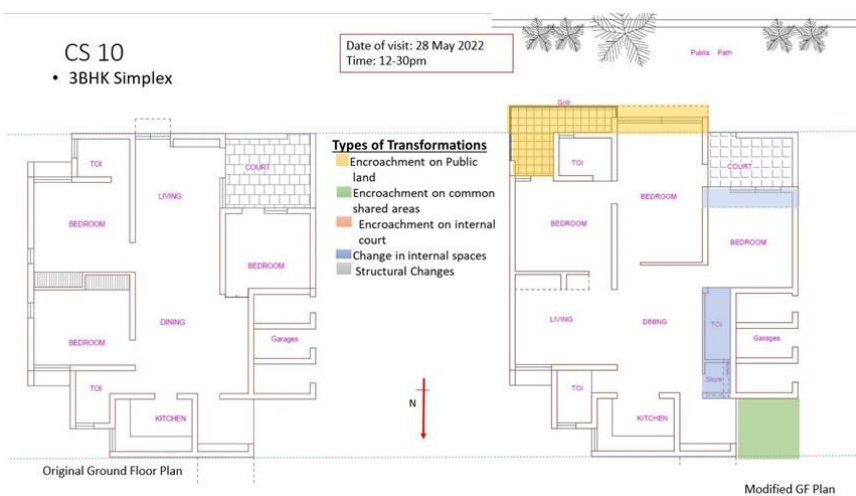


Figure 7: Sample 2 original and modified plans (Source: Author)

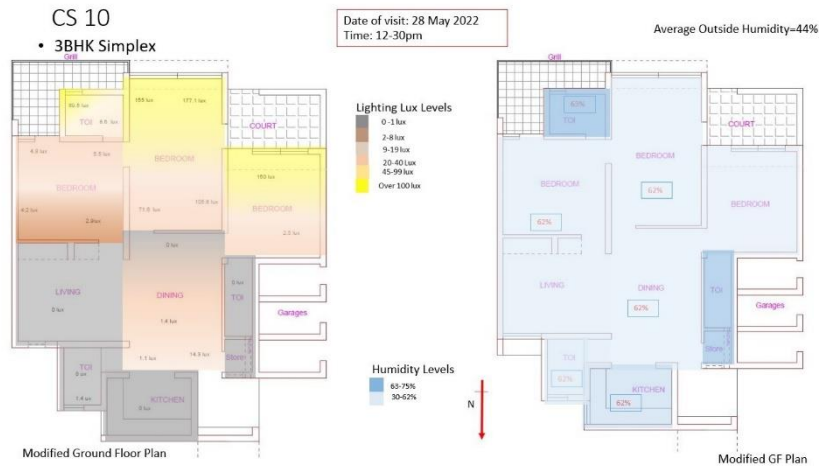


Figure 8: Sample 2 natural light and humidity (Source: Author)

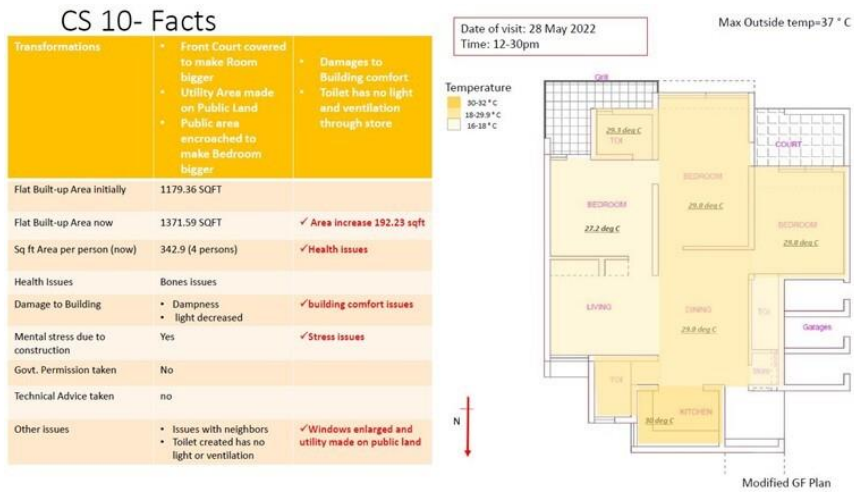


Figure 9: Sample 2 CS facts and room temperature (Source: Author)



Figure 10: Sample 2 on-site photos (Source: Author)

## 4. Findings and Analysis:

### 4.1 Results of Field Study:

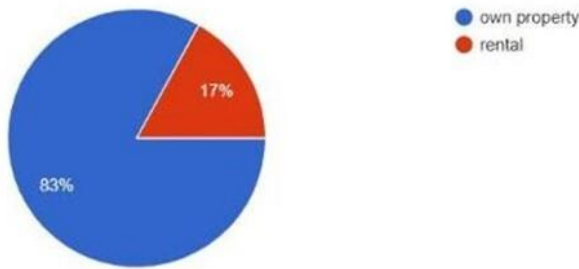


Figure 11: Pie chart showing owner-renter ratio (Source: Author)

Observation: 83% of the Participants are owners.

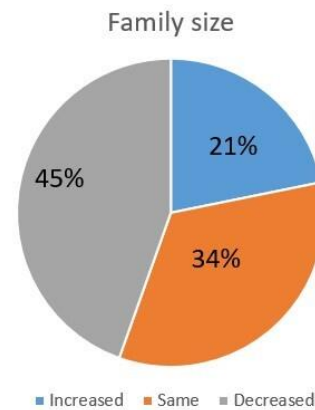


Figure 12: Pie chart showing the family size (Source: Author)

Observation: 45% of the Participants' family size decreased, 34% of the families had the same size, and 21% of the families increased in size.

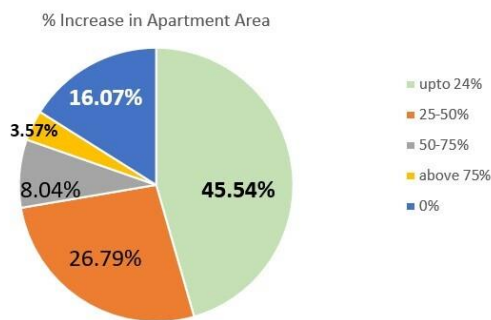


Figure 13: Pie chart showing % changed apartment area (Source: Author)

Observation: 45.54% of the Participants' apartments showed at least 24% increase, 26.79% showed increase from 25-50%, 8.04% showed an increase of 50-75% and 3.57% showed an increase of over 75% in area.

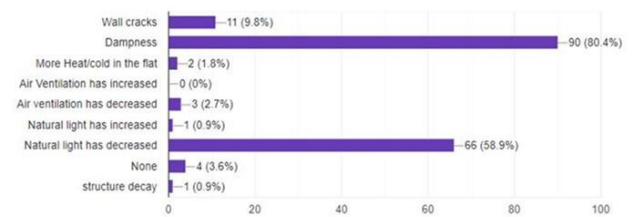


Figure 14: Bar chart showing the building damage (Source: Author)

Observation: 80.4% of the participants felt that Dampness was an issue. 58.9% said that Natural light had decreased in their flats.

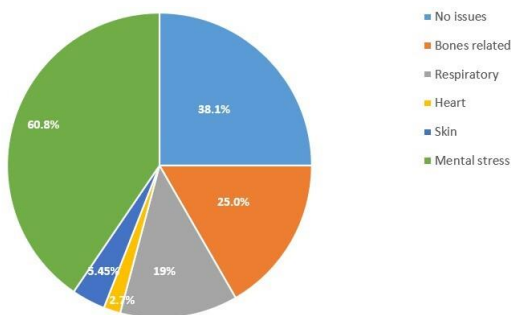


Figure 15: Pie chart showing % Health issues (Source: Author)

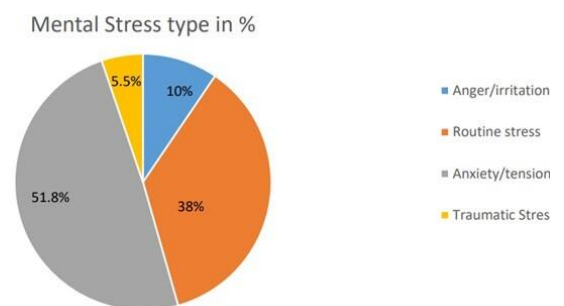


Figure 16: Pie chart showing mental stress type (Source: Author)

Observation: 60.8% of the survey participants had mental stress due to the modifications done by the neighbours, 5.4% had skin issues, 25% had bones related health problems, 18.75% had respiratory issues.

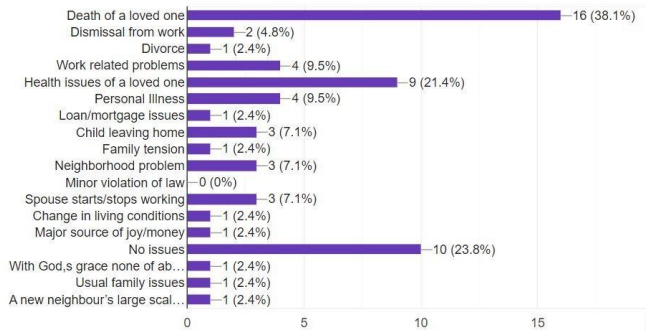


Figure 17: Bar chart showing life changing stressors (Source: Author)

Observation: 51.8% of the survey participants had Anxiety/tension due to the modifications done by the neighbours, 38% had routine stresses about the changes, 10% had anger /irritation at the construction issues, 5.5% had trauma stress.

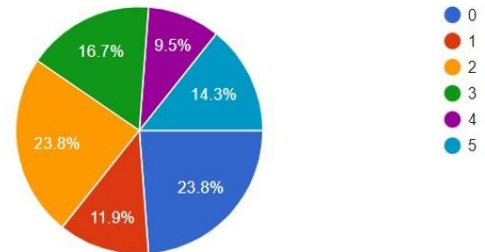


Figure 18: Pie chart showing Mental Stress rating due to Neighbour's renovation (Source: Author)

Observation: 73.8% of the participants had stress from Life-Changing Events.

Observation: 76.2% of the participants had some level of Mental Stress by the neighbour's on-going renovation. 16.7% had a rating of 3/5 for their mental stress and 14.3% had a rating of 5/5 of their mental stress due to neighbour's renovation.

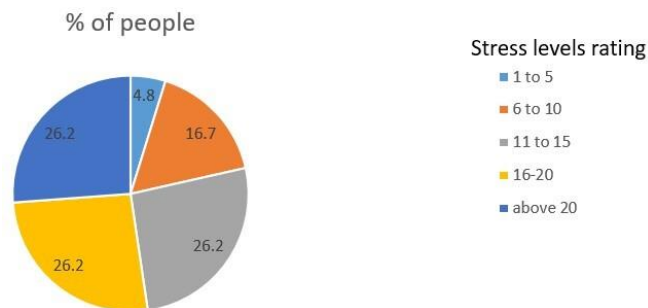


Figure 19: Pie chart showing Total Associated stress (Source: Author)

Observation: 78.6% of the participants had some stress level of 11 or above. The average stress rating was 15.9.

## 5. Discussion:

1. Owners and Renters: The majority (83%) were owners that could make modifications (fig 12). 84% of the participants had increased their apartment area. 45.54% of the Participants' apartments showed at least 24% increase in size, indicating a majority (fig 14). Majority of the participants felt that Dampness was an issue and 58.9% of the participants said that Natural light had decreased in their flats, indicating a decay in building health (fig 16).
2. Residential modifications and Associated stress: Majority of the survey participants had mental stress due to the modifications done by the neighbours (fig 17). These stress issues were due to- dampness, breaking of bathroom tiles, noise, pollution, dust due to changes, inconvenience of movement, and non-cooperation.

The occupants are very distressed and angry about the damages to their homes, which led to skin rashes, anxiety, breathing issues, poor anger management, depression and loss of pride in their home. 73.8% of the participants had stress from Life-Changing Events adding to their mental stress. 78.6% of the participants had Overall stress levels of 11 or above and the average stress rating was high (fig 20).

3. Mental Stress rating: 76.2% of the participants had some level of Mental Stress by the neighbour’s on-going renovation, showing the effect of building modifications on human health (fig 19).
4. Relationship of stress associated with Renovations and Overall stress rating: It cannot be concluded that stress associated with residential construction is directly related to overall stress borne by a person (fig. 20 and fig 21).

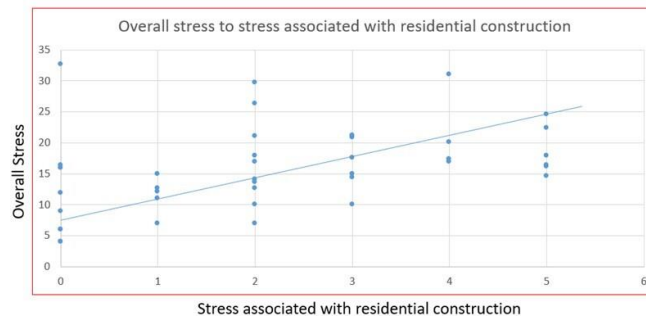


Figure 20: Scatter Diagram showing Stress Associated with Residential construction to Overall Stress ratio (Source: Author)

1. Relationship of Life-changing stressors and Stress due to residential modifications rating: Maximum Life-changing stress rating is 17.08 has its stress due to renovation rating 4 (fig. 22). Life changing events stress is definitely related to mental stress due to residential construction.

**Stress**

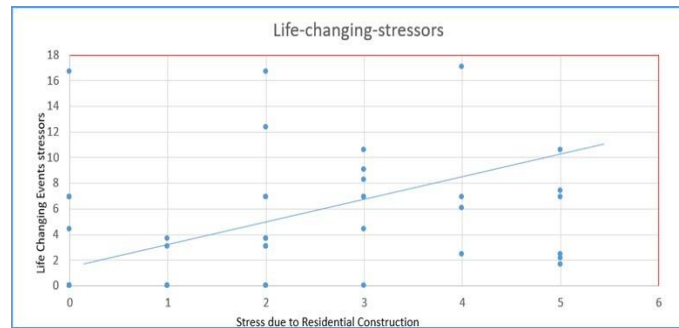


Figure 21: Scatter Diagram showing Stress due to Residential construction to Life changing events Stress ratio (Source: Author)

2. Relationship of Damage to Property rating and Mental Stress due to residential modifications rating: Maximum Damage to property rating is 5, and it has stress due to renovation rating 5 (fig. 23). Damage to Property is definitely related to mental stress due to residential renovations. The statistical correlation between the two is 0.72, showing a positive correlation.

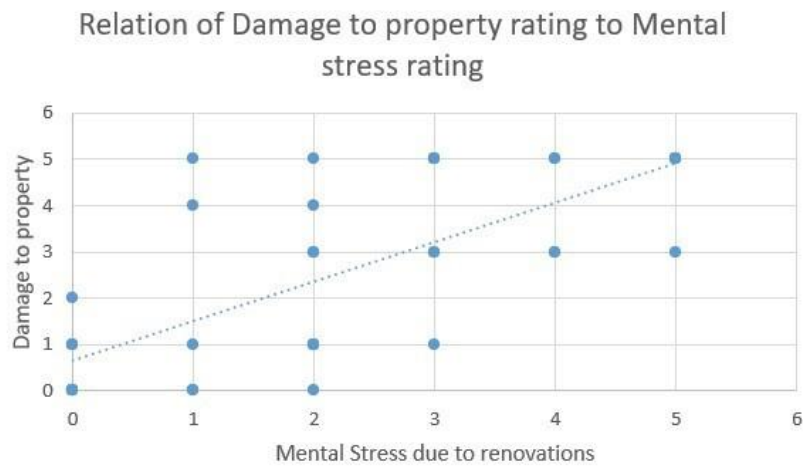


Figure 22: Scatter Diagram showing Mental Stress due to residential construction to Damage to property (Source: Author)

## 6. Recommendations:

Mental Stress due to on-going residential modifications is avoidable. Hence it is recommended to have clear and simple guidelines for the modifications to cause least stress to the neighbours.

### 6.1 Suggestions for bridging the gap:

1. Results of this study indicate that an annual post occupancy evaluation of the residential buildings, by the government, will help in maintaining the needs and aspirations of the occupants, and the conditions of the buildings.
2. A smooth and simple process is needed; for getting approvals for the change in their apartments, with technical help for a fee; ensuring a sound-built structure.
3. Housing policies should be in tune with the evolving middle-income group and be able to realize the true potential of this expanding group in India.
4. Government apartments designs should be flexible and incremental, to be able to expand, causing least stress to the neighbourhood and keeping in mind future generations.
5. Green areas should be well integrated with apartment facing greenery for natural ventilation and light, which would help in creating stress-free zones.

## 7. Conclusion:

House is a haven from the external conditions and families live together to create small societal units. A residence should provide peace, harmony, happiness, pride, safety, and stability to the residents. Besides being the external envelope, it should be able to create a stress-free environment. Stress due to the home renovations can be a cause for concern, which may be difficult to diagnose. Hence a stress-free home environment is very much needed.

Government and municipal agencies need to keep record of building health and human health as they are interconnected. Changing family structures cause family needs to change and these cause home requirements to evolve. Incremental and flexible design layouts, which can be constructed with sound technical help, within byelaws and government policies are the need of the hour. Growing middle income group, which has the potential to add to the country's economy, should be taken care of. Healthy human capital, having growing consumption trends should be harnessed soundly, with an eye to the future growth. A dedicated strategy of sound guidelines, with single window housing addition approvals and revised housing design policies, along

with recurring post occupancy evaluation techniques, will help in forming articulate markers for urban housing and contribute to good human health.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Application of Project Management: A Step towards Business Management in a Creative Industry

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## Abstract:

*This paper contributes to making successful and dynamic architectural projects using design principles and Business management strategies for startup firms. The study will focus on leading and managing projects in an innovative industry. It aims to expand and develop the leadership role of a project manager in small architectural companies. It briefly describes the importance of architectural design with effective, sustainable management strategies that improve efficiency, productivity, and the company's outcome. This paper follows a mixed approach specific to the creative industry that escorts, architects, and project managers from the corporate sector, startup associations, and academicians. It will also highlight the importance of project managers and create awareness for smaller organizations in the artistic sector. The research study findings will benefit stakeholders, project managers, and practicing architects. Lastly, this study promotes the importance and knowledge in agile working environments, emphasizing effective leadership for a successful project in creative industries.*

**Keywords:** *agile working environments; startup; sustainable; management strategies; creative industries*

## 1. Introduction:

In today's rapid growth of the creative industry, artistic, and aesthetic innovation expressions and business acumen have become paramount. As the industry continues to expand its horizons, the need for effective project management has emerged as a pivotal factor in ensuring the success of creative endeavours. The application of project management principles has evolved from being merely a tool for traditional business enterprises to becoming a critical step towards efficient business management within the dynamic and multifaceted realism of the creative sector (Galloway & Haniff, 2015).

The creative industries such as design, architecture, entertainment, fashion, etc. are encompassing effectively. The most important characteristic that makes this field so interesting with its unique challenges and opportunities in terms of organization, collaboration, and resource allocation (Galloway & Haniff, 2015). In this context, project management emerges as a guiding light, offering a structured approach to navigating the complexities of creative ventures.

This application strikes a delicate balance between artistic freedom and business objectives. Project management in the creative industry involves fostering collaboration between individuals with diverse skill sets and backgrounds, aligning their efforts toward a common goal. It involves optimizing resource utilization, managing timelines, mitigating risks, and ensuring a seamless workflow – all of which are pivotal to meeting

client expectations and delivering projects within budget and on schedule. This project management approach is not just confined to large-scale endeavours; it permeates every facet of the creative industry, from individual freelance projects to full-fledged studio productions. As such, understanding the core tenets of project management – such as scope definition, task delegation, progress tracking, and stakeholder engagement – becomes a fundamental skill for professionals within the creative landscape (Ruseva, 2019).

The application of project management principles in the creative industry heralds a new era of strategic business management. By blending creativity with structured methodologies, businesses and individuals alike can unlock the potential for innovation while ensuring that their projects are executed with precision, efficiency, and a clear alignment with business objectives (Holzmann, 2020). This journey towards effective project management marks a significant step forward in navigating the intricate landscape of the creative industry, enabling its participants to not only express their artistry but also to thrive as successful business entities.



Figure 1: Steps for Project Management (Source: Vector Stock, 2023)

## 7.1 Aims and Objectives:

### Aims:

This research aims to provide maximum optimum solutions for the research problems faced by any size organization in the creative industry. It creates awareness of and importance of project managers in design industries. This research also shows a brief description of the sustainable goals in project management and how it is inculcated in the offices.

This research also aims to communicate the importance of a manager in the design sector. The goal of this research is to come up with optimized solutions for a company to hire a manager who can look for projects from all sides and earn a profit for the organization.

### Objectives:

The research objective contributes to the high quality and creative work. However, the main objective is to understand the project and meet the deadline of it. The most important objective is to communicate with the clients, stakeholders, investors, etc. efficiently and effectively. The other objective of the project manager is team motivation. Finally, the objective that is delivered in this research paper is market research and trends. This market research and trends help the project to grow and help to generate profits in the organization.

## 2. Literature Review:

The literature review in the creative industry gives a broad understanding of the project management field and its evolution, current trends and technologies, drivers and barriers, and gaps that will be adapted as a prospect in the project management field. The review will also provide different approaches and aspects of project management processes and implementation in the organization. It will also provide a literature gap that will be inculcated in this research paper and create awareness amongst the firms.

### 2.1. Creativity and Innovation in Project Management:

Creativity can be defined as the capability to produce a modern design that motivates the projects. It plays an essential role in ensuring that creative projects are completed successfully on time considering the budget. However, they also play a vital and significant role that requires a better understanding of project management skills in a creative process. They must be able to balance the needs of clients, creative professionals, and project requirements in the given timeline. Their potential to foster collaboration, manage creative personalities, and navigate the unique challenges of the creative industry is essential for project success (Kumar, 2012).



Figure 2 : Creative Elements (Source : Petrovic et al., 2017)

The figure 2 represents the components of creative elements from a project management perspective. Furthermore, distributed into three parts i.e. “professionalism, motivation, and creative thinking skills.” The three parts are overlaid to perform success for the business.

Creativity is not only always thinking of something unique and different “out of the box.” It is also a process of contributing innovative ideas, concepts, and technologies that should be utilized in the practical world and it cannot be done alone, it comes up with team efforts, efficiency, dedication, and discipline (Petrovic et al., 2017). Therefore, it is not a single member effort, it rises to different talents, knowledge, skills, understanding, and proficiency to solve problems and satisfy the client’s requirements. Creative management does not need a good designer or unique team members. It needs to produce planning, initiating, monitoring, and completing a project with unique ideas and team management concerning clients, stakeholders, and investors. The unique ideas are later collaborated with “innovative thinking.” Hence, creativity leads to innovation. Innovation is a process that combines the expertise and ideas that turn into a new concept. It implements all the ideas, examines, and finally creates a new product at several stages (Kumar, 2012).

Creativity and innovation play an essential role in the project management field. They can help organizations to produce better results, stay competitive amongst others, and adapt to growth in the business environment. Some methodologies adapt creativity and innovation towards project management (Kumar, 2012). The

methodologies like creative problem solving, and project manager help their team to think creatively when there are blockages in the projects. The project managers in the organization also can take brainstorming sessions, design thinking workshops, and other creative problem-solving techniques that can help to solve and come up with innovative solutions. The other methodology is to adapt the agile framework to the daily activities of the organization. Agile project management methodologies like Scrum, and Kanban encourages iterative and flexible approach to execute the projects and products in the given timeline. This methodology also shows continuous improvements, implements resources, performs adaptability and flexibility, and fosters innovations throughout the projects. The next methodology that should be performed by an organization is design thinking. In this methodology, the design thinking principles in project management can lead to optimizing solutions as per the client's requirement. This approach involves skills like problem-solving, optimizing solutions, and fulfilling clients' needs and requirements (Holzmann, 2020). Lastly, the methodology uses creative communication techniques such as visualizing and creating new concepts related to contemporary trends and technologies. Communication skills also help in making complex situations into easy and creative situations.

In conclusion, creativity and innovation have become an important part of the project management process. The team members and project managers in an organization should encourage innovation and creative processes to address challenges, problem-solving and convey successful projects to the clients (Holzmann, 2020).

## **2.2. Sustainability in Project Management:**

Sustainable project management is an approach to managing projects that inculcates all the criteria of sustainability into individual projects. Its main goal is to deliver the projects successfully and to minimize the negative social, economic, and environmental aspects of the projects. The sustainable project management not only helps the firm to reduce risks in the projects but also contributes to the sustainability goals of each project. In sustainability, three main approaches are considered while delivering the projects and products. It is known as the "TBL (Triple Bottom Line)" approach. TBL considers environmental (planet), economic (profit), and social (people). The projects should aim at this approach while delivering (Chawla et al., 2018). The sustainable project management also looks after the certification of green buildings and adheres to the standards such as LEED, GRIHA, etc. for eco-friendly buildings.

### **Social, economic, and environmental aspects in project management:**

The social responsibility includes addressing stakeholders, the community, and their concerns related to projects and solving them with a positive impact. Furthermore, it implements labour practices and respects human rights within the project team and stakeholders. The social responsibility also comes up with fair labour practices, looking after their wages, and working habits and providing opportunities that benefit the projects. It also identifies new ways of working in which the project can benefit the community such as new job creation, improvement in infrastructure, etc (Okeniyi, 2013).

The economic aspects of the project indicate the optimization of the use of financial resources and aim for cost-effective project management processes. It also opts for long-term viability to examine the economic sustainability of the project looking for criteria like return on investment (ROI) and ongoing revenue generation (Morfaw, 2014). The economic sustainability recognizes the risk factor for the budget of the project and makes sure to sustain it financially.

The environmental aspects should contribute to reducing greenhouse gas emissions and should use recycled resources and minimum use of transportation that are connected to the projects (Morfaw, 2014). The renewable energy resources minimize waste and support the adequate use of resources throughout the process of the project. The sustainable design goals promote environment-friendly design criteria to reduce a negative impact on nature (Tharp, 2012).

Hence, sustainable project management goals not only contribute to the reduction of carbon emissions for the environment but also support economic and social responsibilities. These goals finally succeed in improving the outcome of the projects, risk reduction, and leading to a positive impact on the company. Therefore, sustainable project management comes up with more sustainable products and protects the environment. It can also be more beneficial to invest in this technology. Technologies like air capture and carbon mineralization could aid in removing carbon emissions from nature (Okeniyi, 2013).

By embracing these technologies and goals, the team members and project managers will be more capable of designing and creating projects sustainable and greener globally (Morfaw, 2014).



Figure 3: Sustainable Project Management (Source : Petrovic et al., 2017)

### 2.3. Project Management and Leadership in Creative Industry:

In a creative industry, leadership needs more skills and qualities that are liberal and diverse. It includes not only cultural leadership skills but also a brief knowledge of creative processes, innovations, and the aspects of leadership qualities (Destouni, 2018).

The factors like visualization and aesthetics, communications, adaptability, risk management empowerment, ethics, and networking come under leadership qualities. In visualization and aesthetic qualities, the leadership should understand the needs and requirements of the projects and produce current ideas and solutions in a creative process (Walzer, 2020). The leaders should also take care of methodologies like agile framework, scrum process, or any other project management process that will help the organization to grow. The leaders should conduct daily meetings to understand the scope of the work. This helps to communicate effectively with the team members and discuss the feedback, and new concepts. The leader should be flexible with the circumstances and open to all the changes in the creative industry. They should be adapted to the modern technologies and their implementation in the projects. The leaders should also understand where to make changes in the projects and where to be in competitive situations. The creative industry many times involved in risky situations. The leaders should plan the risk situation and overcome the problems, instead of keeping risk at the back end (Sabri, 2021). The leader should also support the failure and motivate the team members to learn from it. In a creative industry, ethics plays an essential role. The leader must implement ethical values and standards in every project. They need to consider concerns like different diversities and intellectual projects and promote ethics in an organization. Building and maintaining a strong network can play a key role in the creative industry. It can contribute to partnerships, and connections and can provide many opportunities and growth to the industry (Sabri, 2021).

The creative industry connects cultural leadership with innovations, creativity, collaborations, and adaptivity. The leaders know the process of creativity with their team members and contribute to the promotions and support of the ongoing projects to succeed (Sabri, 2021).

### 2.4. Literature Gap:

The project management process is a complex process in the business sector which is also included in the creative industry. In the future, applications of project management are going to be more important due to the development of current trends and technologies. In this research, the gaps need to be filled with awareness of project management in the creative industry. The next gap is to apply project management methodologies in an organization. To conduct daily meetings through agile or scrum methodologies. The research gaps can be filled by applying this project management principle.

There are a total of twelve research papers mentioned in this article. Six of these twelve research papers are listed for the analysis of this paper.

*Table 1: Analysis of the research papers (Source: Author)*

Research paper nos.	Title of the paper	Name of the author	Analysis
1.	The sustainable project management: A review and future possibilities	Chawla et al., 2018	The research paper is based on the importance and brief description of sustainability's social, economic, and environmental aspects.
2.	Managing projects in Architecture: A study of leadership in a creative industry	Galloway & Haniff, 2017.	This research mentions the leadership skills and qualities in the construction industry concerning financial and aesthetical objectives
3.	Project Managers as a creative leader	Kumar, 2012.	This article highlights the capabilities and leadership required by a project manager to develop creative and innovative ideas in this design industry.
4.	Application of a project manager in the creative industry	Petrovic et al, 2017	This paper focuses on the connection between creativity and economy in the business sector. This paper also suggests different approaches, roles, and duties of a project manager in the creative industry.
5.	Project Management in the creative industry	Margarita, 2019.	In this study, 105 surveys were conducted from companies where the managers worked in the creative industries. This study also helped to identify gaps in project management, resource management, and risk management.
6.	Leadership in the creative industries: Addressing an uncertain future	Walzer, 2020	This article states about pedagogical mindset from a skilled model to holistic approach projects by providing the four areas of leadership skills i.e. “creativity, vision, sustainability, and community.”

### 3. Data approach and methodologies:

In order to collect the data a list of participants is created. These participants will be from any design sectors, stakeholders, investors, etc. from whom the data will be collected. The target population will belong to will belong to real estate, architects' construction industry, and other design sectors. Since these participants have a background related to the creative industry, they will be qualified for the data collection process. From the target population of the participants, a sample size of twenty -25 would be selected. This selection would be dependent on the research topic.

Based on the research topic, a questionnaire is performed. There are fifteen survey questions prepared for participants. The participants will answer these questions on Author (digital platform), based on their understanding.

Therefore, this research will consist of data that will be analysed through the Quantitative method. This analysis is conducted based on the total number of participants. This data is collected through a web-based survey. Later, based on the results, in the form of pie charts, tables, and figures, the analysis will be conducted.

### 4. Data analysis:

This chapter is based on quantitative analysis. The results are analyzed according to their results and evaluations. The results are based on the recipients who participated in these interviews and questionnaires.

#### 4.1. Sample framework of the survey:

The quantitative approach is conducted through a questionnaire. The questionnaire participants were architects, master's in business management and architecture, contractors, and investors. There were fifteen questions based on the application of project management in the creative industry. The total number of participants was thirty-three. The first three questions are based on the basic information of the organization. The gender, age group, and the name of the organization are the knowledge areas of the first criteria.

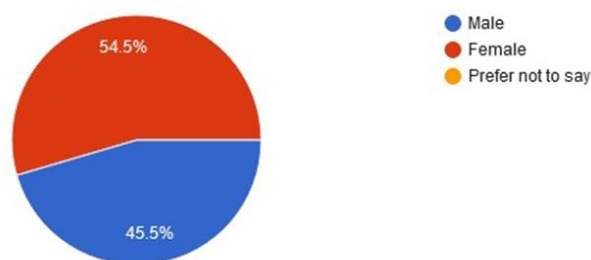


Figure 4: Gender model that participated in the survey (Source: Author)

The figure 4 gives a brief description of the gender i.e. male or female participated in the questionnaire. There were 54.5% of females contributed to this data analysis and 45.5% of males gave their valuable feedback in this survey. As a result, according to the percentages, the females contributed their valuable feedback compared to males.

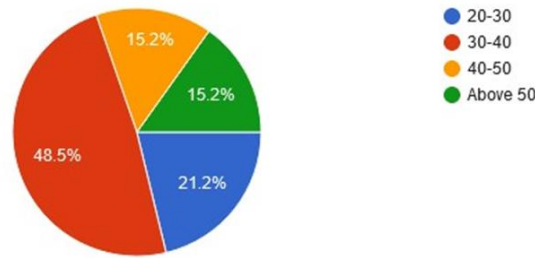


Figure 5: Age group model involved in this survey (Source: Author)

This figure 5 represents the age group of the members involved in this questionnaire. The maximum number of participants were from the age group of 30-40 i.e. 48.5%. and the minimum number of participants was from the age group of 40-50 and above 50 i.e. 15.2%. The youth from this survey were 21.2%. i.e. 7 participants.

Hence, it can be concluded that the age group 30-40 plays the most essential role in this survey.

The next important criterion is about knowing the organization It mentions the number of employees working in the firm and the project manager in the company.

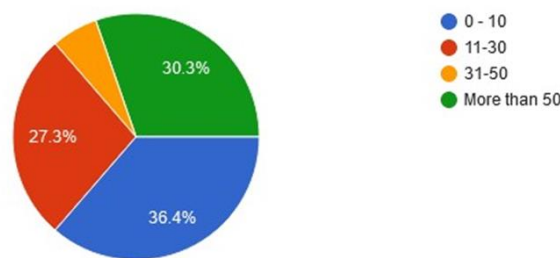


Figure 6: Result for number of employees working in the organization (Source: Author)

This figure represents the total number of employees working in the organization. Out of 33 numbers of participants, 12 number of participants were working in the small-scale firm i.e. 0-10. The middle size firm i.e. 11-30 and 31 -50, 27.3% (9) and 6.1% (2) were working in the organization. There were 30.3% (10) of employees working on the huge scale of the company.

The below figure 7 mentions the presence of a project manager in the company.

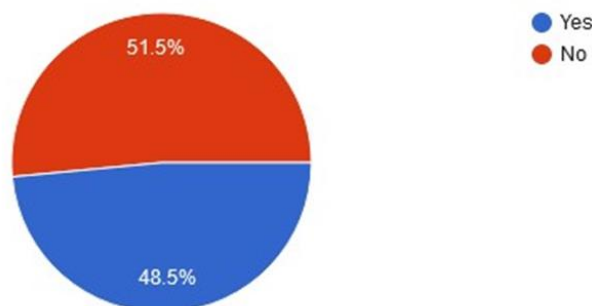


Figure 7: Pictorial model for the presence of the project manager in the organization (Source: Author)

From the given survey, it can be observed that there were 51.5% (17) of participants who were not having a project manager in their design company. There were 48.5% (16) of people who were having a project manager in the company.



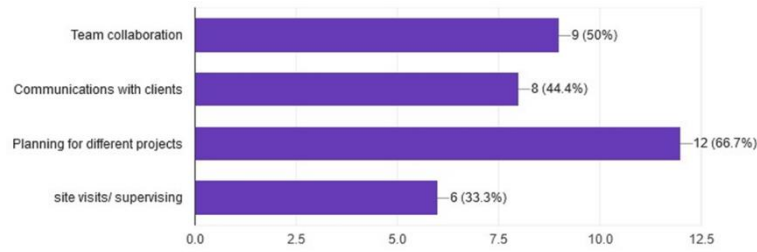


Figure 8: Result as yes for a project manager in the organization (Source: Author)

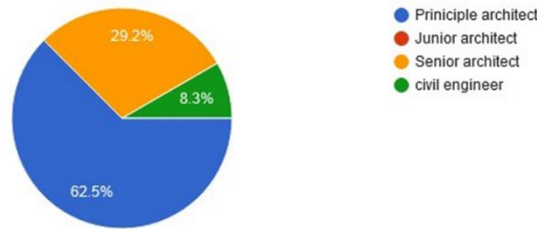


Figure 9: Result as no for a project manager in the organization (Source: Author)

In the above Figures 8 and 9, the analysis contributed as “yes” (present) or “no” (not present) of a project manager in the organization. If the project manager is present in the organization, Figure 8 represents the duties and responsibilities in the organization, and if the project manager is not present in the company, then who looks after the roles of project management in the company.

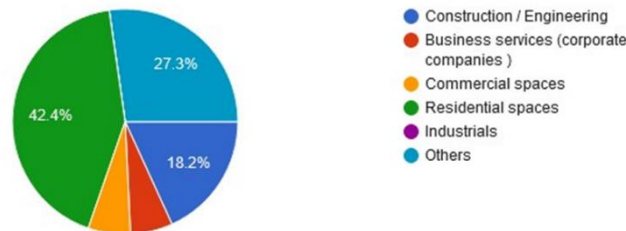


Figure 10: Pictographically representation of the types of projects delivered in the organization (Source: Author)

This figure 10 shows the analysis of the types of projects delivered in their organizations. From the above figure, it can be concluded that 42.4% of the organization delivers “residential spaces” as the typology of the project. The types of projects like “commercial spaces (6.1%) and business services (6.1%)” are the minimum delivered projects in the creative companies.

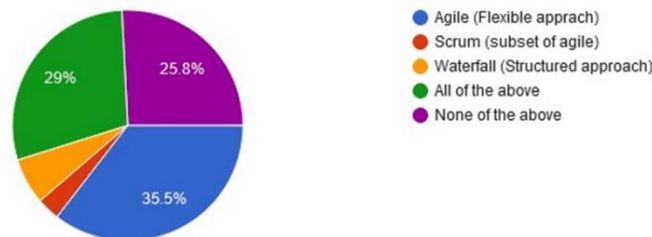


Figure 11: Model for methodologies of project management used in the company. (Source: Author)

## Application of Project Management...

This figure 11 highlights the project management methodologies used in an organization. Most of the participants use the “agile framework” as a methodology in their organization. Some participants use scrum or waterfall methodology in their companies. In Figure 11, it is shown that 25.8% of the participants do not use any methodology in their firms.

The next factor is the sustainable goals for project management. In sustainable goals, the most important criteria are the social, economic, and environmental aspects of project management.

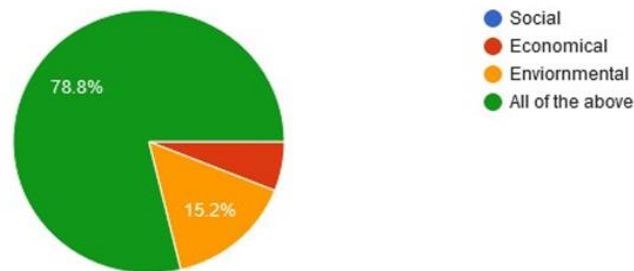


Figure 12: Results for criteria of sustainability towards project management (Source: Author)

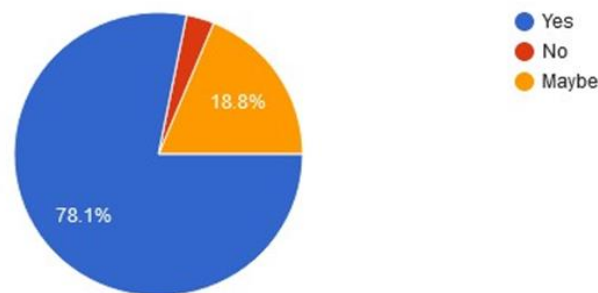


Figure 13: Analysis for adaptation of sustainability in project management (Source: Author)

The maximum percentage i.e. 78.1% says yes, it is important to adopt sustainable goals in the project management industry.

The next factor is the importance of project management in the creative industry. The questions are based on the role of a project manager in the design sector.

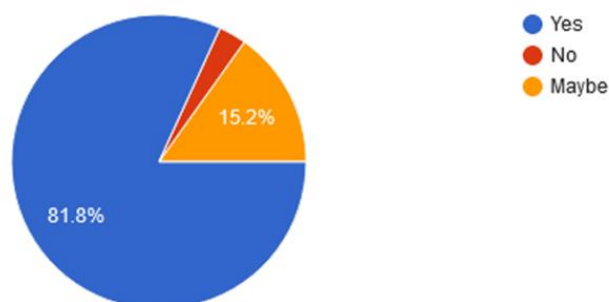


Figure 14: Model represents the importance of project management in a creative industry (Source: Author)

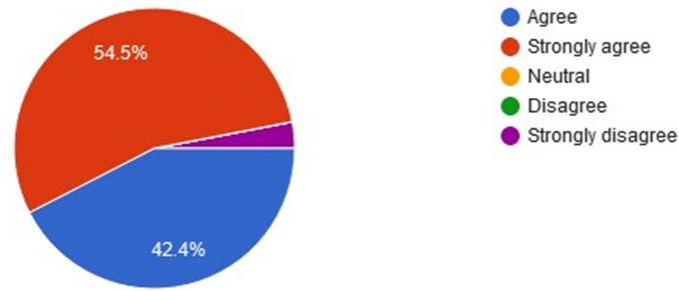


Figure 15: Results for communication in the creative industry (Source: Author)

The above-mentioned figure 14 represents the essentiality of project management in the creative industry. The maximum number of members (81.8%) who participated in the survey gave their opinion as “yes.” In the below figure 15, highlights the application of project management (communication) in the creative industry. The results show that 54.5% and 42.4% strongly agreed and agreed that “communication” plays a vital role in the creative industry.

#### 4.2. Results of Quantitative Analysis:

The results showed that most participants understood the importance of project management in the creative industry. It results from criteria like project management, sustainable goals, and the importance of project management in the creative industry.

For the first criteria, the participants provided their information related to the organization. From the analysis, it can be observed that there is a need for a project manager in a small-scale organization. The second criterion contributes to the sustainable goals of project management. From the analysis, the participants provided their opinion on the factors of the sustainable goals i.e. social, economic, and environmental aspects and its adaptability towards project management. The last criterion mentioned in the survey was the importance of project management in the creative industry. The analysis of this criteria showed that the participant strongly agreed with the application of project management and its importance in the creative sector.

### 5. Conclusion and Recommendations:

In conclusion, project management plays a crucial role in the creative industry. It also acts as a valuable tool in the creative industry. While creativity is the heart of this industry, project management helps enhance the entire creative process. Careful planning and effective methodologies of project management enable the creative team to deliver innovative and high-quality projects in the given time and cost. The project management fosters collaborations, ensures to fulfilment of the requirements of the clients, and contributes the long-term project success and sustainability in the creative industry. Creative organizations may achieve the right balance between freedom of creativity and project consistency by adding project management practices into their tasks, leading to more reliable, effective, and fruitful results. This strategic plan benefits both the designers and their clients by enabling creative businesses to flourish in a marketplace that is becoming more demanding and competitive.

The main idea that initiated this research has been derived from the gaps in the literature review on the application of project management in the creative industry. The gaps showed the relevance of the awareness of project management in the creative industry, the sustainability of project management, and the methodologies of project management i.e. Agile, scrum methodology in the creative business sector. The research also contributed to research questions that clearly illustrate the applications of project management in

the creative industry that are explained in this research. However, the research evaluates how these factors support creating awareness of project management in the design sector.

The daily work of the project manager has been studied in this research by floating questionnaires amongst architects, builders and civil engineers and the results are presented in the form of qualitative analysis as discussed above. It evaluates the feedback of participants in the survey. The results state that the role and responsibilities of the project manager and their day-to-day work like supervision for the visits, evaluation of the completion of the projects, scheduling meetings, examining the process of project management criteria and its implementation in the project management process and methodologies. To conclude, the importance of project managers and their implementation in the company and the success of the projects.

The sustainable goals for project management and the implementation of the same is to achieve long-term success while minimizing adverse effects on the environment and society, the management of sustainable projects emphasizes incorporating environmental, social, and economic factors into project planning and execution. To conclude, achieving sustainable objectives in project management requires a comprehensive strategy that considers the environmental, social, and economic factors. It requires leadership commitment, a change in organizational culture, and the incorporation of sustainability following the project's lifetime. The organization could assist in creating an environmentally friendly future while improving its brand and competitiveness by substituting sustainability first.

The process of project management principles and their importance in the creative industry are discussed further. Project management fundamentals are crucial in the creative sector. They assist in making sure that artistic endeavours are done effectively, promptly, and affordably while fulfilling the demands of the client and preserving the standard of the work. The work of a project manager has significance in the field of creativity for some reasons, including project coordination, leadership, networking, communication, motivation, and client satisfaction. To conclude, since projects in the creative sector often involve complex, various processes, project managers are crucial to the success of these initiatives. They play a crucial role in making sure that creative projects are finished successfully, in fulfilling client expectations, and in reaching organizational objectives. In the creative sector, project managers have a variety of responsibilities outside of just overseeing budgets and timetables. By fostering teamwork, assuring quality, maintaining relationships with clients, and reducing risks, they play a crucial role in the successful completion of creative projects. Their knowledge and abilities play a critical role in the long-term achievement of creative projects.

In this way, the main project management aspects and criteria can be fulfilled like creating awareness, using latest trends and technologies, and adaption to the methodologies of project management can lead to the success of the projects.

## 5.1. Recommendations:

Because creative work is unpredictable and often subjective, project managers in the creative sector have difficulties. In the creative sector, the following suggestions for project managers:

- ***Identify the creative procedure:***

Explore the steps of the creative process, such as conception, refinement, and discussion. Accept the fact that creativity cannot always be intimidated or planned.

- ***Develop Reliable connections:***

Develop a close bond with the members of your creative team. Recognize each person's unique talents, shortcomings, and working methods. Encourage a friendly, open atmosphere.

- ***Communication:***

Let the creative team know exactly what is expected of them and what the project's goals are. Encourage open feedback while holding onto a positive attitude.

- ***Flexible Planning:***

Be accommodating with project deadlines and give time for revisions and creative experimentation. Include buffers for anticipated creative hurdles or input from clients.

- **Constant Development:**

Be mindful of each project to recognize areas where your project management techniques might be improved. In order to satisfy the unique demands of the creative business, adapt and enhance the approach used in the organization.

- **Creativity in Projects:**

The ability to search for creative solutions to address problems streamline procedures and promote creativity in the management of project strategy.

In the creative sector, project management requires a careful balancing act between structure and adaptability. It is possible to effectively handle resources and expectations while leading creative projects to completion by having a thorough understanding of the creative process.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Barriers in Adoption of Circular Economy and Industry 4.0 Technology for Effective Resource Consumption through Responsible Consumption and Production (SDG12) of Resources

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## **Abstract:**

*Resources and its scarcity, leads to imbalance in the supply and demand that leads to instability in the market, economy and ecology as well. There are basically two types of resources natural and manmade both are scarce its effective distribution helps to reduce inequality in the society and thus leading to sustainable development. United Nations SDG 12, Responsible Consumption and Production of resources deals with it. This paper looks at the three basic human needs Clothing, Food, Shelter and fourth is adoption of Industry 4.0 technology for responsible consumption and production of resources. Adoption of Industry 4.0 technology for effective resource consumption can be the key aspect for the successful implementation of SDG 12. Paper tries to establish the relation between adoption of Circular Economy (CE) and some of the popular urban Industry 4.0 technologies for effective usage of resource consumption. For limiting the scope of paper, Circular Economy and its simple interpretation for urban population is kept limited to Reduce, Reuse and Recycle. In case of adoption of Industry 4.0 for urban population it is also kept very simple for common man, and reviewed for its usage and adoption through internet, mobile technology, social media etc. For conducting the research sample survey is conducted to various age groups, genders and questions linked to above 4 study areas are probed. The sample survey results are analyzed for all four aspects of research - basic needs of human being, clothing, food, shelter and adoption of technology and its relationship with CE & I 4.0 is established. The conclusions about human behavior on issues related SDG 12 i.e. Responsible Consumption and Production and adoption of Industry 4.0 are drawn. The survey results had personal details wherever required further additional probe is done through telephonic discussions. This inquiry further helped in establishing the barriers in adopting the Responsible Consumption and Production of resources SDG 12, Industry 4.0 technology in Urban Areas.*

**Keywords:** *basic human needs, responsible consumption and production (SDG 12), circular economy, industry 4.0*

## **1. Introduction:**

The production processes involve linear and circular economic approaches at present, the conventional linear economy model of “take, make, and dispose” prevails, leaving many questions unanswered (Hofstetter et al., 2021) in the context of Responsible Production and Consumption of Resources (SDG 12). SDG 12 includes eight specific targets (Targets 12.1–12.8) plus three targets related to Means of Implementation (Gasper et al., 2019) for efficient consumption of resources. These targets are not only set for big corporate giants but they are aligned towards society as well. A circular economy describes an economic system that is based on business models which replace the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro-level (products, companies, consumers), meso-level, (Eco industrial parks) and macro-level (city, region, nation and beyond), to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations” (Sarmiento Dos Muchangos, n.d.) Both these economic models evolved over the period of time and has seen many industrial revolutions and scientific innovations. Industrial Revolution 1.0, 2.0, 3.0 each of these revolutions increased the consumption of resources which was take, make and throw pattern i.e. linear economic models. Now I 4.0 offers us the opportunity to convert the linear economy to a circular economic model.(Rahigude et al., n.d.)

## **2. Research Question:**

Responsible Consumption and Production (SDG12), Circular Economy (3Rs i.e., reuse, recycle & repurpose), Industrial Revolution 4.0 & Common Man in Urban Areas, if this is the focus of work and if we try to understand the impact of use of Industry 4.0 technology in the day-to-day life of common man for SDG 12 actions? Industry 4.0 technology may have many new advancements and revolutions that are impacting the large industries and corporate houses and they could be seeking the great rewards of the same, the paper tries to focus on impacts of I 4.0 through innovations of mobile technology on common man’s life for SDG 12?

## **3. Scope of Work:**

Resource consumption scope is limited to basic human needs like – Food, Clothing, Shelter, and one more aspect is added that advancement of Technology (I 4.0) i.e., use of mobiles, internet and easily accessible technologies of I 4.0 that are available to urban population.

## **4. Methodology:**

Human behaviour depends on so many parameters some of them are listed here – sociocultural, religious beliefs, education, economic conditions etc. In this context for understanding the human behaviour of urban population in the context of SDG12, Circular Economy, Industry 4.0 adoption i.e., simple usages of mobile and internet technology, survey sample form was floated to around 100 respondents through Google Form. The questions were hypothetical and situation based. The questions were probing on Food, Clothing, Shelter, & Advancement of Technology and its uses in the Circular Economy (3Rs), Industry 4.0, Environmental care and sensitivity. In case of Shelter the hypothetical situation of pet animal’s shelter is considered. The grouping of the questions was done in such a way that human behaviour in the context of individual capacity, community



capacity, role of government, adoption, application and use of advanced technology is tracked. For comprehending the results in better manner and for drawing conclusions some basic individual's personal information is also collected. The survey forms were floated and after certain time some of the individual reminders were given and where ever the results were not satisfactory or skew one to one telephonic communication was established and further clarifications were taken.

## 5. Literature Review:

Scope of literature review is kept to broad understanding of the advancements of Industry 4.0 technology and its impacts on Common Urban man. Major Drivers of Industry 4.0 are (McKinsey and Company, n.d.) –

- Connectivity, data, and computational power – Cloud, block chain, internet
- Analytics and Intelligence – advanced analytics, machine learning, artificial intelligence
- Human–Machine interaction – Augmented reality (AR), Virtual Reality (VR), Robotics and Automation
- Advanced Engineering – Additive Manufacturing, Renewable Energy, Nano Particle etc.

If we read all above 4 items carefully common man in urban area is directly impacted due to use of advancement of mobile and internet technologies. Transition of from 2G, 3G, and 4G and now availability of 5G technology to common man has impacted urban life and urban development. Very competitive market of service providers has kept very limited players in the market. In the early times BSNL, MTNL, Airtel, Tata, Vodafone, Aircel, Jio were the some of the service providers in India. Amongst them Jio is the key service provider and post Covid 19 after 2020 common man in Urban Areas life is hooked to mobile handsets. Common man's entire life and day's cycle is dependent on mobile handsets and consumption of data. At the back end big players like Google, Amazone, Tata, Reliance, D-Mart, Myntra, to other service providers Ola, Uber, Dunzo, etc they are using all above mentioned Industry 4.0 technologies for exploitation of Indian Market take economic benefits of the same. All these advance technologies are getting used for consumption of resources. But the question is being these corporate giants and common man using them in the interest of environment and SDG12? At present 2D printers are almost part of every individual's house or personal office space and very soon additive manufacturing may become part of every individual's personal space. In this context it will be interesting to understand human behavioural pattern towards SDG 12.

## 6. Results:

The survey results are formulated in five subsets its starts with basic background of respondents in the form of age group, gender, occupation & Education becomes first set of results followed by four sets of results which are about behavioural aspects of users in terms of adopting the industry 4.0 technology for effective resource consumption through adoption of Circular Economy. In this focus is kept on understanding individual behaviour, community level issues and behavioural pattern for effective resource consumption. The last four subsets of results are linked to basic human needs like food, clothing, shelter, & adoption of Information Technology Resources.

### 6.1 Respondents Background:

Urban Population, use of mobile technology, email communication are the most updated technologies used by common man in the day-to-day life. Post Covid 19 after evolution and spread of use 4 G, 5G Spectrum in India use of mobile devices have increased people have very well adopted to it and same is reflected in the sample survey that was conducted. In the adoption of technology there is no gender bias involved and both the

genders have responded equally to survey (Figure 1). Majority of the respondents are within the age group of 16 years to 40 plus years of age. Very negligible % of the respondents are of the 6-15 years of age where children are in the primary and secondary school and during this period mostly, they are dependent on parent's handsets and they use it for academic activities. Majority of the users 85% of them are above 16 years where student population enters in the 11<sup>th</sup> standard and at this age as per need, and requirements independent access to these technologies become essential and these are made available to individuals in Indian Culture (Figure 2).

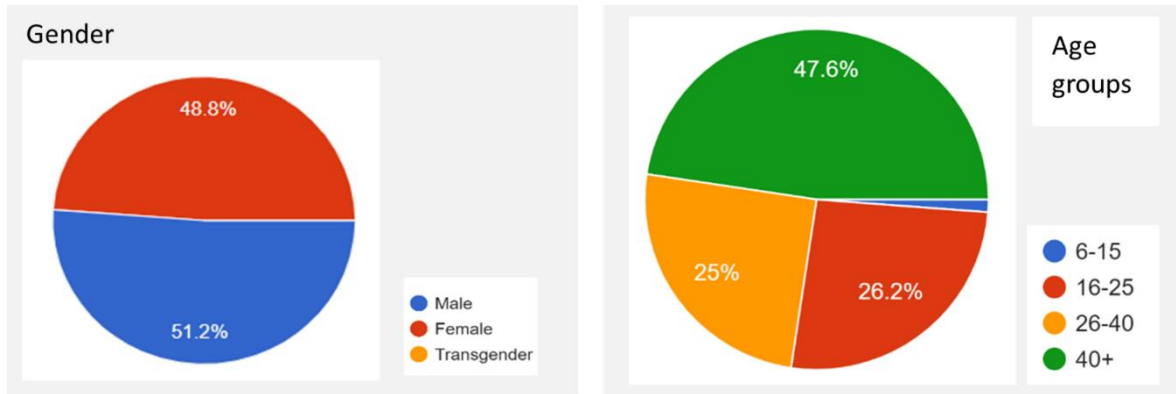


Figure 1: Gender Responses (Left) and Age Group of Respondents (Right) (Source: Author)

Mobile and internet technology and its usage can be observed in the entire cross section of the society and users are involved in jobs, profession, business, education and home makers in the urban areas are well versed with the use of technology and they have very well adopted to the advancement of the technology. Occupation distribution is almost in the range of 30% plus or minus in the professionals, jobs or service sector users and students' population each (Figure 3). Here the noteworthy point is almost 27% of student population have responded to the survey it shows very positive side that urban Indian student population is very much adaptive to new technological revolutions. In terms of education background also it shows majority of participants 80% of them are graduate, post graduate and finished their PhD research works (Figure 4). This shows that participants are literate and they are educated and they might understand the importance of issues related resource consumption, climate change, global warming, and in this context, one has to read and interpret the various responses of the results and interpret them. If this is the situation, then how do we convert this opportunity in to effective resource consumption through responsible consumption and production (SDG12) of resources.

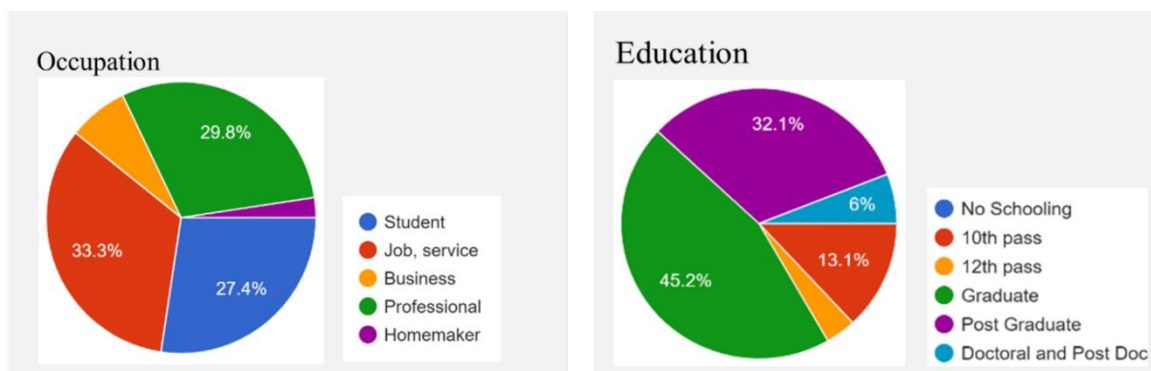


Figure 2: Occupation of Respondents (Left) and Education Profile (Right) (Source: Author)

## 6.2 Food as the basic human need:

Food as the resource when it is cooked at the individual’s family or at community function and if it is surplus in the quantity?

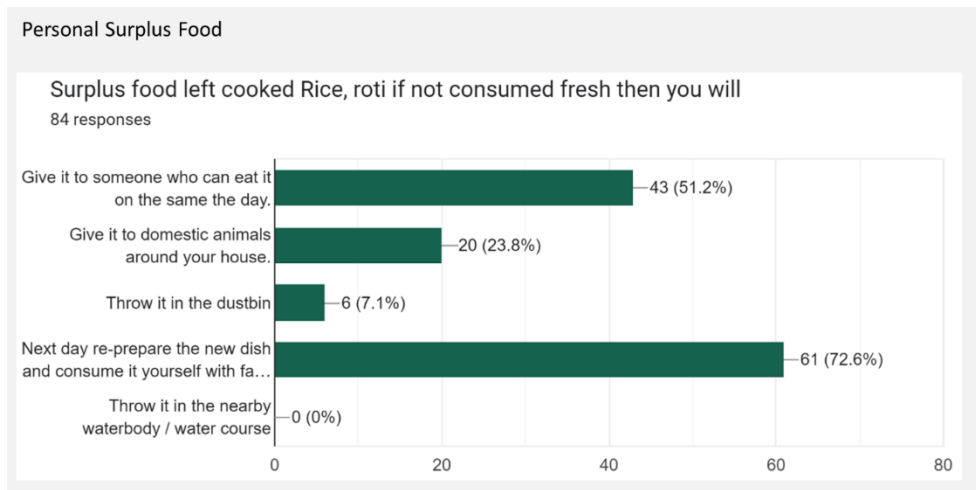


Figure 3 - Surplus food at Individual, Family level (Source: Author)

On this left-over excess food behavioural pattern of urban population is reflected in the survey results. This pattern is influenced by culture, religion, food habits, beliefs etc. The survey tries to establish the relationship between use of I 4.0 technology, natural resources conservation & surplus food (Indian bread *Chapati*, Rice) management at individual, family & community level. Zero % participants (*Figure 5*) wish to manage waste by disposing it in water bodies, may be this could be for avoiding water pollution this need to be further probed because one can say it can be consumed by aquatic life. Around 7% of respondents are in favour of throwing it in the dustbin but remaining almost 93% of respondent would like to repurpose, reuse, recycle it for various purposes as per the priorities that they set for themselves. As the respondents had options of choosing multiple options aggregate % is more than 100% Majority of participant do not mind consuming it with new preparations, reason could be food and its cultural habit of conserving the resources.

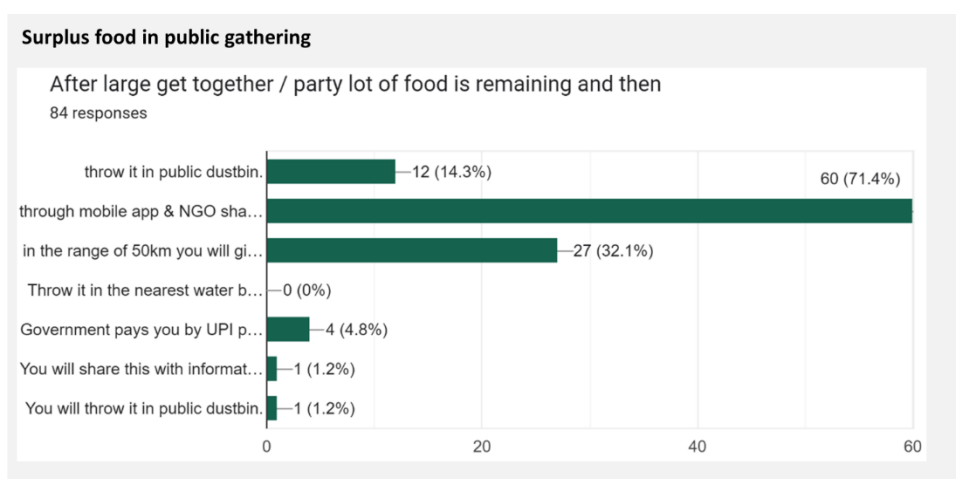


Figure 4 - Surplus food in Public Gathering (Source: Author)

Second and third bar from top shows 71% & 32% are using the mobile app and distribute it in poor and repurpose it by giving it as a food in the range of 50 km. Fifth bar shows 4.8% people believe that government can repurpose it and pay them through UPI payment option. Throwing it in the public dustbin and water course is not preferred by the respondent.

### 6.3 Clothes as the basic human need:

Cloths as the basic necessity for humans when used for optimum period when individual wish to repurpose it 37% & 43% respondents preferred to exchange it with readymade brand of cloths, and request their family members to use it and buy new one for themselves (Figure 7). Option of throwing it in the dustbin and giving it rural and urban poor is not preferred option.

Cloths, house hold linen etc 66 % and 51 % participant wants to repurpose the clothing making designer quilt, give it to Khadi Gram Udyog NGO/ Women self-help group for repurpose (Figure 8). Very few opted for throwing it away and taking advantage of UPI based rewards points for repurposing.

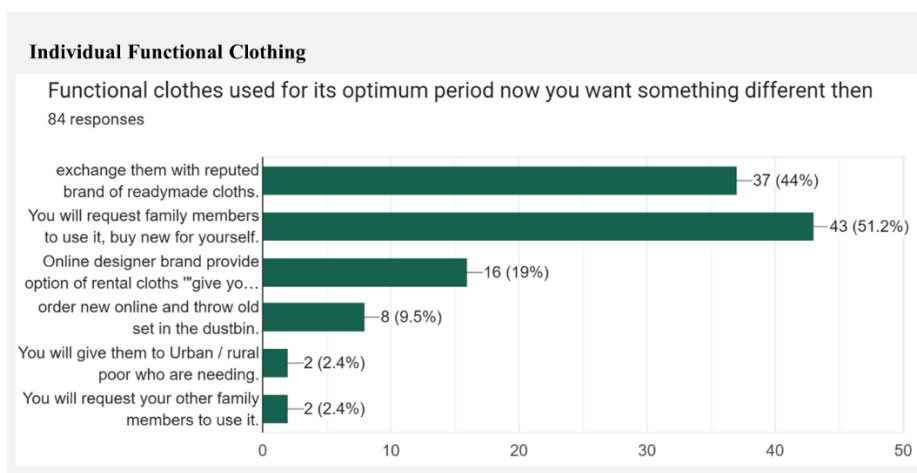


Figure 5: Functional Personal Clothing (Source: Author)

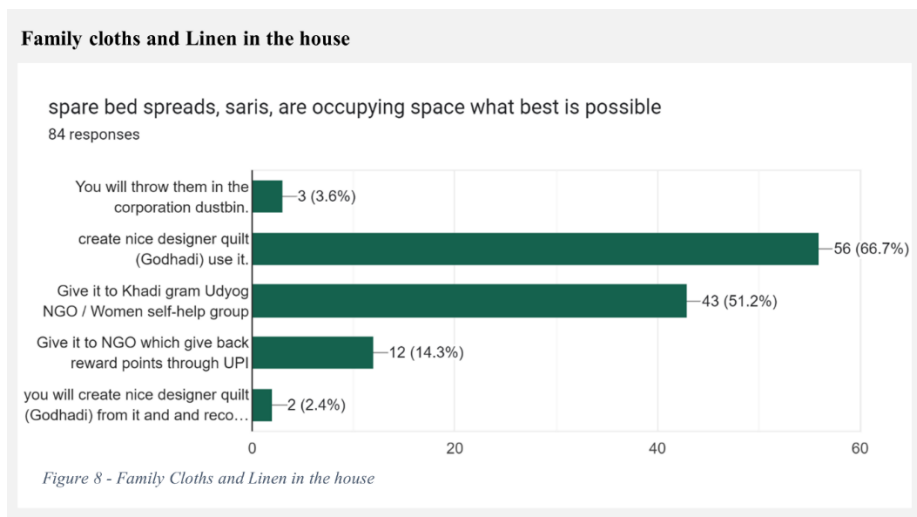


Figure 6: Family Clothes and Linen in the house (Source: Author)

### 6.4 Shelter as the basic human need:

Transforming human shelter through 3R was not feasible for individual to respond on so example of pet’s shelter is considered. For the pet shelter, out of various options given 64% & 27% respondents expressed waste resources can be recycled, repurposed and second-hand shelter through social media (*Figure 9*). Around 22 % opted for making the shelter from new resources and get it executed from skilled team. 20% respondent opined that they would prefer to work in reuse, recycle and repurpose works (*green jobs*).

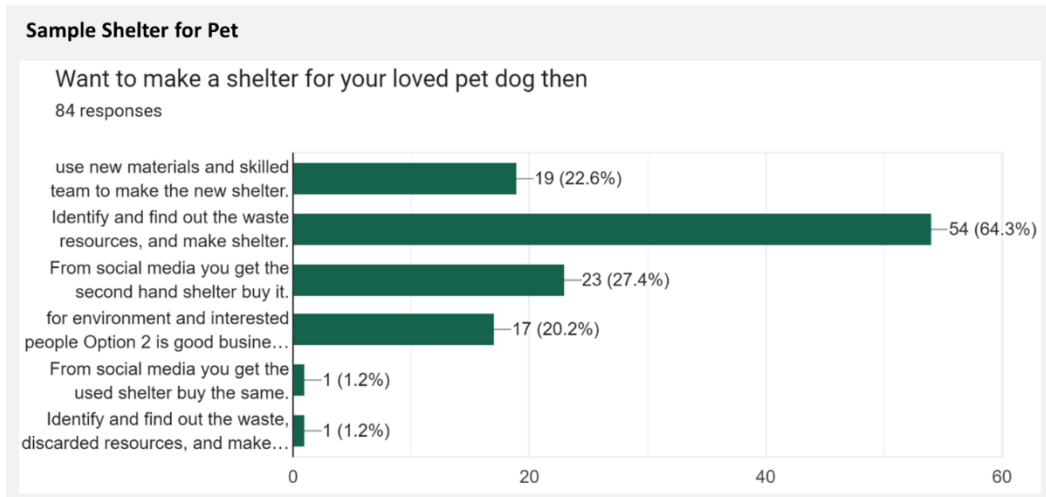


Figure 7 – Sample Shelter for pet (Source: Author)

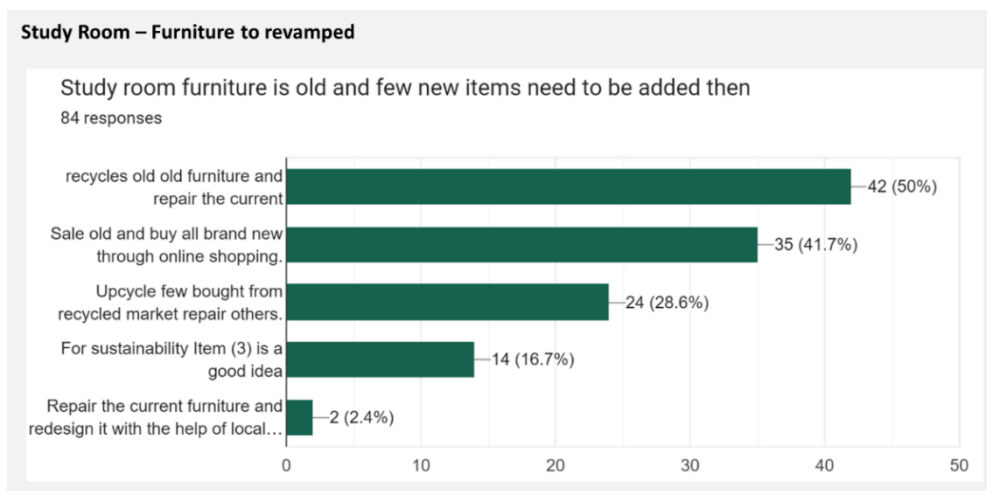


Figure 8 – Study Room Furniture to be revamped (Source: Author)

For the study room furniture revamping around 29% of respondent have shown comfort in getting old furniture items from market and upcycle them (Refer figure 10). Around 42% are responses show that they will sale the old items and buy the new through online platform. 50% of the respondent have opined that they will recycle the old furniture and repair the existing one for revamping study room.

### 6.5 Information Technology as the basic human need:

For mobile hand set upgradation 50% of the participants are ready to lose the exchange value but they want better brand (Refer figure 11) 45% are showing the interest disposing the old item with E Waste company and buy the new one. 2% respondents have opined they will throw it the dustbin.

About Information Technology Infrastructure (Refer figure 12) around 52% are ready to exchange and get the upcycled products. 42% are confirming they can sell it to E Waste company. Very least preference is given to advertisement, government E Waste company, dustbin as the option of disposal of waste.

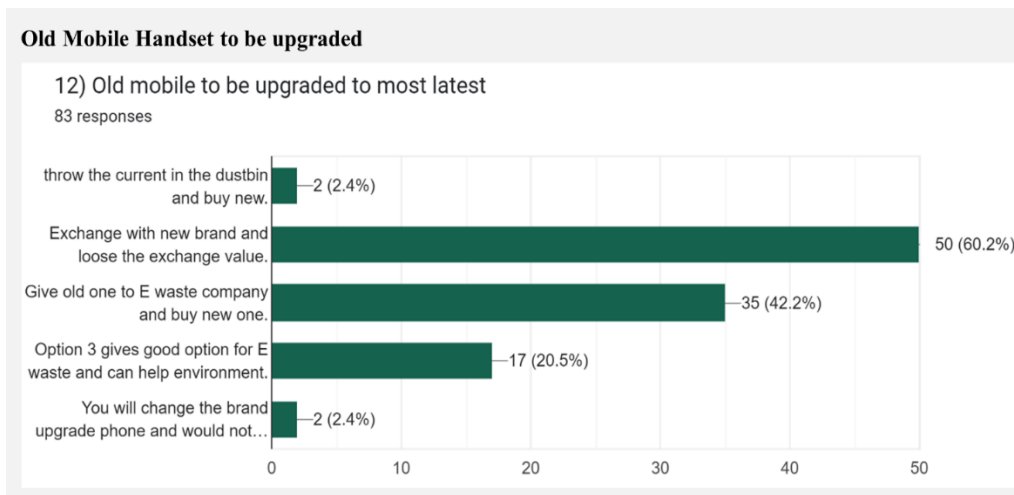


Figure 9 – Old mobile handset to be upgraded (Source: Author)

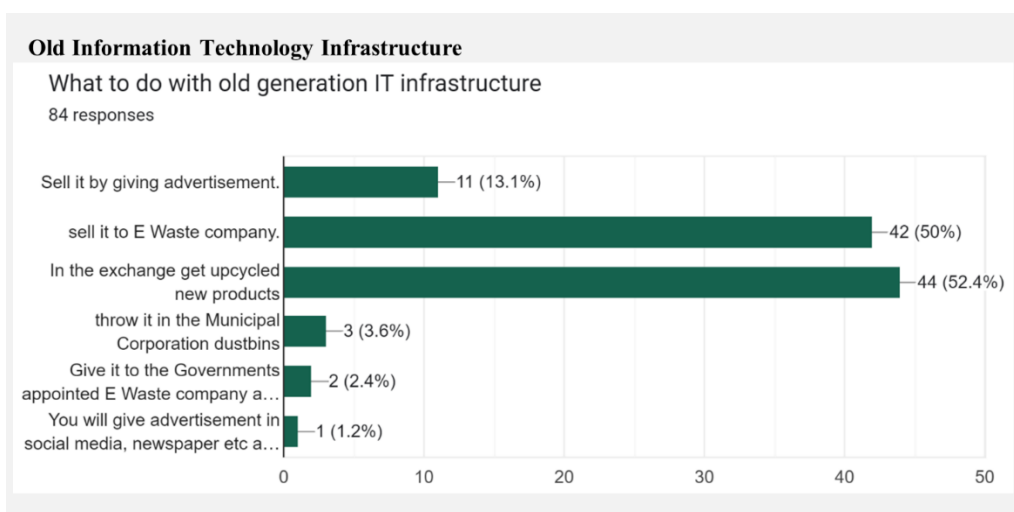


Figure 10 – Old Information Technology infrastructure (Source: Author)

## 7. Discussions:

The survey was conducted through google form and as per age groups telephonic feedback and discussions were conducted with participants. Key points that came up were above 40 years of age population is very effectively using mobile technology for communication. But spread and extent of Industry 4.0 revolution is creeping in to work places and upskilling and adopting to the technological change is the biggest challenge and in case if they do not adopt to I 4.0 they feel that they will face jobs threats. In the same age group senior citizens expressed that almost 50% of them have adjusted to the technological change. 50% need to upgrade themselves for adopting to use simple communication mediums like emails, use of what's app etc but they consider themselves as retired. 50% of the population is young Indians who are ready to adopt to these challenges and ready for technological revolutions. This generation feels Covid 19 pandemic showed them new ways of communications, education and working systems. They are provided with simultaneous job options as per their choices and skills that they have. They are all available online platforms. This has increased their opportunities for learning new things and options of jobs have increased. New cultures of work from home, hybrid work systems have evolved and it's a separate area of further research works.

## 8. Conclusions:

Post pandemic survey of adoption of Industry 4.0 technology for use of Circular Economy (Reuse, Recycle & Repurpose) for basic human needs i.e., food, clothing, shelter & technology shows the clear trend. Urban population is aware about environment they live in they do not wish to pollute the natural resources. The population shows very clear pattern that they are ready to adopt to the simple technology which can be accessible through handheld devices. Age group of 40 years and above expresses I 4.0 as the job threat unless and until they upskill themselves. Age below 40 years are happy in adopting to new challenges and seek the benefits of same. Respondents show the trend that they do not have faith in government systems and mechanism for adoption of Circular Economy through Industry 4.0 technology.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Coconut Fiber: The Answer to Sustainable Building Materials

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## **Abstract:**

*In today's rapidly changing world, the need for sustainable alternatives for construction materials has become increasingly pressing. As population growth and urbanization continue to surge, the demand for buildings and infrastructure has escalated, putting immense pressure on natural resources and ecosystems. Traditional construction materials, such as concrete, steel, and brick, often come with high embodied energy, excessive resource consumption, and significant carbon emissions. This unsustainable reliance on finite resources increases environmental degradation and contributes to climate change. As awareness of the negative environmental impact of construction rises, there is a growing consensus among architects, engineers, policymakers, and the public that a shift is needed in the construction industry. There is a need to not only find better alternatives but to re-examine the construction system entirely. This paper aims to reintroduce coir fiber- a fibrous natural material found in coconuts- as a possible alternative to traditional construction materials. This study is conceptual and idea-based. It highlights the need to be creative in our approach towards the built environment and to draw inspiration from our surroundings. It is based on the review of secondary datasets and literature. It introduces a construction system that employs the properties of coir fiber and enhances them by drawing inspiration from mycelium of mushrooms.*

**Keywords:** *coconut fiber; natural; organic; sustainable; innovation*

## **1. Introduction:**

As our global population continues to grow, and urbanisation expands unabated, the demand for buildings and infrastructure has soared to unprecedented levels. This rapid growth places immense pressure on our natural resources and ecosystems, resulting in significant environmental challenges. Among the chief contributors to these issues are traditional construction materials like concrete, steel, and bricks, which come burdened with high embodied energy, excessive resource consumption, and substantial carbon emissions. The environmental consequences of relying on finite resources in the construction industry are undeniable, amplifying ecological degradation and exacerbating the pressing issue of climate change. As awareness of these challenges grows, there is a growing consensus among architects, engineers, lawmakers, and the general public that a transformative shift in construction practices is imperative. Research shows a strong focus on reducing carbon emissions throughout a building's lifecycle, from design and construction to its operation. (Wang et al., 2022) However, there's a gap in quantifying the carbon footprint of recycling construction waste at the end-of-life stage. This study specifically investigates the carbon emissions associated with recycling key construction materials like concrete, brick, steel, wood, and mortar. It's important to consider this aspect since the building sector is reported to contribute significantly to global carbon emissions, accounting for roughly 40%. While efforts are being made to mitigate these emissions, it is proving difficult to do it on a considerable scale due to the sample size of the construction industry. In the current times, taking inspiration from nature is becoming



increasingly feasible due to increasingly advanced technologies. This paper aims to explore the viability of coir fiber as an eco-friendly alternative to traditional bricks, with a focus on its potential to mitigate carbon emissions and reduce environmental impact in the construction industry. Derived from the middle shell of coconuts, coir fiber exhibits unique properties that make it a promising candidate for reducing carbon emissions in the industry. By harnessing this biodegradable material, we aim to address the environmental impact of traditional bricks and pave the way for a more ecologically responsible approach to building.

As fertile land dwindles and populations bloom, the future of agriculture stares us in the face – and it might be skyward. Traditional farming, reliant on dwindling arable land, struggles to keep pace with our growing needs. This is where vertical farming emerges, a beacon of hope amidst the shrinking soil fertility crisis. Within these vertical farms, crops thrive in meticulously controlled environments, independent of the vagaries of soil health. Nutrient-rich mists nourish plants, artificial sunlight bathes them in optimal wavelengths, and recycled water sustains their growth. This not only bypasses the limitations of depleted soil but also minimizes water usage and reduces reliance on chemical fertilizers, both crucial aspects of a sustainable future. This technology holds the potential to revolutionize food security, offering a glimmer of hope in a world grappling with the challenges of dwindling resources and a burgeoning population. So, as we look to the future, let's turn our gaze skyward, for the seeds of a greener tomorrow might just be sprouting in the clouds. This study takes a comprehensive approach, investigating various aspects of coir fiber, including its extraction, processing, and potential future applications. It also proposes a design for the incorporation of coir into a building by drawing inspiration from nature. This paper intends to explore the limitations of the material and draw comparisons between regular bricks and coir-based bricks. By examining the viability of coir fiber as a building material, this research seeks to contribute to the ongoing efforts to mitigate carbon emissions in the construction sector and foster a more sustainable built environment.

## 2. Methodology:

Biophilic architecture tends to draw inspiration from nature by adapting its form and thus, the design for the prototype drew inspiration from mycelium, the root-like structure of fungi. However, this study delves deeper into the cellular structure of mycelium and its behaviour and draws inspiration from the behaviour of the cells when they come in contact with nutrients. The study is conceptual and exploratory in nature, encouraging the idea of creative and innovative solutions for sustainability. This study is an out-of-studio project, with a mix of experimentation, primary research and secondary datasets.

## 3. Coir Fiber:

Derived from the fibrous husk of coconut fruits (*Cocos nucifera*), Coir Fiber is a versatile natural material. After extraction and cleaning, these fibers acquire a golden hue, aptly earning them the nickname ‘The Golden Fibre.’ (Fibre | Coirboard, n.d.)

Coir is a material made from the fibrous husks of the inner shell of a coconut. (see, figure 1) It is an eco-friendly, renewable substance that is one of the hardest natural fibres and is advantageous in different applications like soil erosion control, reinforcement and stabilisation of soil. It can also be used as a fertiliser, mulch, and a way to help conserve water. (MSME India, 2020)

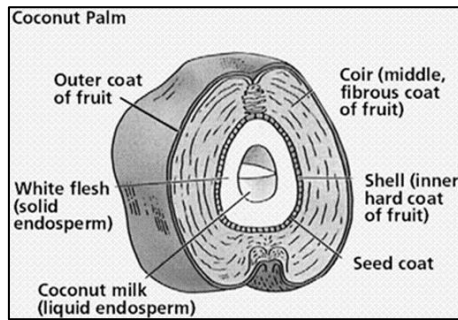


Figure 1: Parts of a coconut depicting Coir Fiber (Source: Asokapandian et al., 2013)

Coir, a naturally flexible fiber, comes from the fibrous husk of coconut fruits. This outer husk holds a surprising amount of coir, with 20-30% by volume consisting of these versatile fibers, which vary in length. Processing involves grinding the husk to separate the long fibers ideal for commercial applications like rope and mat production. The remaining material, a mix of shorter and medium-length fibers along with pith (inner tissue), is often called waste-grade coir. This waste can be further processed through screening to remove some or all of the remaining fiber, leaving behind coir pith as the final product.

### 3.1. Properties of Coir fiber:

1. Naturally stable: It is Moth-proof, and resistant to fungi and rot.
2. Insulating material: Exceptional insulation for temperature and sound.
3. Naturally fire resistant: Offers inherent resistance to catching fire.
4. Self-extinguishing: Suppresses flames on its own if ignited.
5. Moisture-proof: Unaffected by water and humidity.
6. High durability: Withstands wear and tear effectively.
7. Resilient: Bounces back to its original shape after pressure.
8. Anti-static: Does not attract or hold static electricity.
9. Low maintenance: Easy to clean and requires minimal upkeep.

### 3.2. Extraction of Coir Fiber from Coconuts and Production of Coir Mats from Coir Fiber:

One common method involves moistening the husks and processing them in a machine called a buster. This machine breaks down the husks, separating about 60% of the fibers. The husks are then fed into a beater to further extract the fibers. Finally, a revolving screener cleans the extracted fibers. This method can process around 25,000 husks per eight-hour shift. (India, 2018)

Traditionally, coconuts are de-husked using a machete to remove the outer husk from the inner nut. The husks are then soaked in water to promote the growth of microbes. These microbes break down the softer parts of the husk, leaving behind the raw coir fibers. This raw coir contains both usable long fibers and shorter, unusable material called coir pith. The coir pith is typically discarded or used as mulch.

The raw coir undergoes a beating process in a fast-rotating drum with sharp blades. This loosens the fibers from the remaining material. A slower rotating drum then separates the fibers by length. Shorter fibers are used for mattress padding, while medium-length fibers become coir doormats. The longest and strongest fibers are used for making twine and rope. Finally, the medium-length coir fibers suitable for doormats are bundled and assembled into various shapes, sizes, and designs. (How Are Coir Doormats Extracted and Made into High Quality Door Mats? n.d.) (Goodyear Rubber Mats and Flooring, n.d.)

### 3.3. Coir in Construction:

As a sustainable alternative to sand, coir fiber shows promise in specific concrete applications. Coir offers several advantages: it's a renewable resource, improves thermal insulation, enhances permeability, and reduces shrinkage during drying. These properties make coir concrete particularly suitable for drainage applications. While its overall strength is lower than traditional sand concrete, it remains strong enough for non-load-bearing structures.

Coir ply offers a viable alternative to traditional plywood. Made by combining coir fibers with resin and specially treated wood veneer, coir ply provides several benefits. It boasts superior abrasion resistance compared to traditional plywood. Additionally, coir ply demonstrates greater temperature stability, resisting warping and expansion/contraction due to extreme temperature fluctuations. (Coir.com, n.d.)

### 3.4. Similarities between Coir Fiber and Mycelium:

- Both are insulating materials
- Both are organic materials
- Both are biodegradable
- They both possess a thread-like structure
- Mycelium's root provides nutrients to the fungus whereas coir fiber acts as a reinforcement agent to fortify the shell of coconuts.

## 4. System in Nature for Biophilic Inspiration of Prototype:

The term mycelium refers to the thread-like root structures of fungi. (see, figure 2) Mycelium develops from the fungal hyphae. It is the vegetative part of fungi. Mycelia plays an important role in reproduction. They also help in the decomposition of organic matter, which makes them very important in nature. It consists of a mass of thread-like structures called hyphae. (Alemu et al., 2022).

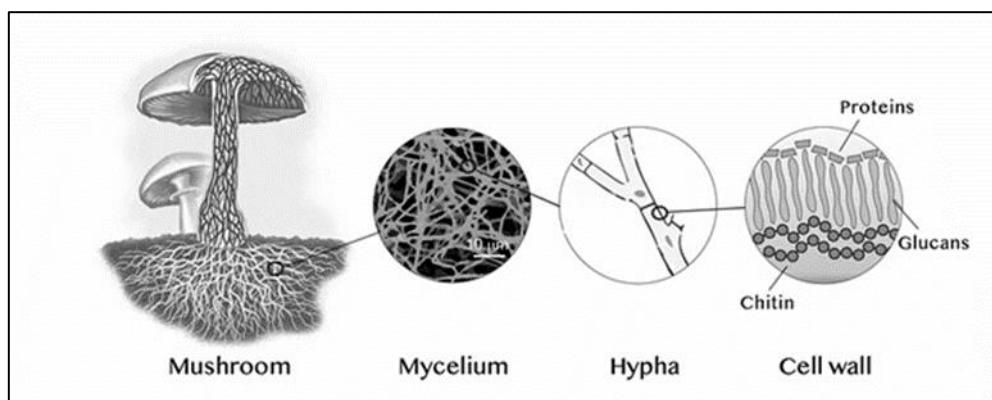


Figure 2: Detailed view of the structure of Mycelium (Source: Haneef et al., 2017)

### 4.1. Properties of the Material from System in Nature:

- **Binding**-When mycelium grows through organic materials such as straw, or agricultural waste, it binds the matter together like glue. The resulting material is very versatile and when used in construction, it has the potential to ease environmental problems caused by resource depletion, deforestation or toxic emissions.

- Thermal conductivity: Initial testing indicates that mycelium insulation has good thermal conductivity with an indicative range of 0.03 – 0.06 W/m.K (BIOHM, n.d.)
- Fire Performance: Mycelium does not contain synthetic, resin-based materials that can cause harmful toxic smoke and the quick spread of flames during a fire. (BIOHM, n.d.)

## 5. Concept of Prototype:

The idea for the prototype/brick originated from the growth pattern of mycelium. The mycelium at its cellular level acts as a binding agent by growing in the direction of available nutrients, creating a hollow circular structure in the centre which grows larger as the mycelium spreads over an area. As the mycelia deplete available nutrients in the inner part of the circle, the inner portion gets hollowed as there are no more nutrients. Therefore, this leaves an empty central area as the mycelia spreads outwards more. (see, figures 3,4 and 5).

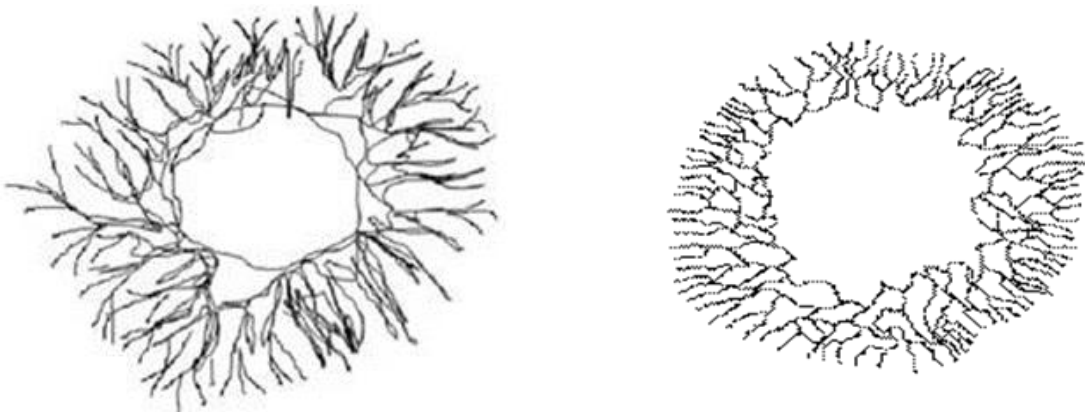


Figure 3: Cellular Structure of Mycelium when it receives nutrition (Source: Lepp, 2013)

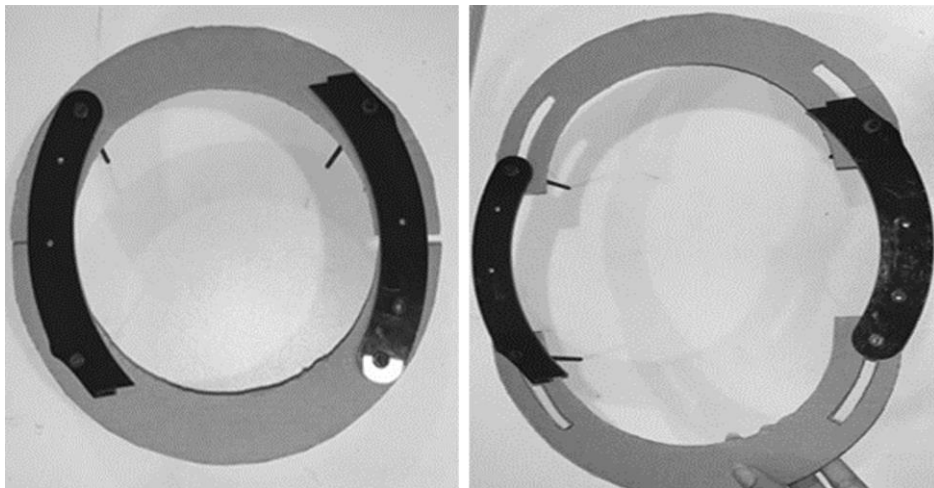


Figure 4: Prototype Iteration-1 (Source: Authors)

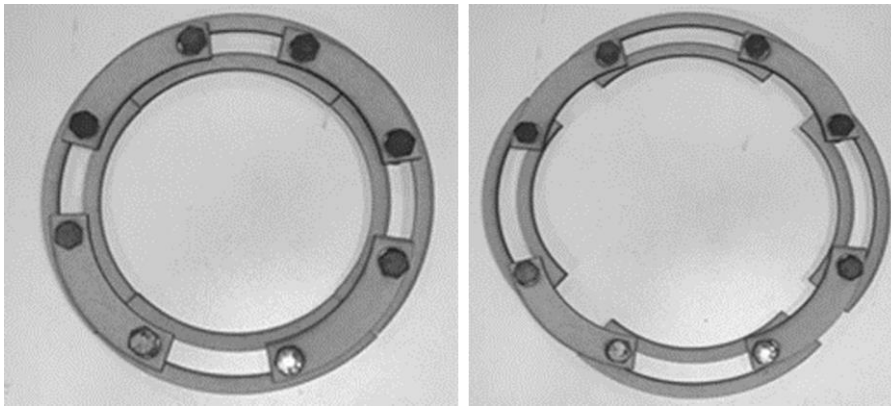


Figure 5: Prototype Iteration-2 (Source: Authors)

The increase in the number of units maintains the polygonal properties of the iteration-1 but this iteration due to its increased number of members is much more amorphous in nature. (see, figure 6)

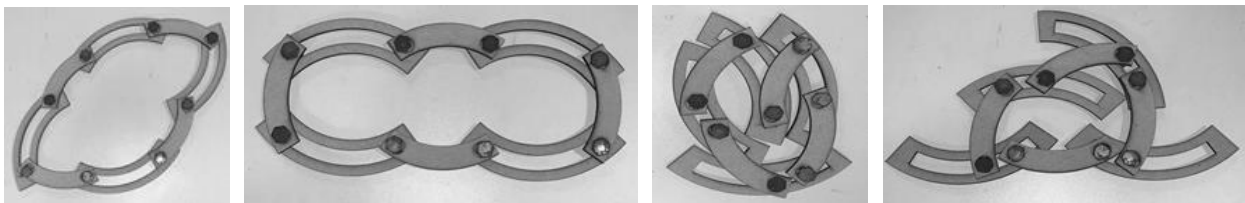


Figure 6: Prototype Iteration-2 showcasing the amorphous nature it possesses (Source: Authors)

Various other experiments were done to understand the interaction between two bricks/prototypes and how they can be connected to effectively form a structure. (see, figure 7)

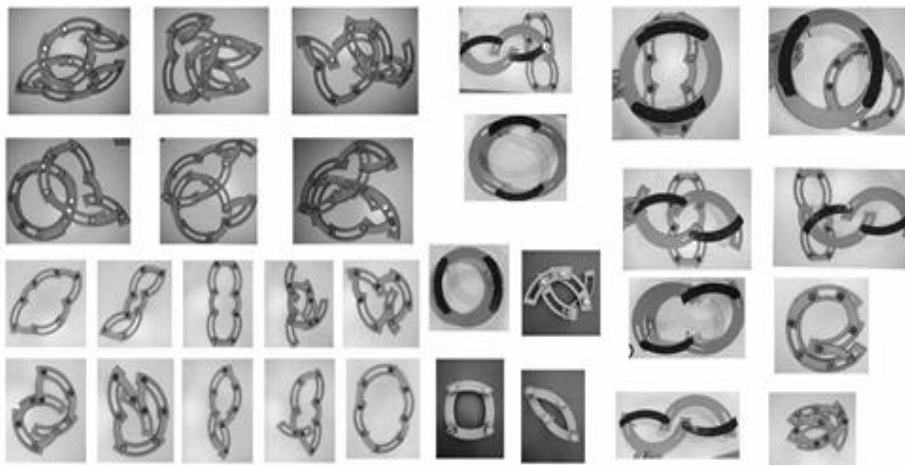


Figure 7: Various Prototype iterations that were experimented (Source: Authors)

### 5.1. Incorporation of Coir Fiber in Prototype:

The material used for the prototype was primarily coconut coir, a naturally occurring fiber used worldwide for its remarkable durability and scrapping properties. The back and side frame of the floor mat comes embedded with Natural Rubber, a material with excellent weight-bearing capacity. The coir inserts in the rubber frame can withstand harsh climatic and physical conditions. The prototype may be used to create a wall similar to how bricks are used by using wooden sticks as joining elements. The walls may not be load-bearing but provide thermal insulation and ventilation. (see, figure 8 and 9)



Figure 8: Incorporation of Coir Fiber in Prototype (Source: Authors)

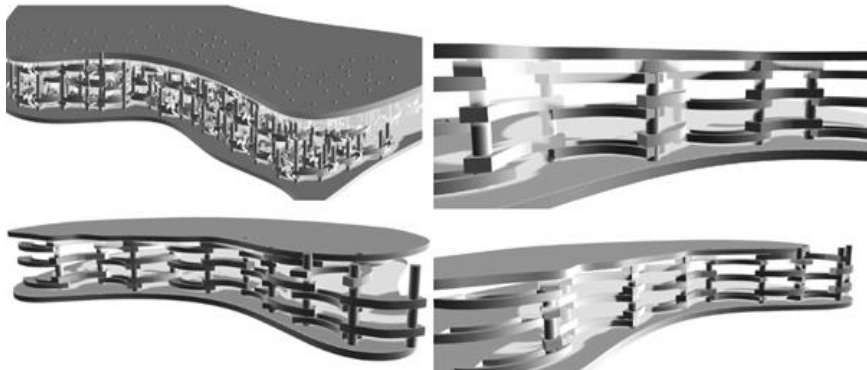


Figure 9: Possible incorporation of Coir Fiber brick in a building (Source: Authors)

## 6. Vertical Farming:

In the coming future, it is expected that the soil fertility and the farmable soil available will decrease significantly and thus it is safe to assume that we could have a severe food shortage, especially considering the population explosion expected in the upcoming years. (see, figure 10 and 11) Even presently, Indian soil is lacking in the nutrients that are essential for adequate fertility of the soil. In India, an analysis of over 2 lakh soil samples revealed that, on average, 36.5% of soils were deficient in zinc; 23.4%, in boron; 12.8%, in iron; 7.1%, in manganese and 4.2%, in copper. (PricewaterhouseCoopers Private Limited, 2019) Thus the prototype considers and aims to help with this problem with the ecological response of the soil.

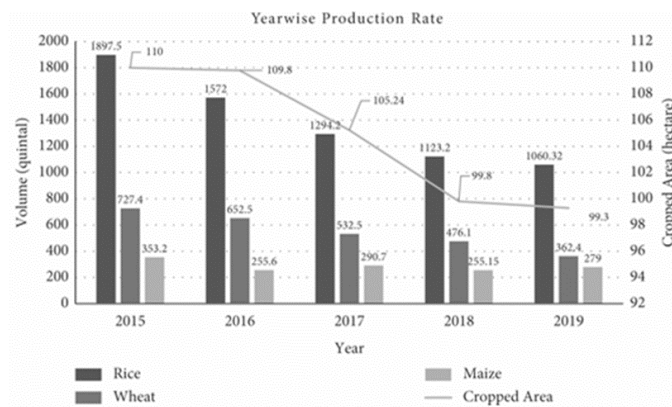


Figure 10: Graph showcasing the decreasing fertility of soil throughout the years (Source: Bhandari et al., 2021)

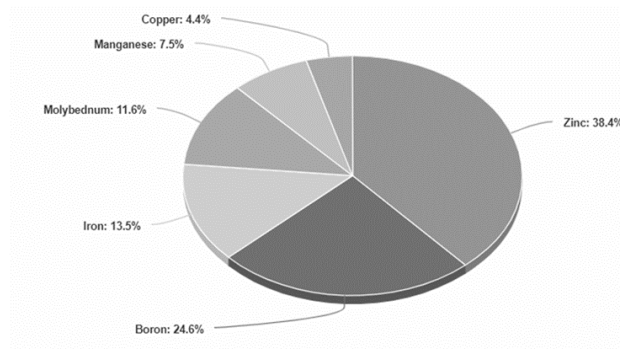


Figure 11: Micronutrient deficiency in Indian soil (Source: PricewaterhouseCoopers Private Limited, 2019)

Vertical Farming is the advanced level of agriculture technology where this has to be practised when there is unavailable land and other requirements for the perfect structure of farming mode, this is the new way or approach at the advanced level (Jegadeesh & Verapandi, 2014)

### 1.1 Incorporation of Vertical Farming into the Building System:

A liquid solution with nutrients is misted in air chambers where the plants are suspended. By far, aeroponics is the most sustainable soil-less growing technique, as it uses up to 90% less water than the most efficient conventional hydroponic systems requiring no replacement of the growing medium. (see, figure 12)

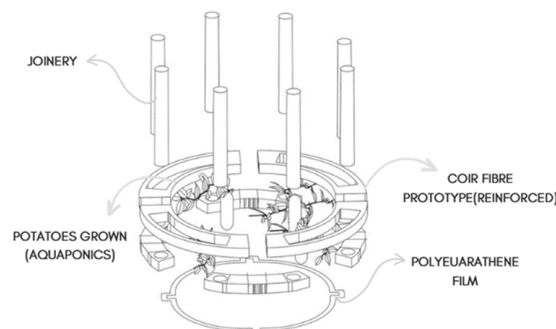


Figure 12: Diagram showcasing the prototype using vertical farming via Aquaponics (Source: Authors)

The food is grown inside the prototype. The coir fiber acts as a healthy breeding ground for the seeds of plants. The food is sprayed with nutrient-rich water. Coir fiber can be used as a medium for vertical farming not only using aquaponics but also using hydroponics. The ability of coir to retain water helps it act as a substitute for soil for farming. Despite being a natural plant material, coco coir decomposes slowly, minimising nutrient release into the growing medium. This characteristic makes it ideal for hydroponics, where growers have complete control over nutrient delivery. Furthermore, coco coir boasts a neutral pH level, effectively retaining moisture while ensuring adequate root aeration – crucial factors for healthy plant growth in a soilless system.

## 7. Justifying the need for Prototype:

While significant strides have been made in minimising carbon emissions throughout a building's lifecycle, from design and construction to operation, there's a gap in understanding the carbon footprint of recycling construction waste at the end-of-life stage. This study specifically focuses on the carbon emissions associated with recycling key construction materials like concrete, brick, steel, wood, and mortar. This is crucial because

the building sector is estimated to contribute a significant portion, roughly 40%, of global carbon emissions. (Wang et al., 2022).

The prototype is completely biodegradable and organic in nature. It is also easily produced and can be mass-produced including various options for different iterations of the original disk version of it.

Coir, a versatile natural fiber extracted from the husk of coconuts (abundantly grown in tropical regions with global production exceeding 60 million metric tons annually), offers a readily available and eco-friendly alternative to synthetic fibers. Compared to synthetics, coir boasts several advantages: affordability, renewability, recyclability, biodegradability, and minimal environmental impact. Coir's extensive applications range from traditional uses like mats, yarns, ropes, and floor coverings to more modern applications such as insulating panels, composites in the automotive and construction industries, and even textiles. Its easy availability and low cost make it a promising candidate for reinforcing medium-strength composite materials. (Goyat et al., 2021)

Coir's high lignin content, compared to fibers like flax and cotton, translates to superior strength but slightly less flexibility. This natural material biodegrades in around 20 years above ground, and with proper coating, decomposition can be accelerated to 4-5 years when buried while coir is naturally biodegradable, a fascinating aspect is that even significantly decomposed coir fibers (up to 50% biodegradation) retain most of their valuable physical properties. This opens doors for upcycling coir waste into valuable materials. (Kumar & Rameez, 2022)

**a. Production:**

The method of production of the prototype consists of two major steps- preparation of stencils and cutting of coir fiber. The stencil is customisable in nature, allowing the prototype to take whichever shape or size is required. For the purpose of this study, prototypes were produced in a limited number using two curved stencils (see, Figure 13 and 14)

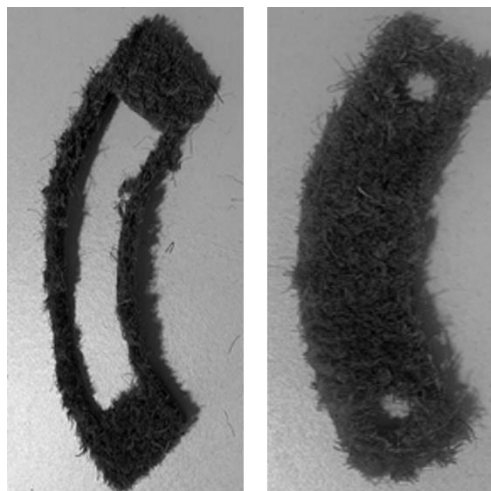


Figure 13: The two components of bricks employed for the study (Source: Authors)

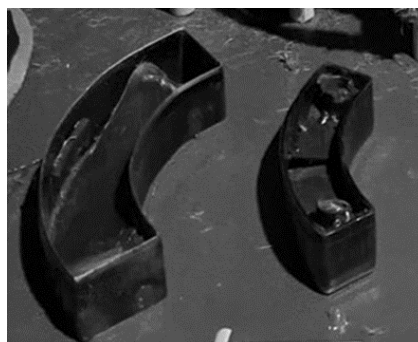


Figure 14: Stencils used for the prototype (Source: Authors)



After creating the stencils, pieces can be cut by placing coir fiber on a flatbed and using an Industrial Hydraulic Cutting Machine to press the stencil into the fibers. Some margin for error is expected in this process. The process can be replicated to produce the prototype on a mass scale.

### **b. Possible Future Applications:**

Natural Fiber Reinforced Polymer Composites (NFRCs) are revolutionising various industries with their versatility. Their affordability makes them a perfect fit for cost-conscious sectors like low-cost housing and consumer goods, where traditional lightweight reinforced plastics might be too expensive. But NFRCs' potential goes beyond these common applications. They're finding increasing use in demanding fields such as the automotive industry, which is incorporating NFRCs into car parts to take advantage of their lightweight properties. The aerospace industry is exploring NFRCs for components like tails, wings, and propellers because of the potential weight savings they offer. The marine industry sees promise in NFRCs for boat hulls due to their strength and potential weight reduction. Storage tanks could benefit from NFRCs as a potential alternative material in some applications. The sporting goods industry is another area where NFRCs are being explored for their potential applications. (Adeniyi et al., 2019).

The coir industry thrives as a rural industry with strong agricultural roots. It provides employment opportunities for over 700,000 workers in India's major coconut-growing regions. This export-driven industry significantly contributes to the country's foreign exchange earnings. For instance, in 2018-2019, coir exports generated over Rs. 2192 Crores in revenue (figures valid up to January 2019). (India, 2020) Using coir as an additive for cement is already occurring in the present day. Expanding that idea, coir can easily be used as a construction material of the future while also remaining biodegradable.

### **c. Possible Setbacks:**

1. The primary drawbacks are its relative moisture and fiber volume content, as well as other limits due to length and fiber orientation, which are common to natural fibers. (Onukwuli et al., 2022)
2. The prototype can be expensive to produce, with an average minimum cost of ₹3000 to produce the stencil for an iteration.
3. Since coir fiber is not a widely used material in the construction industry, it lacks the proper research and documentation. This can be beneficial for vertical farming and usage of the walls of a structure to actually grow food effectively but it also means it would by itself not be enough to prevent a building from rain. This means that it could take some time to get the prototype ready for mass usage in the urban construction industry and even then, might need individual research by the contractor, architect and even the client using the material.
4. Coir fiber is not waterproof but instead retains water. Some forms of coir can hold up to nine times their weight and also become much heavier and also be prone to various issues which can come upon the prototype retaining water.
5. The life of coir is roughly twenty years which makes the prototype easily biodegradable but it also means that at its core, unmodified coir might not be suitable for structures planned to be long-lasting considering the general life of buildings is nearly fifty years (Kumar & Rameez, 2022)

**d. Comparisons between the Traditional Brick and the Prototype:***Table 1: Comparison between Traditional Bricks and Prototype (Source: Authors)*

<b>PARAMETER</b>	<b>TRADITIONAL BRICK</b>	<b>PROTOTYPE</b>
Strength	A traditional brick has far more strength and is capable of having a far taller and more stable structure.	The prototype despite being very stable in nature is designed as only a biodegradable alternative to the traditional brick and is thus not as structurally strong as the traditional brick.
Durability	A traditional brick structure is made in a way that it can last for hundreds of years.	The coir prototype has a shorter lifespan and is more suitable in today's rapidly changing environment.
Biodegradability	Brick is not very biodegradable in nature with the current brick-oriented construction industry contributing to a bulk of pollution.	Very biodegradable in nature and has multiple instances where the prototype after the building was of no use was buried in soil and disintegrated soon thereafter.
Mass Production	Bricks are produced in large quantities in kilns that cause massive pollution and are dangerous for the workers involved.	The coir prototype can be mass-produced easily by creating just one stencil, owing to the wide availability of coir.
Cost	₹8/brick	₹80/prototype
Ease of Building	A process of laying bricks using layers of cement and mortar is needed. Curing is needed and the process takes time.	The prototypes can be made and simply stacked on top of each other easily. The time needed for coir construction is comparable to precast construction.
Insulation	Provides decent insulation. It can be increased with rat-trap bonds but it either affects size or structural stability.	Provides strong insulation between members with minimal area needed.
Resistance to Fungus	Brick is not fungi-resistant contrary to popular belief	Fungi resistant
Vertical farming	No applications	The strong potential for vertical farming is discussed extensively in the paper.

In the present times, brick masonry is considered one of the most common types of masonry. The standard size of bricks in India is 190x90x90 mm. (IS: 2691:1988 Revision 2, Clause 4.1 & 4.2). These bricks shall be made

of clay, shale or a mixture of these materials with or without admixtures and burnt to meet the requirements of this standard. (IS: 2691:1988 Revision 2, Clause 3). These bricks are manufactured in a brick kiln. Emissions from brick kilns are composed of fine dust particles, hydrocarbons, SO<sub>x</sub>, NO<sub>x</sub>, fluoride compounds, CO and a small number of carcinogenic dioxins. Recent studies on brick kilns in District Budgam have shown some major negative impacts on the environment with respect to air quality, human health and vegetation in particular. (Skinder et al., 2014)

## 8. Conclusion

In the present day and age, it has become imperative to rethink architecture and building systems as a whole. Using nature as our inspiration can help to come up with innovative solutions for the problems posed by the present building practices. Coir fiber can be used as a possible sustainable solution to the problems of present building materials due to its favourable properties.

Biophilic architecture tends to draw inspiration from nature by adapting its form. However, this study delves deeper into the cellular structure of mycelium and its behaviour and draws inspiration from the behaviour of the cells when they come in contact with nutrients. The cellular structure of mycelium helps enhance the properties of coir fiber.

This paper intends to encourage creative thinking in the search for alternate building solutions and to look back at our roots in nature for inspiration. This research is conceptual in nature and as per the findings of this paper, the concept shows immense potential in the field of both construction and architecture. Thus, it is recommended that the concept be taken to a lab for further research and experimentation.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# A Study to Investigate the Use of Adobe as a Sustainable, Alternative Building Material and its Use as a Potential Substitute for Concrete in Construction in the Urban Context of Pune City

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## **Abstract:**

*Man, first started building structures in accordance to seek shelter for himself. As his knowledge evolved so did the way he used the materials available around him. Thus, began the evolution of Mud structures for the basic need of shelter. As the years went by man's knowledge has only increased and so did the construction materials with the development of technology. Earth materials were replaced almost entirely by burnt bricks, cement, and steel. Unfortunately, these days so many of us think that we can only build "properly" by using items such as reinforced concrete, cement blocks, burnt bricks, etc. But the manufacturing of steel and cement for reinforced concrete is now called 'energy intensive'. Adobe is the oldest building material in use and some structures still standing, it should be enough to dissolve all the myths regarding the potential of Adobe, as Primary Building Material, that should be revived. In addition to being simple and economic, adobe bricks are fireproof, durable, non-toxic, possess low sound transmission levels through walls, and provide sufficient thermal mass to buildings. These benefits state the role of the earth in comparison with the contemporary housing Structures of RCC and the research aims to study the potential of Adobe by evaluating the Life Cycle Assessment, Cost Analysis, and strength performance, which would help reduce the use of cement concrete in construction.*

*This research will examine and compare Mud Structure and RCC Structure by Material Study, Case-study of a Mud House in Mahatma Society, Kothrud and a similar scaled RCC house in the nearby locality. Structured interviews will be conducted with the homeowners on comparable aspects like living comfort, maintenance, and economy, etc. The Field test will obtain the material strengths and durability on close grounds. The Final Results will help determine that if Mud passes all the Structural and Physical bounds and can it be used as an alternative building material.*

**Keywords:** *adobe; life cycle assessment; conventional material; alternative building material; sustainable housing*

## 1. Introduction:

“Earth has enough to satisfy every man’s need, but not his greed.”

– Mahatma Gandhi

People began to appreciate the necessity of a "Sustainable lifestyle" after the Covid 19 pandemic. Sustainable benefits include not just food, clothing, and lifestyle, but also shelter. Mud is the most earth-bound and thus the most sustainable of all the materials. We believe that because we live in a city, we can only build our homes out of concrete and cement. Houses built of mud are referred to as 'kachcha,' whereas houses made of cement are referred to as 'pakka.' This is an idea that has been drilled into our heads. For a greener future, sustainable housing is vital. To fight the changes in nature that occur as a result of urbanization, the use of environmentally friendly materials in construction must become the new trend. People used to live in houses that they built themselves out of locally accessible natural resources. Mud was employed in the form of mud blocks or in its natural state for wall construction. In ancient times, it was also used as a mortar for binding together construction blocks, plastering walls, and laying down flooring. Mud has its own set of challenges and approaches. Man began to construct structures in order to provide shelter for himself. As his understanding grew, so did his approach to the materials available around him. Thus, began the evolution of Mud structures for the basic need of shelter. As the years went by man’s knowledge has only increased and so did construction materials with the development of technology. Earth materials were replaced almost entirely by burnt bricks, cement, and steel. But, that stage of evolution is where man started getting unbalanced with nature.

Unfortunately, many people nowadays believe that the only way to build "correctly" is to use materials like reinforced concrete, cement blocks, burnt bricks, and so on. The production of steel and cement for reinforced concrete, on the other hand, is now referred to as "energy intensive." In our fast-paced society, we are surrounded by concrete jungles that are continually expanding. The usage of these materials is uncontrollably increasing, and it is unregulated. Earth construction is frequently seen as pre-modern or backward in our country, India. This thinking is also leading to the extinction of traditional earthen building knowledge. Many people seem to believe that it is primarily used for dwellings in poor rural areas, although there are several instances of earthen airports, hospitals, mosques, even museums. Earth is also thought to be a frail, temporary material, yet some of the planet's oldest existing structures are built of it.

Mud is an excellent thermal insulator. The dwellers of mud dwellings were able to enjoy a high level of comfort due to its strong thermal regulating properties. It is a cost-effective natural material with little or no embodied energy. Almost any structure that uses concrete can also be done with mud. Bamboo can be used to reinforce mud structures instead of steel reinforcements. Despite the benefits listed above, the concept of mud house is just slowly gaining popularity. The objective of this paper is to build a comparative study between mud construction and RCC construction in the similar setting of Pune City, Maharashtra, India. The methodology adopted for the study consists of literature review, interviews with practicing architects and House owners, and case studies of their projects.

## 2. Literature Review:

Mud has been used as a primary building material in many forms since Ancient Times, including mud blocks, mud walls, and mud plaster. Mud bricks were used to construct the world's first skyscraper. There are many such remarkable and ingenious earth architecture that can be discovered all over the world. Techniques have improved over time, and rammed earth may now be manufactured in situ. The more resistant compressed earth blocks (CEB) can be stabilized using cement as a substitute for adobe. Because it is used on or near the extraction site, raw earth does not require any industrial processing and requires little or no transportation. Its use does not require the use of fossil fuels and does not emit CO<sub>2</sub>. Earth is a 100% recyclable material when used without cement or any other industrial addition, as is frequently recommended. (Detheir, 2020)

In terms of the Indian scenario, the country has a rich tradition in mud architecture, with more than 65 million of the country's 118 million houses made of mud. In Kerala, for example, houses are usually built with mud and laterite blocks, with tiled roofs supported by coconut timber rafters and purlins (horizontal beams). While mud seems to have some limitations, it is far more energy efficient than building materials such as bricks, concrete, cement, and steel. Despite the reality that Indian cities are rapidly modernizing in order to find their place in the global society, several architects in the country are modelling their practices in an effort to return to nature what we have taken for granted. (Down-to-earth, 2018)

### **Mud: An Eco-Friendly Construction Materials:**

One of the most significant parts of architecture has always been the materials used in construction. Every building material, as well as the method of applying it, has its own set of characteristics. These energy-intensive procedures have prompted us to reconsider our building material selections. Mud is one of the most frequently available building materials that, if used more extensively, has the ability to make a substantial difference.

The type and process of mud construction vary by location. It varies depending on the climate and the type of soil available. We use a different construction method for each type of mud. Mud construction techniques are broadly classified into five types:

- Daub and Wattle
- Rammed earth
- Adobe construction
- Cob wall construction
- Earthbag construction

Adobe, also known as sun-dried bricks, is a popular mud construction technique used all over the world. Even today, various workshops are held to raise awareness and encourage the use of this specific technique. This natural building material is made up of 25-30% clay, 70-75% sand, water, and other organic materials such as straw, manure, or sticks. Because of their higher thermal mass, adobe bricks are more beneficial in hot climates. It protects against external heat waves. Sun-dried bricks are most popular in West Asia, West Africa, Spain, Eastern Europe, and South America. (AL-Ajmi, 2016)

The availability of suitable mud for each method, skilled labour, transportation facilities, and climatic conditions are all elements that impact the choice of construction techniques. Cob walls are often used for aesthetics rather than functionality, whereas rammed earth walls put a higher priority on the building's structural aspects. In earthquake-prone areas, wattle and daub construction is preferable. Fibre reinforcement can improve the strength and durability of rammed earth building. By using suitable soil and proper stabilisation methods, it is possible to construct two storey mud buildings using the rammed earth technique and two or more storeys with compressed earth blocks. (Sruthy, 2013)

Mud bricks have many advantages over standard building materials like concrete masonry. These advantages include a simple production method, the lack of skilled labour, the availability of mud from natural resources, low-cost construction materials, and the capacity of mud constructions to perform satisfactorily in hot environments. Mud bricks, on the other hand, have a number of disadvantages as a building material. Water absorption causes mud brick swelling, while evaporation of water from the mud brick causes shrinkage and cracking; therefore, mud brick is a relatively delicate material that cannot endure earthquake hazards. (AL-Ajmi, 2016)

### **3. Methods and Methodology:**

This study's research methodology is based on a review of the literature, interviews with practising architects and engineers, and case studies of their projects. The study's comparative parameters of analysis between Adobe Construction and RCC Construction have been identified. As a result, this research focuses on the

## A Study to Investigate...

feasibility of using natural materials such as adobe and bamboo, as well as traditional construction techniques, for sustainable development in the urban context of Pune City.

The research relied first on two sources of information: information derived from the literature review, related to Mud Construction, the second source of information included live case study of a mud house in Kothrud, Pune and a RCC Bungalow in the same vicinity, as well as interviews with their Architects and Project Engineers.

Cost analysis, material availability, material composition, construction techniques, required field tests, suitable reinforcement, living comfort, and precautions and limitations were used to compare the case studies.

### Interviews and Case study:

To keep in line with the objective of this study, a thorough analysis of the current status of mud construction in Pune city is still being explored. Experts from the mud construction and RCC construction industries were interviewed. Following that, a case study of their work was conducted to validate the reality on the ground.

### Interviews:

Practising architect (Anujna Dnyaneshwar), practising engineers (Aniket Patare and Rohit Shinde) were identified as experts for the interview.

Table 1: Interviews (Source: Authors)

Name of the Expert	Major Project	Date of Interview
Ar. Anujna Nutan Dnyaneshwar	Pathak Residence, Mahatma Society, Kothrud	19 <sup>th</sup> Feb,2022
Project Engineer Aniket Patare	Pathak Residence, Mahatma Society, Kothrud	20 <sup>th</sup> Feb,2022
Project Engineer Rohit Shinde		10 <sup>th</sup> March, 2022

### Case study -Mud House in Kothrud:



Figure 1: Pathak Residence aka Mud house in Pune (Source: Author)

This will present a new architectural alternative for sustainable living with a minimum carbon impact, despite its location in the centre of an urban jungle. The house reflects a hope that the cycle will break if not reversed in an age where individuals are mimicking metropolitan lifestyles. There are several misconceptions about



earth construction; for example, many people believe that mud dwellings are only temporary, poor shelters, weekend travellers, or something 'experimental.' However, the truth is that this new Mud House in Pune City is come to disprove the misconception once and for all. Finally, the project may aid in the preservation of old architectural traditions that are being lost as a result of modern living.

This dwelling appears as a simple, little house buried among the woods when you walk into the residential lane surrounded by other residential houses. This modern, urban home, located in the busy, fast-paced city of Pune, invites you to pause and take in its warmth. While the plot's floor space index (FSI) permitted the owner to construct two to three stories, the load-bearing capacity of the materials applied - mud, stones, sun-dried bricks, and wood - limited the home to two stories.

The owners were informed that the house will not be able to be altered or expanded in the future. Because not everyone is familiar with the procurement of some of the materials not commonly used in urban constructions, the material and transportation costs on this 2656 square foot (built-up area) houses were 20% higher than what a conventional cement building would have cost. The materials were transported from Manchar, which is part of the Pune District's Ambegaon Taluka. This locality is approx. 60 km away from Pune city.

### **Architecture of the house:**

The double-height ceiling with skylights greets you after the entryway wooden pergola, making the living area appear open and spacious. (Fig 1) The roof shelters the area overlooking the first-floor landing. Morning light flows through the canopy of trees and through the windows into the dining room. It creates a seamless transition zone from the kitchen to the living room, with no obstacles between them other than the layout and ceiling height. (Fig 2)



*Figure 2: Living Room Space with ambient, (Source: Girish Doshi)*



*Figure 3: Dining Room (Source: Girish Doshi)*

Further investigation reveals that the foundation is made of stone and mud, while the roofing is made of timber and bamboo with Mangalore tiles. The house is 90% mud and is constructed using various techniques at each level. Although it is not a cement-free structure, it does save a substantial amount of cement or industrial material, which is replaced with ecologically acceptable materials. The Mud is particularly insulating in terms of thermal comfort. Interior rooms are significantly warmer in the winter and substantially cooler in the summer when compared to other thinner walls. The walls of the house are thicker, at 460 mm, then those of a typical urban structure, which are 50–150 mm thick. "Having a ceiling fan during summers in Pune makes little sense because the air is constantly warmer in the ceiling area," the architect explains. It's useless to force that air down on someone sitting in the middle of the room. You might have a standing, portable, or table fan close to the window for the one month of peak summer to increase the breeze and cross-ventilation. "That should suffice." Without any stabiliser, adobe walls with mud plaster and adobe flooring (cement or lime). The ceiling is constructed out of timber beams and bamboo secondary beams from the first-level composite floor slab. The structure's load is transferred to the walls by reinforced concrete (RCC) beams, although no RCC is utilised in the walls. Due to the presence of clay and sand in the material obtained during testing, the walls are only comprised of mud, rice husk, and a small amount of fly ash as a stabiliser. The only part that required cement was the area above the ground and below the adobe walls. It contains a two feet-stone wall put together with cement. At the top of the door and windows, there is one RCC band which uniformly transfers the load to all the mud walls. Lime plastered RCC lintel band allowed the structure to have bigger openings for windows and doors, as opposed to the traditional load-bearing structure.

The 'Rat Trap Bond' brickwork process is used to construct toilets out of baked bricks in cement mortar. Featuring a filler slab ceiling and internal lime plaster finish, as well as leather finish Kota flooring and dado. (Fig 6) The Rat trap bond method is a brick masonry wall building method in which bricks are stacked vertically rather than horizontally, creating a cavity (hollow area) within the wall. In the 1970s, architect Laurie Baker brought it to Kerala, where it was widely employed because to its lower construction costs, decreased material requirements, and improved thermal efficiency over traditional brick wall.



Fig 4. Master Bedroom Toilet (Left) and Office space (Right), (Source: Girish Doshi)



Fig 5. Master Bedroom, Source: Girish Doshi



Fig 6. Residential RCC Bungalow near the Mud House in Mahatma Society, (Photo Credit: Author)



Fig 7. Residential RCC Bungalow near the Mud House in Mahatma Society, (Photo Credit: Author)

**Project Details of the cases to have a comparative analysis**

Table 2: Comparative analysis of Structures (Source: Author)

Mud House	RCC House
<b>Project by</b> – Maatimol	<b>Project by</b> – Samyak C2 Infra pvt. ltd
<b>Architect</b> – Anujna Dnyaneshwar	<b>Architect</b> – Sandeep Bamb
<b>Contractor</b> - Aniket Patare	<b>Contractor</b> - Rohit Shinde
<b>Year of Construction: 2018</b>	<b>Year of Construction</b> – Under Construction
<b>Year of Completion:</b> 2021 (delayed due to Covid)	
<b>Location</b> – Mahatma Society, Kothrud, Pune	<b>Location</b> – Mahatma Society, Kothrud, Pune
<b>Size</b> - 2656 sq. ft.	<b>Size</b> - 3100 sq. ft. (approx.)
<b>Description</b> – 2 Floor Residential House mostly built with Earth Blocks and Pitched Bamboo Roof. West Facing.	<b>Description</b> – Minimalistic 2 Floor Residential House built with Reinforced cement concrete and flat roof with Glass Fenestrations. East Facing.
Building Material	Building Material
<b>Structure:</b> Load Bearing Structure	<b>Structure:</b> RCC Load Bearing Structure
<b>Foundation:</b> Stone Foundation	<b>Foundation:</b> RCC Footing and Foundation
<b>Walls:</b> Mud Walls	<b>Walls:</b> Fly ash Bricks
<b>Slabs:</b> Wood Bamboo Floor, Filler Slabs	<b>Slabs:</b> RCC slabs
<b>Windows:</b> Mud Flooring, Wooden Flooring	<b>Windows:</b> Glass and aluminium frame

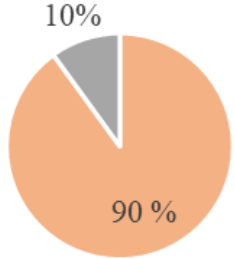
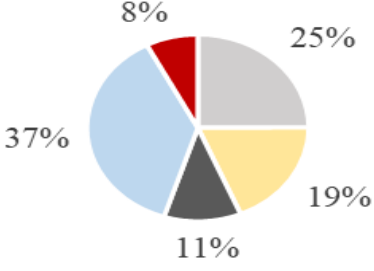
<b>Finishes:</b> Natural Exposed Mud Finish, Lime Plaster	<b>Finishes:</b> Exposed Concrete.
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#### 4. Results and Findings:

The scope of the research and analysis is confined to the feasibility of mud as a building material in Pune and its potential as a concrete substitute, based on a comparison of case studies of similar status under the following parameters

##### Comparative study based on Site Visits, Interviews

Table 3: Comparative Analysis of the Material (Source: Author)

Parameters	Earth construction	RCC Construction
Built up Area	2956 sq. Ft - Built-up	3100 sq. Ft
Life Span	Stands for 50 years or more and all its debris can be recycled.	Little over 50 years
Cost Analysis	90 lakhs Costing includes – -Material and Labour -Real Wood Flooring -Sanitary ware	2800 Rs per sq. ft 75 lakhs approx.
Material Availability / Transportation	Manchar is a census town in Ambegaon taluka of Pune district  Distance - 60km from Pune	Local Vendor in Kothrud  Distance - 5-10 kms
Technology Used for Walls	Mud and Rice husk Rat-Trap Bond CSEB wall. (460 mm thick)	Brick Walls Cement Plaster
Composition of Material Preferred	<p>CONSTRUCTION MATERIAL</p>  <p>■ MUD ■ OTHERS - CONCRETE</p> <p>Mud and Rice Husk Concrete Lime Plaster</p>	<p>CONSTRUCTION MATERIAL</p>  <p>■ CEMENT ■ SAND ■ AGGREGATE ■ STEEL ■ BRICKS</p> <p>Cement Sand Aggregate Steel Reinforcement</p>
Parameters	Earth construction	RCC Construction

Field Tests	Colour Test Touch and Smell Soil Test for impurities in sand and clay content.	Sampling Concrete Slump Test Unit Weight
Stabilisation Method	Most common and effective stabiliser is Soil itself. Rice Husk – Mud  Stabilisation with 5% Fly Ash Due to impurities in sand.	Reinforced Concrete
Traditional Construction Methods	Load Bearing Construction – 6 x 6 in RCC columns and beams, RCC Lintels.  Toilet Construction – Pure RCC Structure	RCC Load Bearing Structure.
Suitable Reinforcement	Mud - Rice husk and Straw  Load bearing Frame – RCC Steel Reinforcement.	Steel Reinforcement
Type of Plaster Used	Lime Plaster and Mud Plaster	Cement Plaster
Foundation Flooring Roof	Stone and mud  Mud without any Stabilizer _ GF Floor  Wood Flooring _ 1 <sup>st</sup> Floor.  Timber and bamboo with Mangalore tiles.	RCC Footing RCC Column  Marble Tile Flooring  Tile Flooring 1 <sup>st</sup> floor  Flat Accessible roof
Drawbacks	Material vulnerability to erosion, termite attack and development of shrinkage cracks Compromise in open Floor Space due to thicker walls. Don't have flexibility for alteration or expansion.	Concrete causes damage to the most fertile layer of the earth, the topsoil. Making cement results in high levels of CO <sub>2</sub> output. More Labour and construction space Adds to the Noise pollution.
Parameters	Earth construction	RCC Construction
Frequency of Maintenance	Necessary Sweeping of the Floor. Minimal Hairline Cracks are seen over time. - Most houses will experience cracks in the walls at some point. For the majority, it's a natural occurrence caused by settlement: ... Newly plastered walls can often experience hairline cracks as they dry out.	Periodical inspections and timely repair of small defects are required. Clean-up's – Washing, Painting,

Living Standards and Comfort	Breathable Spaces Similar to the Common RCC house with some adjustment and Lifestyle Alternations.	Closed Spaces
Thermal Comfort Indoor – Outdoor temp diff.	Significantly Lower Temperature Difference is Observed.	Not determined.
Precautions and Limitations	Soil with organic smell must be discarded. Not have the flexibility for alteration or expansion Roofing – Core Cut – A core cut is necessary to: Examine the roofing system for moisture and determine how much is present.  No Walls can be removed.	Use of Proper Reinforced during Construction. Water Damage Due to Leaking
Wall Fittings	Drilling a nail in the walls in not possible Wooden Plank can be placed during the construction for fitting the accessories. The Location is to be decided prior to the wall construction.	No issue
Economy	20%–25% Cost Effective	Cost Extensive

Raw mud's major drawbacks include its sensitivity to erosion, termite assault, and the development of shrinkage cracks. As a result, natural or chemical stabilisers must be used to improve its physical and mechanical qualities. Cow dung was once used as a stabiliser for mud walls to protect them and increase their durability. Depending on the soil type, lime, and cement, as well as mud, are traditionally employed as stabilisers.

The fact that mud buildings do not require plastering is an extra benefit. It is also possible to save money on plastering by doing so. The walls can be plastered with mud itself. By combining different textures of mud obtained from various locations, different shades of colour can be added to the mud walls. When comparing the cost of the construction, mud walls save roughly 10%–20% when compared to brick walls with cement plastering.

The roof is the most exposed part of the house to adverse weather conditions. The majority of modern approaches for dealing with moisture and rain rely on 'breaking off the contact.' Everything from waterproofing chemicals to oil paints and enamels is based on the premise that we can coat surfaces in these magical products and entirely eliminate their contact with degrading external factors like water.

"Contrary to popular belief, even using natural materials, it is not inexpensive cost by default," explains the architect. Even if you didn't have to pay Nature for gathering the resources, you still had to pay for the human effort. The walls of the houses should be able to breathe. Stabilisation with 5% cement is enough to make the mud walls strong and resistant to termite attack and water penetration. Lime plastering provides better finish and good appearance.

## 5. Discussions:

The major findings from the literature review, interviews and case studies are reviewed in this section. Literature review reveals that mud is a versatile and sustainable material for construction. Raw mud blocks should be properly stabilised with traditional (cow dung), conventional (cement or lime), or artificial (Bitumen) stabilisers, which, when reinforced with either natural (Rice Husk) or artificial fibres, provide the construction with improved strength and durability. Yet, there is room for a scientific investigation into mud as a construction material, as well as a detailed examination of how mud survives in an urban setting over a longer time span.

Due to impurities, the mud used for construction is exported from a distant location rather than being used on-site, according to the comparison analysis. Mud, on the other hand, requires a lesser number of field tests, which are simpler than the apparatus required in concrete testing. To support the weight of the structure, each structure has its particular type of foundation. Adobe, unlike steel, does not require any reinforcing. Due to the breathability of the walls, there is a significant difference in the thermal comfort of the mud house. Mud has some significant limitations as a structural material, making it a liability before to RCC. Both structures require maintenance from time to time, but mud requires more frequent attention.

Building a home is an investment that will last a lifetime. Choosing natural construction materials over standard cement constructions resulted in lower construction costs but higher wage for workers. However, just because it's made of mud doesn't mean it's cheap. It is cost-effective. It is, without a doubt, a worthwhile investment. Solar panels have been added on the additional roof platform, further enhancing the house's cost-effectiveness. The scope of the study can be expanded in the future by conducting surveys of city residents to determine their opinions on Mud as a Building Material.

## 6. Conclusions:

Some of the beneficial physical characteristics of using adobe as a construction material were highlighted in literature review and extracted from the Case study about the potential of mud as a sustainable construction material in the urban setting of Pune city, and they are stated below:

1. Environmentally friendly: Mud is a non-polluting, non-embedded energy material that allows you to stay in touch with nature. Mud can be reused again and over again without affecting the environment.
2. Thermal comfort: According to resident feedback, mud is a good thermal insulator. Mud houses are cost effective since they require less mechanical cooling because of the cooling effect of the thicker mud walls compared to the standard RCC walls.
3. Economy: When compared to conventional structures, it has the potential to save 15 to 20% of the cost. Because the principal rooms have skylights and a greater number of windows, fewer electrical equipment are used. Solar panels have been added on the additional roof platform, further enhancing the house's cost-effectiveness in the long run.
4. Health aspects: Mud buildings provide better health and positive energy to their residents due to their unique breath ability.

Despite these stated benefits, People have more faith in concrete over mud construction. People avoid mud construction due to a lack of knowledge and concern about the longevity of mud structures. People favour materials and processes that are widely available and readily accessible. As a result, they are hesitant to leave conventional materials (bricks, cement, concrete blocks, etc.). People are sceptical about the reliability of mud constructions, despite the fact that they are sturdy and long-lasting. The majority of technology is out of reach for the average person. Due to a lack of experienced labour, a bad aesthetic look with bulges and cracks may develop, needing frequent repair.

It has been determined that mud's potential as a sustainable building material above conventional concrete structures is undeniable and extensive, as long as it is promoted and practised in accordance with sustainable

concepts. To build structures in the city, it would take a lot of faith and patience by the owners. The use of mud in urban settings is still in its early stages, however due to a lack of easily available resources, such as materials and experienced labour, the use of mud as a direct concrete substitute is not yet feasible in Pune.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# 04

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## **TRACK 4: CULTURE AND HERITAGE**

BNCA Conference Proceedings 2023



# Stepwells: An Ancient Technology of Water Conservation

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## **Abstract:**

*The research aims at studying in-depth the ancient manmade water resources as well as water conservation structures the “Stepwells” of the Indian Subcontinent. It encompasses the study of origin and the evolution of stepwell construction methodology as they were a reliable source of water accessibility for the native. The research adopts a case study method. The case studies include various archaeological sites and the stepwells that are currently in use. It throws light on the factors affecting their site selection, design principles, materials used, and construction techniques. This research helps us understand how the basic “wells” transformed into “stepwells” which not only gained importance as socializing places but also evolved as massive ornamented underground structures. The causes for the gradual loss of prominence and later abandonment of these ancient water sources are also discussed.*

*The design and construction techniques of these stepwells are peculiar to certain regions which grant them their uniqueness and beauty and makes this research more interesting.*

**Keywords:** *water conservation, stepwells, construction techniques, water scarcity*

## **1. Introduction:**

‘Water is life.’ Since time immemorial human history has always revolved around water sources. The earliest settlements and human civilizations have always prospered in the vicinity of rivers and lakes. Eventually, the water sources started dwindling which gave rise to water conservation structures like “Stepwells”.

The earliest Stepwells were elementary structures that were dug into the ground and are commonly found in Western India and other arid regions of the Indian Subcontinent.

With the progression of time, these multi-storeyed Stepwells not only assumed immense importance as a water source and a place for socializing but also represented the rulers and his kingdom’s great patronage for art and architecture by way of embellishment and ornamentation.

India’s landscape is adorned with Stepwells from different eras and are of varying dimensions. A 5000-year-old Stepwell has been recently discovered in one of the largest Harappan cities, Dholavira, Kutch which is three times bigger than the Great Bath at Mohenjo-Daro. Abhaneri, Rajasthan boasts of having Chand Baori the largest stepwell in India.

## 2. Objectives of Study:

- To study and understand the origin, evolution, and function of Stepwells in India.
- To understand the principles and factors considered for selection of site, designing, and construction of Stepwells using four case studies.
- To understand factors that led to the Stepwells becoming redundant and being abandoned through case studies.
- To study the advantages and disadvantages of Stepwells as an effective water conservation tool in current times.

## 3. Research Questions:

- How did Stepwells originate and evolve with time?
- What were the main principles and factors that were considered for the construction of Stepwells?
- What were the causes for Stepwells becoming redundant and being abandoned?
- What are the advantages and disadvantages of Stepwells as a water resource?
- How Stepwells can be used as an effective tool for water conservation in current times?

## 4. Scope and Limitations:

- This study sheds a light on how India's climatic and geographical conditions, as well as historical events and culture, had an impact on the evolution of Stepwells.
- The research is based on published articles, research papers, journals, books, and available data on Stepwells.
- The research is limited to in depth study of four stepwells of different regions of India.

## 5. Literature Review:

The concept of stepwell originated in India. It is popular for its architectural perfection and water engineering. Stepwell provides water for drinking, washing, bathing, water harvesting, and other water related activities. Originally, they were used as reservoirs and storage tanks, and they also functioned as Hindu temples elaborated as stylish stone carving on columns and pavilions. The tourists, explorers and the caravans stay here during a sunny day or overnight. (Pandey, 2016)

Stepwells are deep dug trenches or rock-cut wells or ponds of water reached by a winding group of stairs or steps and are variously known as 'bawdi', 'baoli', 'vav', 'vavdi', 'vai', 'kalyani', or 'pushkarni'. The Sanskrit Silpa-Shastras and ancient inscriptions refer to them as 'Vapi' or 'Vapika'. (Chandra, 2015)

These Stepwells are often referred to as "women's buildings" as many Stepwells were built under the patronage of women.

The three major constituents of Stepwells are namely the vertical well with an arrangement for hauling up water by buckets, the stepped corridor leading down several storeys into the earth and the numerous intermediate tower-like pavilions built as open halls in the stepped corridor. (Jain-Neubauer, 1981)

All stepwells share combinations of the following elements:

1. Toda - A pair of ornate pillars at the entrance of a stepwells to mark its locations. They can be very heavily embellished or very plain depending of the style and scale of the stepwell. They typically contain a small niche to place an oil lamp.

2. Kuta - A landing between sets of steps in a stepwell to provide a place to stand and rest. Kutas is typically covered by stacked pavilions divided into levels corresponding to previous Kutas. Number of Kutas divides the types of stepwells.
3. Ardhakuta - A supporting arch, like a Kuta, but without a pavilion or landing.
4. Well shaft -The circular shaft provided at the end of the stepwell giving access to underground water can be claimed as the well shaft. (Joshi, 2017)

Stepwells dot the Indian Subcontinent from the northernmost and central parts of Delhi, Uttar Pradesh, and Madhya Pradesh along with Rajasthan, Gujarat, and Maharashtra and then western peripheries to the south in Tamil Nadu, Karnataka, and Telangana. [Pathak and Kulkarni, (2007); Lautman, (2013); Shubhangi and Shireesh, (2015); Parasa (2018)]. A few examples of the Stepwells include – Agrasen ki Baoli (Delhi), Chand Baori (Abhaneri, Rajasthan), Panna Meena Ka Kund (Jaipur, Rajasthan), Rani- ki- Vav (Patan, Gujarat), Adalaj (Ahmedabad, Gujarat), Surya Kund (Gujarat), Pingleshwar Mandir Stepwell (Parbhani, Maharashtra), Ahilyapur Stepwell (Dhule, Maharashtra), Charthana Stepwell (Parbhani, Maharashtra), Loni Bapkar (Pune, Maharashtra), Lakkundi (Karnataka), Pushkarani (Karnataka).

## 6. Methodology:

The research adopts a qualitative method. The case studies presented are taken from secondary data sources like articles, research papers, journals published on the subject by eminent historians, archaeologists, journalists, architects, etc.

Accessed, studied, and analyzed the drawings of Stepwells which helped in understanding the basic concepts, principles and various parameters taken into consideration for construction of these wells.

Studied the water management techniques and handling of the water crisis in the yesteryears thereby evaluating the feasibility of using that knowledge and the ancient techniques in the current times.

### 6.1. Case Studies:

For this research four stepwells from the central and western part of India have been studied, which are as mentioned below:

1. Agrasen ki Baoli (New Delhi)
2. Chand Baori (Rajasthan)
3. Loni Bhapkar (Maharashtra)
4. Birkha Bawari (Rajasthan)

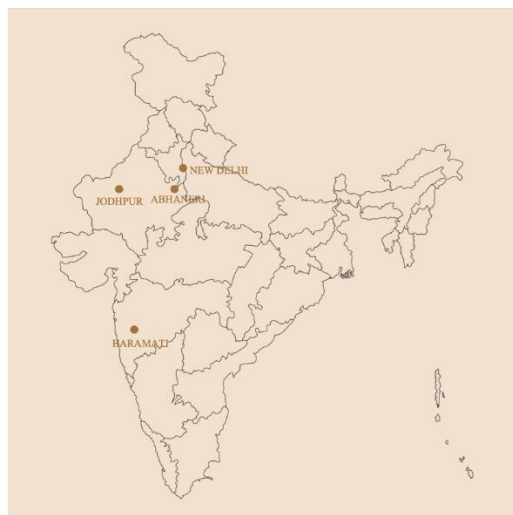


Figure 1: Locations of studied Stepwells (Source: Author)

Amongst them Stepwell (i) and Stepwell (ii) are being revived by the Archaeological Survey of India (ASI) whereas Stepwell (iii) and Stepwell (iv) are currently in use.

### 1) Agrasen Ki Baoli:



Figure 2: Location - Agrasen Ki Baoli, New Delhi (Source: Author)



Figure 3: Agrasen Ki Baoli (Source: Author)

- **Location:** New Delhi
- **Climate:** Subtropical
- **Context:** It is located at Connaught Place, New Delhi, it is surrounded by a peaceful residential area.
- **Period:** There are no historical records to prove who built the stepwell but it is believed that it was originally built by the legendary king Agrasen and the present architecture hints at it being rebuilt in the 14<sup>th</sup> century during the Tughlaq or Lodi period of the Delhi Sultanate.
- **Shape and Dimensions:** Agrasen ki Baoli is a 60 meter long and 15 meter wide historical stepwell. The four storeyed structure has distinct arched niches distinguishing the four levels. From far the stepwell seems to be a three storeyed structure and as one approaches the baoli the fourth level is revealed.
- **Type of stepwell:** Baoli
- **Function:** For centuries it had been an utilitarian well, offering respite and shelter to travellers coming in and out of Delhi.
- **Material and Special features:** The number 108 has a religious significance for the followers of Hindu faith and this baoli has 108 steps.
- **ASI Protected:** It was designated a protected monument by Archaeological Survey of India under the Ancient Monuments Archaeological Sites and Remains Act of 1958.

## 2) Chand Baoli:



Figure 4: Location – Chand Baori, Rajasthan (Source: Author)



Figure 5: Chand Baori

- **Location:** Abhaneri, Rajasthan
- **Climate:** Arid
- **Context:** Chand Baori is a deep four sided well with a partially destroyed temple adjacent to it dedicated to Harshat Mata (Goddess of Happiness).
- **Period:** Constructed in the 9<sup>th</sup> Century by Raja Chand to resolve water shortage issues.
- **Shape and Dimensions:** Chand Baori is the world's largest and deepest stepwell, extends approximately 100 feet into the ground, down 3,500 steps and 13 levels presenting the most amazing symmetry as they taper down to meet the water pool. It is said to be an upside down pyramid. Despite its open architecture that exposes it to the intense heat, as one descends to reach the water level one realises that the temperature is about 5-6 degrees cooler than up above.
- **Type of Stepwell:** The inverted pyramid style structure along with its unique design of steps is called as 'Jhalra'.
- **Function:** The reason behind the construction of this stepwell is not fully clear but some believe it was not only used as a water harvesting site but also served as a gathering place for the community.
- **Material and Special Features:** The structure has symmetrically carved steps on three sides and the fourth wall has pavilions with sculptures and carvings, and enclosed rectangular courtyard kind of structure - a stage that may feature dances, dramas and all forms of performing arts. The well also boasts of beautifully carved jharokhas, galleries supported on ornamented pillars as well as a royal residence.
- **ASI Protected:** The Stepwell is no longer in use; it is managed by the Archaeological Survey of India (ASI) which is responsible for conserving this ancient marvel of India.

### 3) Loni Bhapkar Stepwell:



Figure 6: Location - Barav at Loni Bhapkar, Maharashtra (Source: Author)



Figure 7: Barav at Loni Bhapkar

- **Location:** Baramati, Maharashtra
- **Climate:** Tropical
- **Context:** The barav is a part of the Mallikarjun temple complex which consists of Shiva and Vishnu temples, with the barav located at the intersection of the axes on which these two temples are located.
- **Period:** It is a 14<sup>th</sup> Century water storage system.
- **Shape and Dimensions:** The shape of the barav is nearly square with its topmost part measuring 21m and approximately 14m at its bottom. It has two intermediate landings with an overall depth of approximately 4.7m.
- **Type of Stepwell:** Baravs are stepped square or oblong rain and groundwater storage structures (Pathak, 2018). They are subterranean structures, and in the section, they resemble a funnel. (Hegewald, 2002) They have one or more intermediate landings for standing and fetching water. Most of the baravs have a square shape, some are rectangular, while a very few are octagonal. Their size decreases from top to bottom. They have a parapet wall around them with one or more entrances. The name barav is believed to have originated from its unit of measuring the length called bav . One bav is equivalent to 1.5m; bara, i.e. twelve such bavs make up one barav. Therefore, some of the baravs are square in plan with its side approximately measuring 18m (12x1.5=18). However, this is not a fixed rule. Several baravs have their sides shorter or longer than 18m. (Marathe, 2019)
- **Function:** The barav is used for ablution before entering the temple.
- **Material and Special Features:** The complex consists of a Shiva and a Vishnu temple with the barav located at the intersection of the axes on which these two temples are located. The Shiva temple is aligned along the southwest – northeast axis while the Vishnu temple is aligned along the southeast – northwest axis. The intersection of the two axes symbolises the interface between the earth and heaven and it was

essential for the devotees to take a dip in the barav before entering the temple. A high parapet wall with rectangular niches is built along all four sides with a wide entrance located at the centre of its southern side. It is said that once 24 Vishnu idols adorned the niches in the parapet wall which brought sanctity to the complex. This naturally ensured that the premises remained hygienic and clean. There is a pillared mandap located on the western side of the barav.

- **ASI Protected:** No

#### 4. Birkha Bawari:



Figure 8: Location- Birkha Bawari, Rajasthan (Source: Author)



Figure 9: Birkha Bawari

- **Location:** Jodhpur, Rajasthan
- **Climate:** Arid
- **Context:** It is located in the Umaid Heritage Township.
- **Period:** It is a 21<sup>st</sup> century stepwell designed by Architect Anu Mridul.
- **Shape and Dimensions:** 'Bawari' is a linear stepped well where steps lead down into the well water and 'Birkha' in local dialect means rain.
- The structure is 224m long and average 10.5m wide with an average depth of 11m from the ground level and an average water depth of 7m. It is 6-storeys deep at the farthest end and about 18m below the surrounding ground.
- The geological investigation had revealed the first subterranean stream at 20m from ground level. Since this was a rainwater harvesting structure, the depth was thus restricted to 18m to stay clear from underground stream of water.



- **Type of Stepwell:** This project is a combination of the traditional ‘Kund’ (stepped pond) and ‘Bawari’ or ‘Vav’(stepped wells) where the entrance court in the form of a kund offers majestic space for gatherings and the bawari stores the rainwater.
- **Function:** It is a stepwell built to conserve over 150 million litres of rain water for the Umaid heritage Township.
- **Material and Special Features:** One of the most distinctive features of this well is the innovative way in which the retaining walls have been conceived and constructed. The construction is a synthesis of re-interpreted structural system of age-old barrel vaulted roofs, local construction practices and site-quarried material of sandstone to create curved slender retaining walls. Instead of the conventional retaining walls for countering earth pressure the concept of tunnels or barrel vaults has been re-interpreted as retaining walls in the form of upended ‘barrel vaults.
- The architecture of the Bawari is totally utilitarian without lavish adornments like that in ancient stepwells.
- **ASI Protected:** No

Table 1: Comparing the cases (Source: Author)

Comparison table				
	CASE I	CASE II	CASE III	CASE IV
Name	Agrasen Ki Baoli	Chand Baori	Loni Bhapkar	Birkha Bawari
Location	New Delhi	Abhaneri,Rajasthan	Baramati,Maharashtra	Jodhpur,Rajasthan
Climate	Subtropical	Arid	Tropical	Arid
Context	Independent structure	Temple Complex	Temple Complex	Residential Township
Period	14 <sup>th</sup> Century	9 <sup>th</sup> Century	14 <sup>th</sup> Century	21 <sup>ST</sup> Century
Shape	Linear	Square	Square	Linear
Dimensions	60x15m	35x35m	21x21m	224x10.5m
Depth	22m	30m	4.7m	18m
Type of stepwell	Baori	Jhalra	Barav	Kund and Baori
Function	Water Conservation (not in use)	Water Conservation (not in use)	Ablution	Water Conservation
Material and Special features	108 steps	Inverted pyramid	Located on axes of two temples	Re-interpreted structural systems
ASI Protected (Y/N)	Y	Y	N	N

## 7. Inferences:

From the case studies it is clear that every Stepwell is distinct and is unique in its own way. The forms and intricacies in design vary from region to region. It also highlights that Stepwells have been constructed in India during various periods and they gave immense socio-economic importance to the region. Stepwells were important means of water conservation and also served as places of social and religious gatherings.

## 8. Findings:

During the research it was observed that not only the scarcity of water but also the region's terrain were the dominating factors in deciding the design and structure of the wells.

For site selection, a survey used to be conducted to understand the ground water availability for perennial water supply as well as the nature of the soil where the 'well' would be constructed. Building sturdier, everlasting structures providing yearlong supply of water for the community would be the aim of such endeavours.

Stepwells not only served as important water resources for the community but also served as places of respite for travellers and passers-by and locations for recreation, social gatherings and important events.

Human settlements have always been near water resources like rivers and lakes. As civilizations evolved and people started moving to different locations which necessarily were not near water sources the need for water storage systems was felt. This led to the birth of manmade water storage systems like ponds, lakes and eventually leading to construction of larger structures like wells and stepwells.

Since ancient times, it has been India's tradition and culture to worship nature as God. Water being essential to life has always been treated as sacred and because of its life-giving properties is equated to Mother Goddess and hence worthy of worship. The era of the Hindu rulers is a testimonial of this tradition as building of stepwells received patronage both from the rulers specially the queens as well the wealthy people of the community. It was a practice to depict stories from Indian mythology and including shrines, temples, idols of deities and gods as ornamentations to sanctify the structure. Stepwells gained importance as places of devotion where ritual purification and prayers were also performed.

With the advent of time many Muslim invaders invaded India and few of them accepted this country as their mother land and settled here. Some of them went on to become eminent rulers of India and understood the importance of these water conservation structures. They too contributed by constructing stepwells and adorning them with Islamic style of architecture like use of domes, arches, geometrical patterns and inscriptions from their holy books.

When the British arrived, they considered the water from stepwells unfit for human consumption and failed to understand the importance of other functions of the stepwells for the Indian community. For instance, the water which was considered having curative properties by the local community was declared poisonous for consumption by the British. Hence, they either filled in the wells or restricted use of these structures. With the advancement of new water supply systems like canals, dams, reservoirs, hand pumps etc water procurement became simpler and less strenuous as compared to procuring water from the stepwells. Gradually, with plumbing systems reaching every household the use of stepwells lost its prominence.

Post-independence, India learnt and adopted water supply system methods from various nations and thus the use of Stepwells became redundant at least in the urban areas if not villages.

We can therefore conclude that the sad demise of stepwells was a result of invention in better and superior water conservation and supply systems and can't be merely attributed to the clash of cultures.

## 9. Conclusion:

Looking at the current world scenario access to necessities like clean air and potable water is becoming difficult day by day. Pollution being the reason for drastic climatic changes, erratic weather conditions is a manmade disaster. A few reports also state that India is facing the worst water crisis in its history and by 2030 it is estimated that demand for water will be twice that of its supply.

This research guarantees a long-lasting and effective solution to the water crisis faced by the ever-increasing population of the world today. A glance at the yesteryears will be the best approach to sort out the anomalies of the current systems in use.

The urban cities are constantly under pressure to accommodate the ever migrating population from the villages. Hence land as well as resources like food and water are becoming scarce.

The local authorities need to arrange for these demands to be fulfilled. In order to provide uninterrupted water supply to the locals, new systems need to be installed which require land, funds, raw materials, equipment, labour, expertise etc. One also needs to consider the time required to complete the construction and commissioning of the said system.

With the rapidly changing scenarios Do we really have the time, funds and resources to implement such projects?

Thus, it becomes imperative to take a look back in time and appreciate the wisdom of our forefathers who already have provided us with tangible solution to our current crisis – ‘The Stepwells’. Let us be proud of these structures that have stood the test of time and are standing strong even today. All we have to do is to reinstate them to their former glory. We can achieve this by cleaning up the stagnated water, carry out the necessary repairs and spread awareness regarding their worth and importance of the ancient asset that we already possess.

## Acknowledgements:

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I would also like to thank my friends Aditi Doshi and Maithilee Gourshete for their constant support and encouragement throughout the study.

Finally, I wish to thank my parents who have always supported and encouraged me.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Study of Virtualization: A Tool for Effective Management of Heritage Conservation Projects

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## **Abstract:**

*This is an age of digital world, everything is becoming online or just a touch away, be it transferring money, controlling your home automation or ordering food. This all can happen in just one touch through your mobile phones. Technology is a big part in the general construction industry.*

*Built heritage forms an important part of our culture and architecture, they serve as landmarks. Effective management of the project plays an important role in successful execution of conservation projects.*

*This paper throws light on the use of technological advancement for digital restoration used as a tool for efficient project management. Accurate documentation is very important. The paper will study different pros and cons of modern vs traditional documentation techniques. It will study different initiatives across the world in regards to digital restoration which ultimately contributes in effective management of heritage projects. The paper aims to study of virtualization as a digital tool for effective management of conservation of the built heritage. The objectives are to study the various techniques & significance of Documentation in Heritage Conservation and to study if Virtualization can be one of the tools available for better Management & Conservation of Heritage Structures.*

*The methodology that was adopted was to identify problem statement and finalizing aims and objectives, then reviewing relevant literature and policy guidelines. After referring case studies of relevant existing projects and circulating questionnaire among field experts the inferences and recommendations were made based on the study.*

## **1. Introduction:**

### **1.1 Background Study:**

Cultures have shared goals and purposes for the advancement of civilization and are created over extended periods, whether in the past or the present. Numerous studies back up the notion of preserving historically significant locations with cultural and historical significance, bridging the gap between material and immaterial values, and highlighting the significance of cultural diversity in the global heritage process as a means of determining future courses based on historical precedent. (Khalid, 2021).

The significance of architectural heritage has grown in light of recent global activities at world heritage forums, particularly UNESCO. India has 38 world heritage sites as of 2018, which is the sixth highest of any nation. In addition, UNESCO has received a list of forty-three preliminary sites for review and approval. Through tourism, heritage conservation also helps to improve the nation's economy (Khalid, 2021).

Considering these aspects, the sooner we start preserving our rich heritage structures, which are masterpieces in themselves, the better it is for us. One of the important facets to be studied is the technological aspect of the conservation of heritage structures.

The use of new technologies has increased dramatically over the past few years, affecting every aspect of our lives. As a result, it has also changed how various communities around the globe perceive heritage. This is especially true for younger generations, for whom exposure to cultural heritage is frequently through a digital substitute that affects their understanding and perspective (Maria Economou, 2015). Digital tools can be used to organize the copious amounts of data involved in scientific research and historical documentation and help in making these more accessible to a broad audience.

By the Burra Charter the process of conserving heritage entails three stages—1. understanding its significance, 2. creating a policy, and 3. administering it as a result of the policy. Prior to taking any action or making any intervention that could modify the thing, it is essential to comprehend the object and obtain information about its physical condition (Burra Charter, 2013).

Cultural heritage is also threatened by a few factors, including aging, urbanization, vandalism, and natural catastrophes. Practically speaking, there is no way to ensure eternal life, and there is always a chance of losing oneself. As a result, we should make sure that they are thoroughly documented so that, in the event of their passing, we may either use the archives for recording and documenting to benefit future generations or, if necessary, use them for reconstruction. Hassani (2015) The phases of the conservation period and the restoration of historic buildings are often defined as follows:

1. Initiation 2. Assessment 3. Options 4. Project Development 5. Implementation 6. Operation (Ferrah Güner A, Benli G, Ferrah Guner A et al, 2019)

Precise documentation must be carried out beforehand to ensure that the data available is accurate on which further work is done. For accurate documentation, it is necessary to make use of technological advancements like terrestrial laser scanning, drone photogrammetry, LiDAR systems, and many more. A combination of conventional and modern techniques will ensure the smooth and efficient conservation of heritage structures.

## **1.2 Concerns:**

- Lack of prioritization towards conservation of heritage structures,
- Lack of accurate documentation and creation of database of the same,
- Inadequate understanding/ adoption of the use of advanced technology in heritage conservation,
- Ineffective Management of Heritage Conservation Projects.

## **1.3 Hypothesis:**

Heritage could be impacted negatively because of various natural & man-made factors whereas virtualisation can be a tool for conserving heritage in the form of documentation. Also, it can be utilized as an efficient parameter for the management of the heritage conservation project to enhance the overall execution of the project.

## **1.4 Research Questions**

- What are the various techniques & significance of Documentation in Heritage Conservation?
- Can Virtualization be one of the tools for Effective Management & Conservation of Heritage Structures?

## **1.5 Aims:**

To Identify if virtualization can be a digital tool for effective management of conservation of the built heritage.

### 1.6 Objectives

- To study the various techniques & significance of Documentation in Heritage Conservation.
- To study if Virtualization can be one of the tools available for better Management & Conservation of Heritage Structures.

### 1.7 Scope and Limitation:

The research therefore refers literature on both national & international level to understand scenarios in various contexts & make recommendations accordingly in Indian context. The study will look at various practices that are currently utilized across the world & will analyse the opportunities & obstacles with the potential best practices in the field of heritage conservation. The scope of the study extends to demonstrate the prospective practices for effective management of heritage projects. The study shall not include study of heritage precincts, natural heritage (including culturally significant landscapes & biodiversity); items of historic importance such as archive materials, books, works of art & artifacts; intangible culture such as folklore, traditions, language, and knowledge.

## 2. Research Methodology:

The study's foundation is a methodical analysis of the body of work that has been written about the conservation and preservation of cultural and architectural heritage in digital format. The thesis examines information from many databases and gathers facts, issues, and solutions related to digital heritage conservation and preservation. The thesis proposes digital protection of UNESCO-designated historical monuments in India. It also seeks to include academics and subject-matter specialists' perspectives. To acquire data, a qualitative research methodology is used.

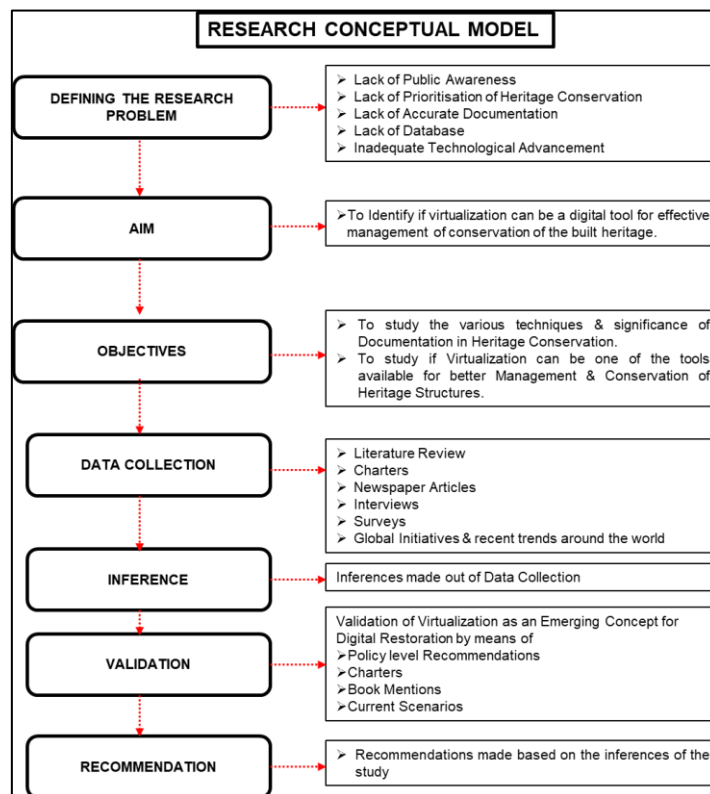


Figure 1: Research Conceptual Model (Source: Author)

### 3. Heritage Conservation:

#### 3.1 Various Stages of Heritage Conservation Project:

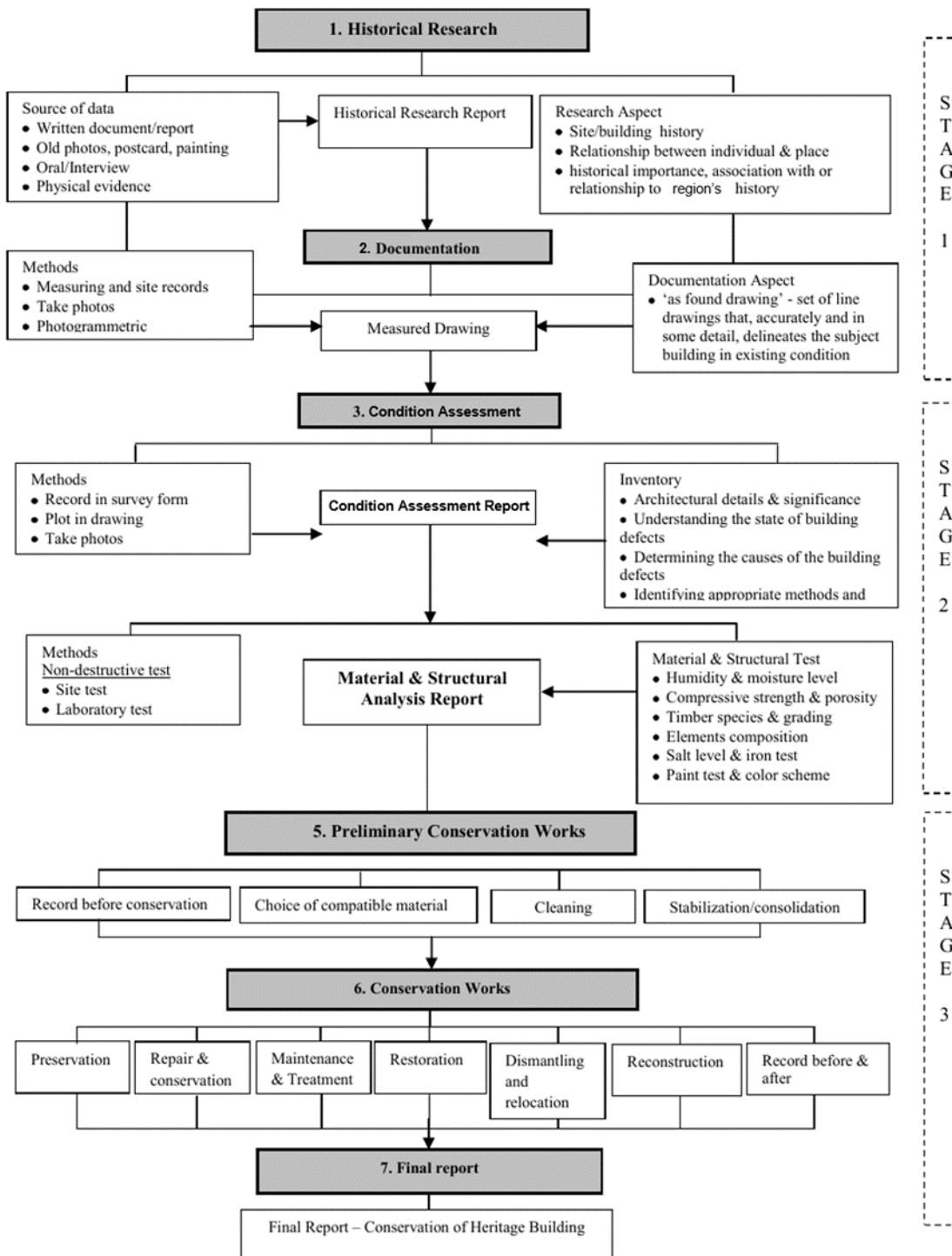


Figure 2: The basic conservation activities in current practice (Harun, 2011)  
 (Source: (Ferrah Güner, Project Management in Conservation and Restoration of Historic Buildings, 2019))



### 3.2 Various Stages of Management of Built Heritage Project:

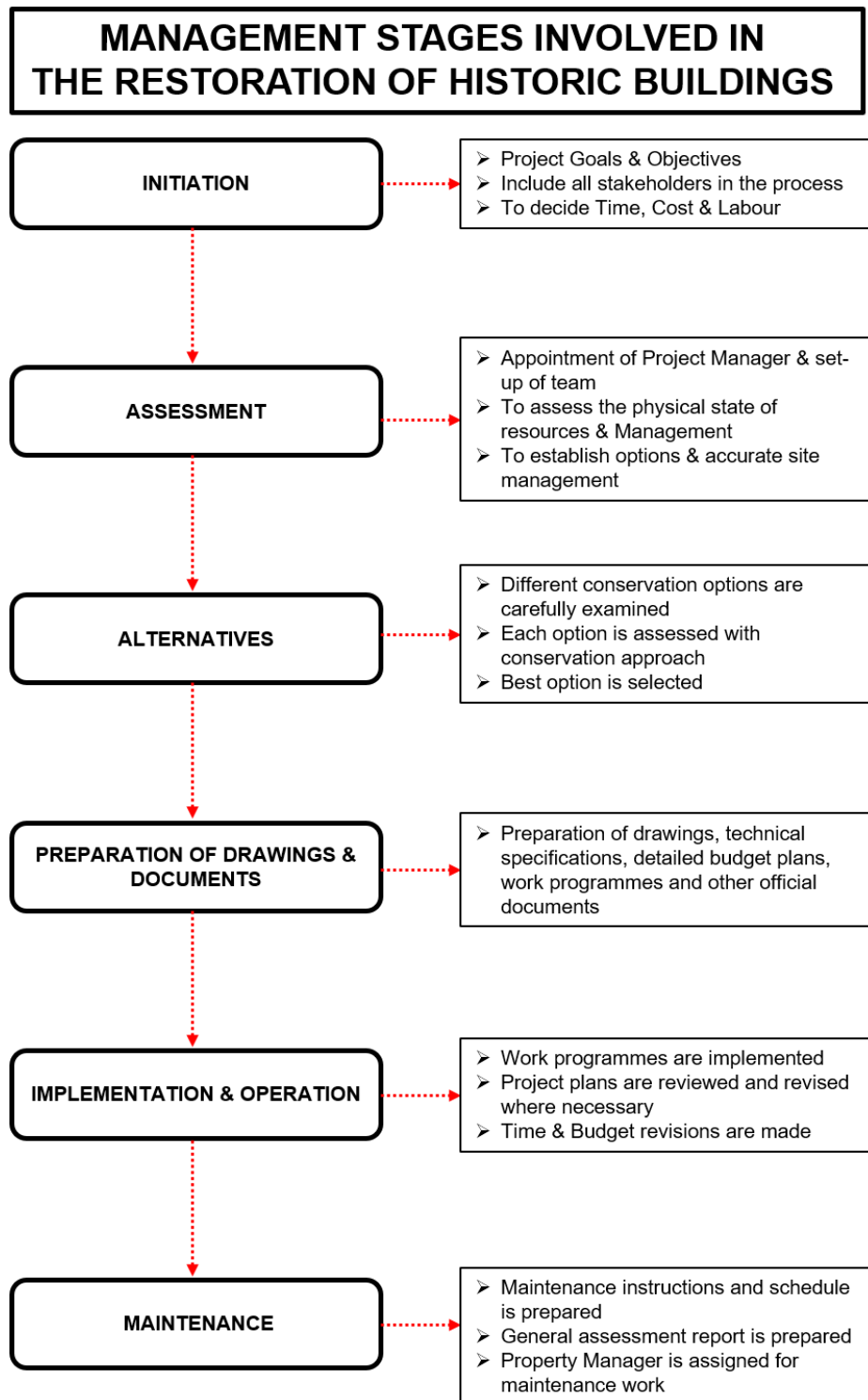


Figure 3: Management Stages involved in the restoration of historic buildings (Source: Author)

### 3.3 Current scenario & establishing need for virtualization:

The Watson Hotel or Royal Esplanade, located in Mumbai, which used to be an important landmark for Mumbai is now on the verge of deterioration. The only existing Cast Iron structure needs urgent attention toward Restoration. Irrespective of the reasons, the need of the hour is to find out a solution to this to retain Mumbai's identity and pass this masterpiece to the future generations.

On the other hand, Notre Dame – Paris, which was already 3D Laser scanned by the historian served as a great source for the restoration after it abruptly caught fire. Natural Calamities like these occur involuntarily on which we don't have any hold, it is in such situations that the role of technology comes to our rescue.

In a scenario where it would have got destroyed, without any concrete documentation, the world would have lost a very important French Gothic Architecture masterpiece leaving no traces for the exact restoration. Both these structures highlight the need for a powerful tool & procedure that might take care of such situations which might occur for any of our structures.

The London Charter seeks to establish the fundamental goals and guidelines for the use of 3D visualisation techniques with regard to standards, documentation, intellectual integrity, dependability, accessibility, sustainability, and documentation. On October 17, 2003, during the 32nd session of the General Conference of UNESCO, the Charter on the Preservation of the Digital Heritage was adopted. It states that, given that the loss of any kind of heritage impoverishes the heritage of all nations, that more information sources are kept up to date in digital formats, and that having access to this heritage will expand opportunities for knowledge creation, communication, and sharing among all people, it is important to preserve this digital heritage for the benefit of current and future generations.

A Group Report published by NITI Aayog – Govt. of India for Improving Heritage Management in India states the importance of use of technologies for National Heritage.

### 3.4 Upcoming initiatives around the world:

#### 3.4.1 A Clever Way to Show What Ancient Ruins Looked Like in Austria:



Figure 4: A clever way to show what ancient ruins looked like in Austria (Source: 7 Ancient Ruins around the world, r. (2018, Feb 13). Retrieved from <https://themindcircle.com/ancient-ruins-reconstructed-with-architectural-gifs/>)

A very good effort has been made towards virtually reconstructing Heathens' Gate through a Glass frame which looks right towards the deteriorated remains of the Heathens' Gate, but what the viewer sees is the complete picture the way it looked like at that time.

### 3.4.2 Ancient Ruins Around the World, Reconstructed:



Figure 5: Ancient Ruins around the World, Reconstructed (Source: <https://themindcircle.com/ancient-ruins-reconstructed-with-architectural-gifs/>)

A similar initiative has been carried out for the 7 Ancient ruins around the world to virtually reconstruct the fascinating past, allowing us to see how the ruins visible today developed from the initial structures in all their glory.

### 3.4.3 Ancient Olympia Application:

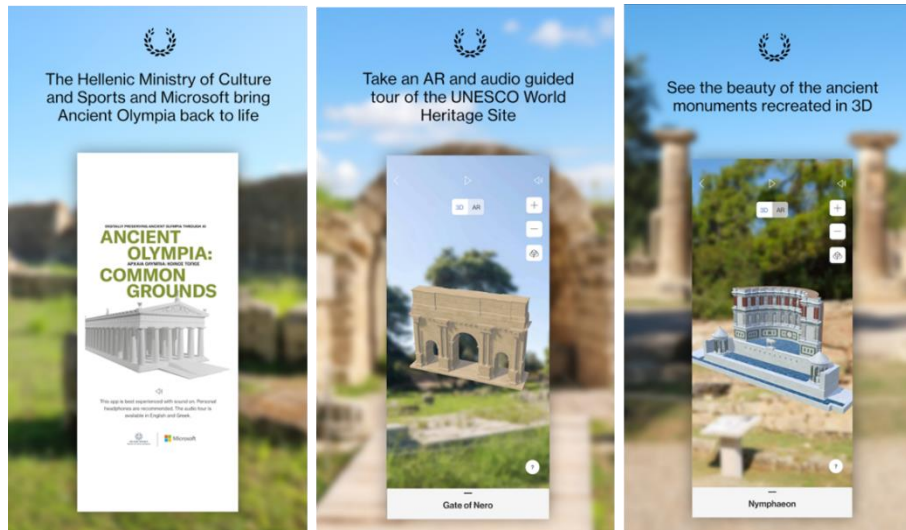


Figure 6: Ancient Olympia Application (Source: <https://olympiacommongrounds.gr/explore>)

Using the "Ancient Olympia" app on your phone, you may learn about Ancient Olympia's existence and prosperity two millennia ago. Olympia emerged as the hub of the ancient Greek civilization during the Games, a location where people came together to celebrate humanity in a celebration called after this hallowed site, despite differences, particularly in politics. With the use of this app, one can travel back in time and enjoy the Ancient Games as they originally existed.

### 3.4.4 CyArK – NGO:

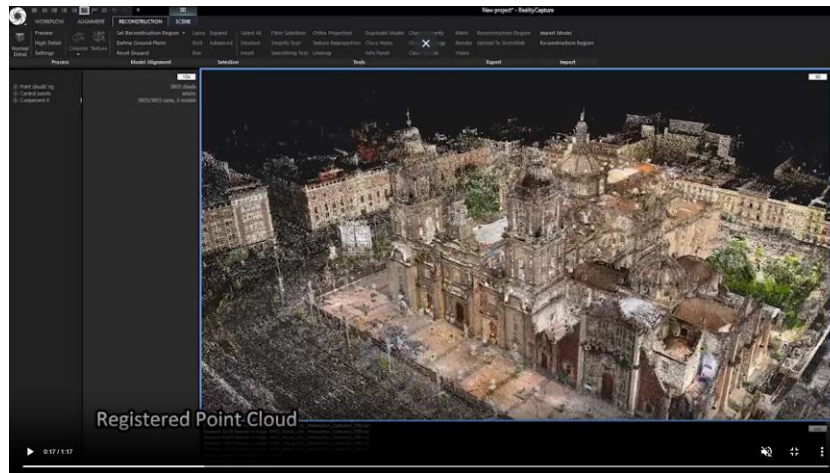


Figure 7: Digital Documentation (Source: <https://www.cyark.org/whatwedo/documentationAndTraning/>)

Figure 7: Digital Documentation (Source: <https://www.cyark.org/whatwedo/documentationAndTraning/>) Ben Kacyra founded CyArK in 2003. Since then, the organization has collaborated with local partners in more than 200 locations across more than 40 nations, leading the way in the use of 3D recording technology for cultural heritage protection and celebration. Through digital documentation and the development of location-based web, mobile, and immersive experiences that encourage introspection, dialogue, and creativity, CyArK aims to introduce new audiences to heritage.

- Creating Equitable Access to Cultural Heritage,
- Building Capacity in the Cultural Heritage Sector,
- Making Data Open and Reusable,

Storytelling. Steps involved in Digital restoration

1. LiDAR (Light Detection and Ranging),
2. LiDAR Registration,
3. Registered Point Cloud,
4. Terrestrial Photogrammetry,
5. Image Alignment and 3D Reconstruction,
6. Aerial Photogrammetry,
7. Aerial Image Alignment and 3D Reconstruction,
8. LiDAR and Photogrammetry synthesis,
9. Photo textured 3D Model,
10. Architectural drawing extraction

## 4. Primary Data Collection:

### 4.1 Expert Interaction:

Expert Interaction were carried out with multiple heritage conservation practitioners, contractors & MCGM officials. Heritage conservation practitioners included eminent personalities like Ar. Rahul Chemburkar, Mr. Chetan Raikar, Ar. Sheetal Gandhi, Mr. Ram Savani, MCGM official Er. Aparna Bhatte Dy. Mun. Architect (DP) & Ar. Pankaj Katole.

## **4.2 Questionnaire:**

A survey questionnaire was carried out amongst 10-15 Industry Experts in the field of Heritage Conservation who are also a part of Academics, to understand the needs, challenges & current practices in the field of Conservation & to understand the application & limitations of the Digitalisation. There were 2 sets of Questionnaires prepared, one for Heritage Conservationists and the other for Academicians. A qualitative approach was adopted to collect information and data was analysed based on the same. Experts pointed out the current challenges faced in the industry and shared their experiences on digitalisation across the world, at the same time encouraged to take this topic up further as a study.

## **5. Inference:**

This research paper delved into the multifaceted realm of heritage conservation and its management, probing the stages integral to this process. The study began by examining the overarching significance of conservation and the intricate stages that constitute effective management of heritage projects. Through extensive literature analysis, the pivotal role of documentation emerged as a cornerstone in the management of such projects. The research method encompassed two comprehensive case studies, focusing on the Watson Hotel and Notre Dame. The analysis of these cases underscored the compelling need for meticulous documentation. The study dovetailed into the endorsement of 3D visualization methods and digital data storage, as advocated by the London and UNESCO charters. The research expanded its purview to global initiatives in heritage conservation, dissecting exemplars like the Ancient Olympia Application and CyArK. These initiatives demonstrated the potency of digital documentation in engaging wider audiences with heritage. The study further conducted in-depth case analyses of Indian initiatives, including the Gateway of India, Saint Marks Cathedral, and Bengaluru's heritage sites, exemplifying the incorporation of virtualization for effective conservation project management.

A crucial finding of the research revealed the utility of virtualization in formulating prospective conservation strategies. Innovations like drone photogrammetry and 3D laser scanning emerged as precise documentation tools. The data derived from these techniques was translated into 3D models via Autodesk ReCap 360 and Autodesk ReMake, offering possibilities for future maintenance and restoration through BIM models.

A case study of Brock Commons illuminated the positive impact of virtualization on project management, underscoring its potential to enhance labour productivity, financial oversight, and project scheduling. This framework was posited as adaptable for heritage conservation, suggesting its applicability and potential positive outcomes. The research culminated with a resounding assertion that virtualization could be harnessed as a powerful instrument in the effective management of heritage conservation projects.

The research also recognized the inherent value of analogue materials in cultural heritage preservation, acknowledging that digitization, while not a substitute for preservation efforts, can complement and facilitate the safeguarding of original heritage-built structures.

## **Recommendations:**

Conservation, excavation, surveying, and documentation tasks should all make use of new technologies such as photogrammetry and 3D laser scanning. India's State Archaeology Departments and ASI ought to think about setting up an internal system.

It is advisable to work in conjunction with foreign universities to introduce the most recent methods of exploration and excavation. In order to serve all types of visitors, advanced technology for site promotion and marketing needs to be actively deployed.

A perfect combination of Conventional & Modern techniques will ensure the smooth & efficient Conservation of Heritage Structures. Projects like Brock Commons Tallwood which have proved the efficiency of virtual design and construction (VDC) model. A similar framework could be adopted in the field on Conservation and the results could be monitored for the management of heritage conservation projects.

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Devising Procedures and Tools for Effective & Efficient Project Management of Heritage Conservation Projects

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## **Abstract:**

*Heritage structures play a significant role in every nation's history and culture, thereby portraying the richness of the country. Therefore, its restoration and preservation are of great importance to maintain and further enhance its splendor, strength, and life, so that future generations can know about the glorious past. India boasts of valuable heritage which needs to be conserved and hence successful project management can play a pivotal role.*

*The management of historic building projects is recognized as a sensitive and it has been observed that conservation works of such buildings are often delayed; often slow to execute, may or may not involve the stakeholders and sometimes exceed the estimated budget and time because of the various hindrances either during planning or execution phases. In project management, the parameters like time, cost and quality are the most important and hence it is vital that right from the start of the project planning, to define the way how each of these parameters will affect the project.*

*The purpose of this study is to investigate the various challenges both general and specific in case of heritage buildings that shall affect the project performance and the timely completion.*

*This research aims to study the built heritage public buildings within the Mumbai Metropolitan Region (MMR), that have undergone conservation and restoration process in the presence or absence of an experienced project manager in this area and have been audited to find the various challenges faced during the same, tools employed during the process and thereby formulating a guideline framework for future and facilitate effortless working. The research methodology adopted for the study was majorly qualitative study which will be conducted through elaborate literature review relating to architectural conservation and the application of project management through the form of structured / unstructured interviews will be carried out with various professionals involved in the execution of such projects.*

**Keywords:** *project management, built heritage; conservation, restoration, project management challenges; performance*

## **1. Introduction:**

Every structure requires maintenance to achieve and complete its projected lifespan and heritage structures are no different from the same. Heritage structures symbolize any nation's historical and cultural value and are hence of prime importance. The conservation of such structures becomes critical as they have already stood the test of time and with rapid urbanization; the need to conserve, manage and revive these structures becomes the need of the hour. Every heritage conservation project is unique and is a highly fragmented sector and encompasses the involvement of multiple variables which include the scale of the project, modes; materials; technology to be incorporated, the governing authorities, multiple stakeholder's involvement etc. which is specific to the project.

India boasts of 5,00,000+ heritage sites and monuments, 3,691 ASI-protected monuments, and 38 UNESCO World heritage site and as per the report India is known for getting its sites inscribed, but the management of the sites post inscription has been a challenge (India, 2019). As per various references and discussions, the execution of conservation and restoration projects have been found to be unpredictable and hence they also become challenging, leading to cost overruns and delays. The challenges faced in such projects have been studied in various parts of the world but there is hardly or no study on the problems of heritage conservation in India and in Mumbai Metropolitan Region; which itself boasts of 590 heritage structures registered as of 2012 (Anon., Nov 5, 2016) from the perspective of project management. Aside from the case of modern structure project management, every conservation project would necessitate an in-depth study, documentation, detailed assessment, the preparation of a feasibility report, and its implementation in terms of techniques, materials, skilled workmanship, and so on that are unique to that project and initiate the methods to mitigate the problems that arise.

Project management shall be very effective in such projects as it shall be beneficial in terms of resource allocation and utilization, effective time management, lowering costs, increasing productivity, monitoring, and resolving issues and thereby resulting in stakeholder satisfaction. Thus, the rigorous implementation of Project Management would become an essential tool for nation-building and a testimony to India's cultural identity at the national as well as global levels.

Thus, to address the research gap, an exploratory study shall be done to understand the challenges faced in conservation and restoration projects, scope of project management and the project manager in mitigating the issues by the employment of various tools appropriate for the particular project. Through the study of various case studies, questionnaires, structured or unstructured interviews with conservation architects, etc. the lacunae in the present work carried out can be investigated and a guideline can be formulated right from the initiation of the conservation project; through its execution process and finally to post-occupancy, thereby becoming a baseline for management of built heritage structures and preserving its cultural value and quality with the involvement of project manager. Thus, the research paper aims to investigate and devise procedures and tools for the effective and efficient management of conservation of built heritage structures in Mumbai; through the study of tangible heritage structures (Grade II) within the MMR region.

## 2. Methodology:

The research methodology adopted for the study was majorly qualitative study which will be conducted through elaborate literature review relating to architectural conservation and the application of project management in the field. The secondary data search will be done through collection of reports for the similarly aligned projects documented in research papers, newspaper articles, electronic and social media. Primary data collection shall be based on personal interviews with experienced and expert conservation architects in the field practicing in the presence or absence of project managers through **snowballing method**, sometimes referred to as chain sampling or network sampling, which will start with one or more participants following that, it will proceed based on recommendations from those participants till the desired output is attained, within the Mumbai Metropolitan Region.

The unstructured interviews will be carried out with various practising conservation architects, academicians teaching architectural conservation in various institutions, project managers and other allied professionals involved in the execution of such projects and government officials. The study will also include unstructured interviews which will be directed and helping in probing more into the challenges involved in such culturally significant projects and whether or not any tools were employed to curb the same and if so, at which stages. These open-ended questions will employ free form of answer and these findings will be manually documented.



### 3. Theoretical framework:

In India, Conservation began under the reign of Emperor Ashoka who initiated the conservation of wildlife in the 3<sup>rd</sup> century BC. It was Firoz Shah Tughlaq who commanded to protect prehistoric structures in the 14<sup>th</sup> century AD. Since India’s independence there are many custodians who aim at preserving and conserving the heritage sites and monuments which includes the Archaeological Survey of India (ASI), State Archaeology Department, Temple trusts and committees, CPWD and other Unprotected Heritage – Public and Private, NGOs like Aga Khan Trust, INTACH etc.

Mumbai with its rich history offers many heritage structures and historical precincts, mostly along the southern tip of the Island city. Mumbai Metropolitan Region boasts of 590 heritage structures registered as of 2012, which is inclusive of buildings, archaeological sites, colonial, industrial, domestic, architectural sites and public spaces (Refer Figure 01). Hence a consulting committee was formulated by Mumbai Metropolitan Region Development Authority (MMRDA) called the “Mumbai Metropolitan Region – Heritage Conservation Society (MMRHCS)”, 1996 which guides the process and every work related to heritage structures needs an approval from the Committee. The heritage structures have been classified as Grade I, Grade II A, II B and III. MMRHCS has identified 2700 heritage properties which include 97 precincts. (MMRHCS, 2019-2020). Greater Mumbai includes: Grade I structure – 78; Grade II A structures – 330; Grade II B structures – 446; Grade III structures – 804; and Precincts – 64 making it a **total of 1722**.

Mumbai boasts of a large number of Grade 2 and 3 structures of which majority grade 1 and 2 have been undergoing the conservation process; in the presence or in the absence of project management and hence the case study of the same has been conducted.

**Project management** is defined as the planning, scheduling, and controlling of project activities to meet the project objectives. In other words, PMI or Project Management Institute; defines project management as the “*application of knowledge, skills, tools, and techniques to a broad range of activities in order to meet the requirements or objectives of a particular project.*” The **major project objectives** include **performance, cost, scope, and time**.

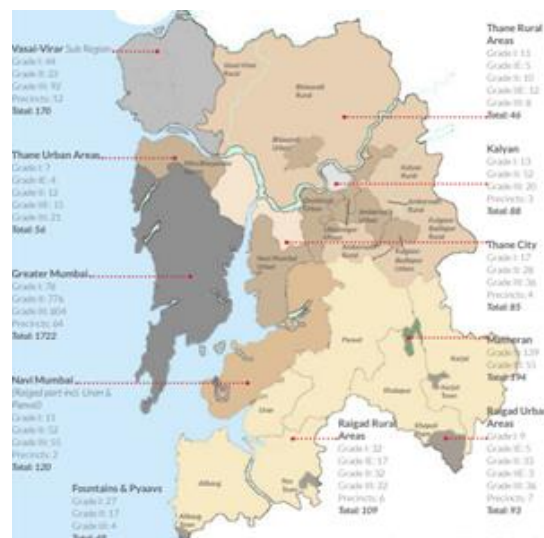


Figure 1: Map showing the areas considered for listing or grading (Source: MMR – HCS)

According to the PMBOK Guide (Project Management Body of Knowledge) (Anon., 2018) by the Project Management Institute (PMI), a project management life cycle consists of **5 distinct phases** including **initiation, planning, execution, monitoring, and closure** that combine to turn a project idea into a working product (Refer Figure 02).

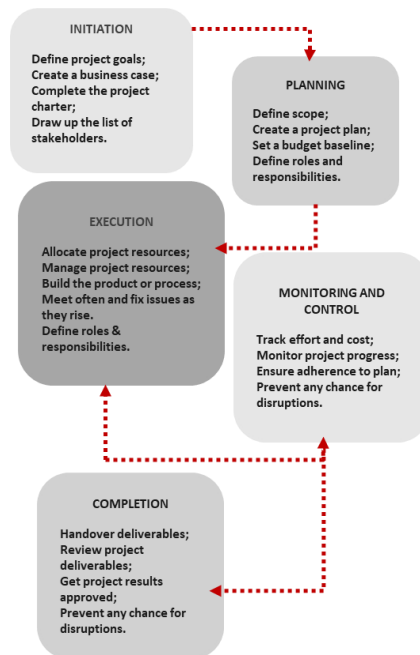


Figure 2: Five Basic phases of Project Management (Source: [www.kissflow.com/project/five-phases-of-project](http://www.kissflow.com/project/five-phases-of-project))

Concept of project management for architectural heritage project is different because of the uniqueness, the various uncertainties involved and complexity in every project which makes the project challenging. While dealing with heritage structures; a lot of time and assessment needs to be done to understand their physical conditions as the primary job is to maintain the cultural and historical values associated with the structures so that they become timeless. Thus, to identify, ascertain and assess the conservation of the cultural value of heritage structures; more time needs to be spent to understand the cultural location, the meaning of the place, physical condition, the physical state of resources, existing management system, etc.

In the study documented by Aysun Ferrah Guner and Gulan Benli (Benli, 2019), the phases of work for built heritage conservation process have been identified into the following 6 phases (Refer Figure 03).:

- *Project Initiation*
- *Project Assessment*
- *Options*
- *Project development*
- *Implementation*
- *Operation*



Figure 3: Six phases of the built heritage conservation process and their outputs (Source: [http://ip51.icomos.org/fleblanc/publications/pub\\_2007\\_conservation\\_process](http://ip51.icomos.org/fleblanc/publications/pub_2007_conservation_process))

From the conventional construction projects, heritage conservation projects at the onset need to be documented and detailed out well so as to give a clear idea of the works to be executed. Hence the documentation, assessment and thereby coming up with the options or methods of executing the work can be finalized which is different from the conventional construction project and hence forms an important and integral part.

In the well documented research paper of “Critical challenges in management of heritage conservation projects in India”; (Kalidindi, 2017), the main challenges during the course of work in conservation of heritage structures had been documented and grouped in categories where in 41 conservation professionals were interviewed in India. The purpose of the research was to understand the varied reasons for the poor performance of heritage conservation projects in terms of time, cost and quality w.r.t the exploratory study carried out in 11 cities across India. The main technical challenges (26 nos.) were identified and then grouped broadly into 8 categories and were evaluated based on their importance. It was concluded that the specific or unique challenges for each project needed to be identified independently, and that more research and methodologies needed to be developed in order to minimize the issues using suitable project management tools.

*Table 01: Factors affecting performance of heritage projects (Source: Journal of Cultural; Heritage Management and Sustainable Development, Volume 7, No. 3, 2017)*

Category	Factors	No of respondents
Competence of agencies	Conservation contractors having less capacity for large works	09
	Large companies not interested or experienced in conservation	07
	Unsafe work methods. Absence of safety culture	06
	Selection of agencies without niche expertise for large projects	03
	Monopoly of few architects and contractors	03
Problems in estimation	Quantity of work cannot be estimated without opening structure	14
	Delays due to large variations in quantity and nature of work	09
	Lack of documentation about original structure	05
Inadequate and unviable documents	DPR not prepared properly.	09
	Technical specifications not available for traditional items	08
	Rigid government contracts and standard schedule of rates not viable	08
Resource constraints	Difficulty in procuring proper material to match the original material	12
	Incompatibility of new material and methods	06
	Problems of bringing labour from distant places	02
Capacity of client	Institutional capacity of client	06
	Limited funds. Problems in prioritizing	05
	Lack of co-ordination among multiple agencies	05
	Delay in payment in Government projects	03
Lack of knowhow	Lack of traditional knowhow among conservation professionals	08
	Lack of skilled labour conversant with traditional techniques	06
	Segregation of architecture and engineering	03
Stakeholders	Lack of interest and involvement among private owners and community	11
	Ownership / tenancy issues	05
Problems in functional building	Problems of executing work without stopping use of building	07
	Public building handed for conservation in phases	03
	Restricted working hours	02

Table 02: Challenges faced in conservation projects, case study heritage structures in Queensland Australia. Source: (Perovic, 2015)





	Aspects	Description
<b>A</b>	<b>Financial and economic</b>	Funding of the project
		Altering certain specifications during the course of work
		contingency
		Delay in payments in case of Govt projects
<b>B</b>	<b>Technical</b>	Lack of conservation literature
		Since projects are not repeated; everyone who is involved faces unchartered territory
		lack of information on the building or site
		Non-availability of structural audit reports
		Sometimes planning is based on archived documents. The problem arises when the records are not kept properly and the archived records may often be the last record and the same may not be 100% reliable.
		Lack of respect for traditional architectural expressions, forms and materials and replaced by modern materials and construction techniques
		Non availability of conservation contractors
		Large companies not interested / not experienced enough to carry out the work
		poor leadership
		Lack of co-ordination between multiple agencies / stakeholders
		Sometimes only a visual inspection is allowed at most of the sites before defining the actual scope of works; due to which it is not possible to ascertain the problems of the building or site under the purview and thereby leading to inaccurate scope definition and unrealized conditions at the site
		lack of compliance with procedural systems
		sourcing additional materials due to limited sources
		Difficulties in finding contractors and trade specialists
<b>C</b>	<b>Social</b>	Non-involvement of the various stakeholders- Lack of interest
		No local awareness
		Problems when executing work without stopping current use of building
		Restricted working hours
<b>D</b>	<b>Policy and regulatory</b>	Current policies and changes
		Standard schedule of rates not viable.
		Demonetization.
<b>E</b>	<b>Political</b>	If a project has an unusual deadline set on account of any vested political interests, it may result in a challenge in accomplishing the same.
<b>F</b>	<b>Environmental</b>	Increasing demand for new projects or development, modern buildings for economic progress of nation.
<b>G</b>	<b>Miscellaneous</b>	Situations like natural calamities, pandemics, epidemics, new infrastructure facilities near the site under consideration etc.

Similarly in a study carried out w.r.t. three selective heritage structure in Queensland Australia (Perovic, 2015) further points were added and with the interviews held with the stakeholders like clients owning or managing heritage structures, practicing conservation architects, government heads or policymakers, project management consultants, contractors etc. the list of challenges have been modified under the following heads namely:

- Financial and economic
- Technical
- Social
- Policy and regulatory
- Political
- Environmental
- Miscellaneous

Through the research paper exploratory research was carried out within the MMR region wherein 4 conservation architects, 2 academicians teaching conservation, 2 government officials involved with MMRHCS, 2 project managers and a contractor specially handling conservation projects were interviewed. The interviewees had expertise and experience in conservation of architectural heritage of different styles and eras. The responses received from the professionals and along with the case studies have proved that there are many challenges that are faced during the course of work and the same determines the time, cost and quality of the project. (Refer table no. 03)

*Table 03: Comparative analysis for case studies taken (Source: Author)*

	<b>Case study 1</b>	<b>Case study 2</b>	<b>Case study 3</b>	<b>Case study 4</b>
<b>Name of the premises</b>	Zara building.	St. Thomas Cathedral.	TCS House / Bombay House originally known as Rallis House.	Ashley House and Somerset House.
<b>Photographic documentation</b>				
<b>Built in:</b>	1906.	1718.	1922 and again remodeled in 1966.	Mid-20th Century.
<b>Present owner:</b>	Oriental realtors (Supariwala group)	Diocese of Mumbai of the Church of North India.	Tata Group	Individual ownership.
<b>Grade of the structure:</b>	Grade II A.	Grade I	Grade II A	Grade III
<b>Assessing significance of the structure:</b>	Historic significance	Historic significance	Historic context	Historic significance.
<b>Past use:</b>	Office cum business center.	Religious.	Commercial.	Residential.
<b>Present use:</b>	At present occupied by Zara	Religious.	Commercial.	Residential.

<p><b>Architectural description</b></p>	<ul style="list-style-type: none"> <li>• 5 storied structures, built in 20th century, follows Edwardian Neo-Classical style</li> <li>• Typical characteristics seen are grand use of space, dramatic columns and intricate Roman-inspired details.</li> <li>• During the past century the building was put to different uses and eventually fell into disrepair.</li> </ul>	<p>he most prestigious in Mumbai. It is a standing symbol of the early 20th-century architecture. The building is known as the “<b>Zero Point</b>”.</p> <p>Edwardian Neo-Classical and Neo-Classical style with a white facade. The building is one of the most important interiors of the St. Ignace Cathedral in Ireland.</p>	<ul style="list-style-type: none"> <li>• 4 storied building in load bearing masonry;</li> <li>• Internal framework of RCC and steel.</li> <li>• Facade of the British-era building is an <b>Edwardian neo-classical look</b> with windows with Georgian bars.</li> </ul>	<ul style="list-style-type: none"> <li>• This imposing building gains its architectural character by the sloping roof with Mangalore tiles supported by a series of decorative wooden brackets and by the sloping chajjas.</li> <li>• The cornice bands at floor levels and simple rectangular architraves contribute to the modest ornamentation on the Ashlar masonry facade.</li> <li>• The rear façade faces the Sassoon Dock in the east.</li> </ul>
<p><b>Works carried out in terms of conservation</b></p>	<p>Restoration and cleaning of stone façade; Recovery of original elements such as the moulding on centenary doors and windows; Inside the store, recovery of the original brick is highlighted and now visible on all floors, to emphasize the historical origins of the building; Ornate façade preserved internally and externally.</p>	<ul style="list-style-type: none"> <li>• Cathedral tower, cathedral apse with flying buttresses and façade restoration and cleaning works;</li> <li>• Structural members that supported the roof appeared weak and pale and was cleaned, re-pointing and re-plastering was done.</li> <li>• RCC roof was replaced by sloping roof reminiscent of original structure.</li> <li>• Stone surface around the</li> </ul>	<ul style="list-style-type: none"> <li>• Facade restoration works;</li> <li>• Structural strengthening works;</li> <li>• Interior refurbishment</li> </ul>	<ul style="list-style-type: none"> <li>• The façade restoration and cleaning work was carried out.</li> <li>• Mangalore tile roof that measures 19,000 sq ft was refurbished.</li> <li>• The corroded RCC chhajjas across all balconies and windows across the structures’ three facades had to be reconstructed.</li> <li>• The rear facade required serious interventions due to disparate grills and inconsistent or damaged chajjas and they had no protection.</li> </ul>

		<p>clerestory seen with visible flaking and stone members were found missing, the same was retrofitted.</p> <ul style="list-style-type: none"> <li>• Timber window frames rectification works.</li> <li>• timber entrance porch had seen leakages; the same was made water tight.</li> </ul>		<ul style="list-style-type: none"> <li>• The louvers, glass barriers and invisible nets have been provided now and they ensure better ventilation, soften the blow of rain and also cleverly conceal the split air conditioning units that dot the outer walls.</li> </ul>
<b>Conservation architect for the project</b>	Ar. Kirtida Unawlla.	<b>Ar. Sheetal Gandhi</b>	<b>Ar. Brinda Somayya</b>	<b>Ar. Vikas Dilawari</b>
<b>Duration of project estimated</b>	9 months.	<b>14-18 months.</b>	<b>9 months.</b>	<b>1.5 years</b>
<b>Work completed</b>	9 months.	14-18 months in line with the centenary celebrations.	9 months	1.5 years
<b>Estimated cost of the project</b>	-	-	Rupees 25 Crores.	Rs. 3 Crores.
<b>Expense incurred</b>	-	-	Rupees. 25 Crores	Above Rs. 5 Cr. (internal repairs for homes were not included earlier on and damage after rain also caused it to increase).
<b>Project Manager involved in the project (Yes / No)</b>	Yes – Project manager as well as Structural consultant.	No.	Yes.	Yes
<b>Name of the Project</b>	Mr. Shahnawaz	NA	Ecofirst – A Tata Enterprise.	Ecofirst – A Tata Enterprise.

<b>manager or PMC</b>				
<b>Challenges faced during the course of work</b>	<ul style="list-style-type: none"> <li>• Demolition of a certain part which was damaged and reconstruction of the same had to be carried out. If done separately would have led to delays and hence demolition of section done and parallel construction started thereby securing walls and work progressed.</li> <li>• Co-ordination between the various agencies within the site viz. firefighting, electrical, civil and other agencies involved from time-to-time for the project was a tedious job.</li> <li>• Small part of the building had collapsed leading to accidental death and that was a hurdle.</li> <li>• Cracks in buildings observed which took a lot of time</li> </ul>	<ul style="list-style-type: none"> <li>• The site was small and thus there were limitations in working.</li> <li>• The quantification of the items in terms of repair and restoration works became a concern during the course of work as they went overboard and consequently led to the escalation of quantities and cost.</li> <li>• Lack of storage space was in fact one of the biggest challenges faced during construction.</li> </ul>	<ul style="list-style-type: none"> <li>• To introduce today's requirements of building without disturbing the original design by rehabilitating the building.</li> <li>• Lack of storage space;</li> <li>• Only minuscule open space on site was occupied by an existing electrical transformer.</li> <li>• The rear side structural glazing wall and cantilevered floating staircase could only be catered to after shutting of transformer after informing authorities.</li> </ul>	<ul style="list-style-type: none"> <li>• All the previous repair works done by MHADA hadn't done justice to the buildings and had resulted in dissatisfaction of the occupants.</li> <li>• The site was occupied by affluent residents; and hence controlling the noise was a major concern.</li> <li>• The site began after the pandemic and the 50-odd laborers had to follow the social distancing norms to the fullest.</li> <li>• RCC chajjas, which were the structures' design strength, posed the biggest challenge since they had begun to corrode owing to their proximity to the sea.</li> <li>• During the restoration of the chajja; the occupants of the building had to be comfortable. Also, during the restoration of the same; the site</li> </ul>



				witnessed 2 cyclones. <ul style="list-style-type: none"> <li>The corroded RCC chhajjas across all balconies and windows across the structures' three facades which have now been reconstructed had no protection to begin with.</li> </ul>
<b>Tools employed in terms of Project Management</b>	Network diagram, CPM and PERT employed	No project management tools employed	CPM, PERT and WBS employed	Project baseline, CPM, PERT and WBS employed
<b>Was the implementation successful (Yes/ No)</b>	Yes.	-	Yes.	Yes.
<b>Remark</b>	Scale of project was small and was successfully executed in presence of pmc.	No pmc involved since work in phase 2 involved mostly of repair works.	Since both properties are belonging to the tata group and were of high budget; hence probably the inclusion of ecofirst as pmc.	

Thus, through the research papers, along with the interviews conducted with the conservation architect and professionals and along with the case studies it has been proved that there are many challenges that are faced during the course of work and the same determines the time, cost and quality of the project.

However, as in most cases as project managers are not involved in the project right from the beginning as understood through interviews with professionals as well as project managers there has not been the right implementation of project management tools in the case of heritage conservation projects thereby leading to implications.

Project management involves the use of various tools at various stages of the project which help in execution and monitoring of the project like:

A **network diagram** which is a useful for the project planning and is flow chart of all tasks i.e. sequencing of tasks which make up a project and helps the project manager to co-ordinate and convey all the parallel activities.

**Critical Path Method (CPM)** is an essential tool which is used by project managers; as the same is used to monitor and assess the progress of the project in real-time; so as to assure that the ongoing project is completed in the estimated time frame. The total duration of the critical path is the minimum time; that shall be needed to

complete the project and any delay in the critical activity which will result in extending the total project duration. Thus, as needed the project managers can divert resources from a specific to other project when needed; such that the resources are used and the project is not delayed.

**Gantt chart** shows the current work status and would map how much time the project would take. It also helps to arrange / order the tasks in which they need to be carried out, assigning the time required and also shows the interdependencies between the different tasks. In case the project goes off-schedule, Gantt chart would help in taking the remedial action and bring the chart back on course if required. It serves as a communication tool and helps showing the team the progress they are making and keeps the team updated on the project's progress.

**Project Evaluation and Review Technique (PERT)** is used to identify the various events, activities or tasks within a project, its sequence, time required by each task and the minimum time frame that would be required for the completion of the project. Thus, it is a decision-making tool so as to reduce the time and cost for the project. With the help of PERT, a project manager is able to understand whether the project is on track or delayed or ahead of schedule. Any changes or adjustments in the project, the same needs to be updated in the PERT and it will help in seeing the new situation. PERT helps one to understand which activity needs to be given priority and accordingly resources are also allocated for the same. It also helps to identify if any activity needs extra attention and the various solutions for the same.

**Work break down structure (WBS);** PMBOK defines WBS as “A deliverable-oriented hierarchical decomposition of the work to be executed by the project team to accomplish the project objectives and create the required deliverables” (Rangel, 2015). It is a visual representation of what has already been done and what sub- activities should still be done to conclude the project. It is an organizational chart or a tree diagram where larger tasks are broken down into manageable chunks which can be supervised and monitored.

**Project baseline** is the mode of graphical representation by which the project values are compared with the base values which have been set as a standard for the project against the actual performance of the project. It encompasses the scope baseline; cost baseline and schedule baseline and the project managers baseline will track the real time progress. Any unplanned work etc, can be checked. It helps in monitoring the entire project, its performance, identify any problems and accordingly find solutions for the same. If no project baseline created to monitor, it may lead to cost overruns, scope creep and project failure.

**Fish bone diagram;** is diagram-based technique and used for brain storming session to identify the potential causes for a problem and thus it represents visually the cause and effects (desirable or undesirable) and ultimately results in finding the appropriate solution.

**Communications management plan;** with so many stakeholders and agencies involved in a project, there needs to be a regular and relevant flow of information between all the concerned. It also includes all the details as to how as per hierarchy communicates what to whom and how often. Thus, everyone involved in the project is aware of every single thing and all in the same loop which ensures satisfaction of all and thus ensures the project's success. Any problem which arises can be tackled with the help of this communication management plan as there is transparency and collaboration amongst all the stakeholders and with the expertise the same can be resolved in an efficient manner.

**Project documentation;** forms a very important part; rather gives a closure to the project formally and is all combined and presented to the Client in one single document. The report or document gives all the relevant information about the project, all the hurdles faced and may also reflect if the next phase is carried out, all the reports, warranties, guarantees, bills, and all the relevant details pertaining to the project. It is documented so as to eliminate any confusion or any conflicts between all the stakeholders about the status of the project.

The diagram (Refer fig no. 04) below shows the different tools and their applications which work for a retrofit project.

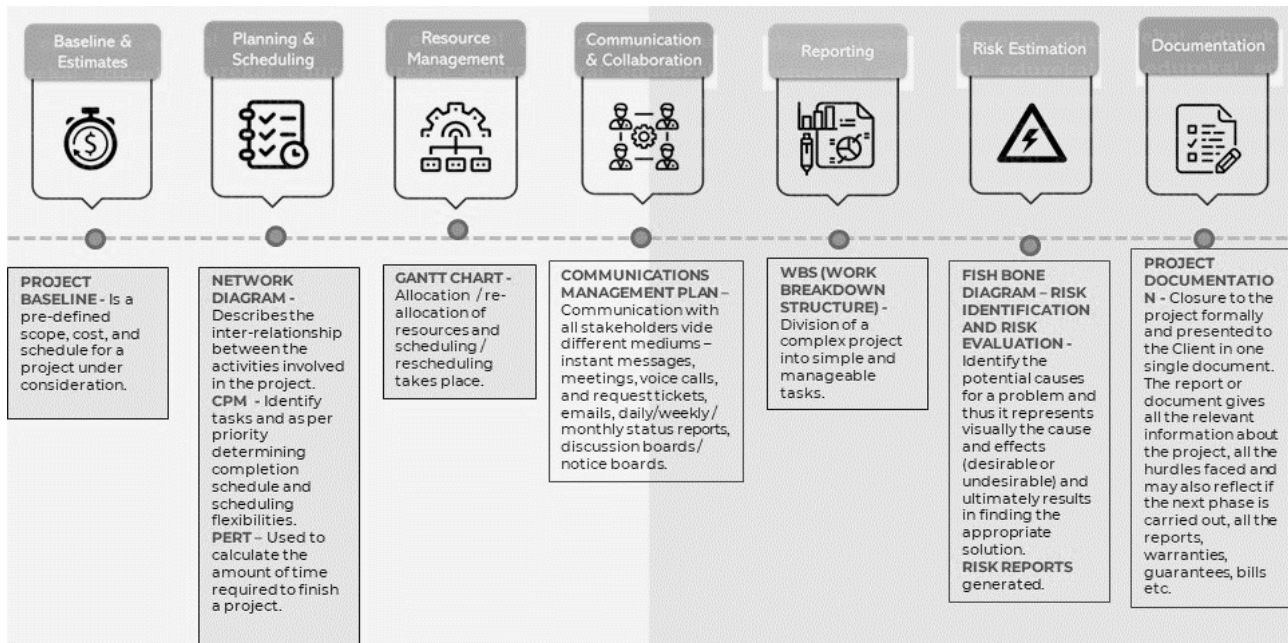


Figure 4: Different tools of project management (Source: Author)

The application of these tools and techniques of project management when employed in the case of a heritage conservation project in the various stages can help manage the project in a much better way. The Table compiled below (Refer fig no. 05) shows how the tools can be integrated with the help of a Project Manager within the various stages of work and executed in a much better way.

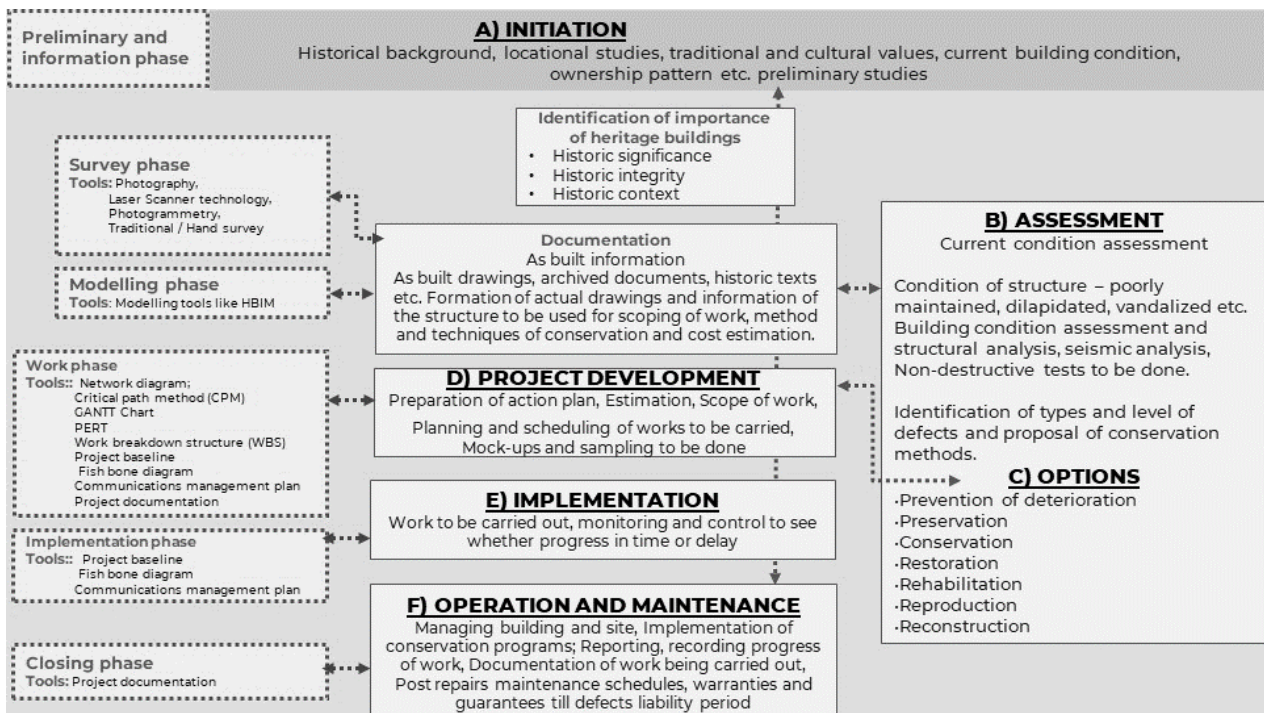


Figure 5: Tools & techniques employed in project management in various stages (Source: Author)

#### 4. Conclusion:

India is a rich repository of tangible and intangible heritage structures that have been maintained by various government or non-government organizations, Trusts etc. Heritage conservation will thereby safeguard our national treasures having immense historical significance, cultural value and ensure no one can harm them. The research has shown that these projects have wide range of complexities and uncertainties depending on their nature and scale; and hence needs the intervention of robust project management framework would be beneficial. In India, within the Mumbai Metropolitan Region itself we have several heritage structures which have undergone conservation and restoration works with or without the presence of a project manager or project management consultancy.

Project management has been successfully implemented in retrofit projects; but same is not the case when it comes to heritage conservation projects. Conservation of heritage structures is very challenging as it involves the protection and restoration of the structure, which is unique in itself, as close to its original condition as far as possible and for as long as possible. There are many challenges that are faced during the course of work and the same determines the time, cost and quality of the project. Hence with the **intervention of project management and the project management tools during the various phases** of conservation project; the **work can be carried out efficiently** in all phases **with co-ordination between all stakeholders, project planning and scheduling, time management, resource allocation and management, budget updating, monitoring, risk management and finally the documentation of works.**

In **preliminary stages** for heritage conservation projects, **documentation of heritage structure** (physical documentation, texts, archived documents etc.), its detailing (with the use of photo documentation, photogrammetry, laser scanning technology) and conditional assessment (NDT, structural audit) will give a clear idea of the **process intervention** viz prevention of deterioration, preservation, conservation, restoration, rehabilitation, reproduction and reconstruction.

The **pre-construction stages** which shall include the preparation of estimates, scope of work shall all depend on this documentation. The use of modelling tools like HBIM will further be able to provide full engineering drawings for the conservation of the heritage structure which includes 3D documentation, orthographic projection, details and schedules and thereupon the estimate can be prepared which shall be as close as possible to the actuals. The **construction or the work phase** shall include preparation of execution plan, scope of the works to be carried out, planning and scheduling of the same where the project manager can employ tools like PERT, Gantt charts, critical path, WBS etc. to execute the work. The monitoring of the work can be done with the application of project baseline and communication management plan such that all the stakeholders are all aware and the project gets completed as desired. The work phase shall also cover the post documentation which shall include handover of as-built drawings, reports, guarantees, warranties, schedules for post maintenance, and the way ahead process which forms the closure of the project till the defect's liability period.

Thus, with the introduction of conversant project manager and the tools of project management for conservation projects improve the performance of these projects in terms of the project management parameters like time, cost and quality. The present research was able to accomplish its research objectives, but the findings are limited to the Mumbai Metropolitan Region which includes grade II and III structures only.

Hence the future research scope should focus on replicating the study findings on actual different case studies of heritage conservation projects in different parts of India over the period of time. Further research should be done to evaluate how the use of project management tools can be inculcated and developed in terms of a framework and can be used directly while executing conservation projects of any scale in any part of the nation. Thus, the benefits of project management in the field of heritage conservation would be more clearly determined.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Cultural Conservation Strategies: A Comparative Case of Majuli Island and Bali's Subak System

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## **Abstract:**

*Cultural landscapes are living legacy as well as unique and valuable assets of a country's origin and development. India is endowed with abundant history and heritage, many of them being cultural landscapes. Majuli Island in Assam, which is the world's largest river island, has a unique cultural landscape. Located in the Brahmaputra River, the island is blessed with abundance of natural beauty, diverse wildlife, and serenity. Majuli Island has been a prominent cultural center of Assam since 16th century by being a primary hub of a neo-vaishnavite culture. Due to lack of relevant measures, Majuli Island is still in the tentative lists of UNESCO Heritage sites. This research paper looks at conservation strategies by a comparative analysis of cultural landscapes of Majuli Islands in Assam, India and The Subak System in Bali, Indonesia which is a UNESCO Heritage site. The research investigates and evaluates by the process of understanding and comparing the urban conservation methods, frameworks and controls taken, along with stakeholders involved in place for these two cases. Findings aiding in the study are based on any existing management/ conservation plans, charters, and similar documents along with other supporting articles, research papers. Finally, the research intends to present recommendations through strategies and policies for effective management, conservation and for increased social engagement amongst locals for Majuli Island.*

**Keywords:** *cultural landscapes; conservation; Majuli Island; Bali Subak System; heritage*

## **1. Introduction:**

*"The true foundation of all cultures is the knowledge and understanding of water." (Viktor Schauberger)*

Water has been the driving force for emergence and evolution of most civilizations, empires, and any form of settlements. As these settlements grew, the relationship of humans with these water bodies have also transitioned above and beyond. They are not only relationships that fulfil basic needs but also have been tied into their cultures and traditions, from daily worship of water and water bodies to celebrating large festivals related to it. Many indigenous communities have been peacefully co-living with nature and water.

Culture on the other hand has also influenced the perception and usage of values of water. Furthermore, when cultural values of any place are combined with natural unique-ness, it forms what is termed as a cultural landscape. Cultural landscapes have been studied and described in multiple ways. The Cultural Landscape Foundation (TCLF) explains, "Cultural landscapes can range from thousands of acres of rural land to homesteads with small front yards. They can be man-made expressions of visual and spatial relationships that include grand estates, farmlands, public gardens and parks, college campuses, cemeteries, scenic highways, and industrial sites. Cultural landscapes are works of art and narratives of cultures, and expressions of regional identity. They also exist in relation to their ecological contexts." . A legacy for every generation, the benefits from the preservation of these cultural landscapes are enormous. These special places reveal various aspects of a country's origins and development like any other heritage-built spaces. As these unique areas have strong and evolving relationships with its natural context which can be evident in different forms, features, and the way the community engages. Cultural landscapes provide meaningful opportunities in various aspects like that

of scenic, economic, social, ecological, recreation and education for the locals, communities and largely to the nation.

India with its diverse geography and vibrant cultural values is bestowed with an abundance of sites fit to be known as cultural landscapes. Many well-known natural wonders are already tagged as a cultural landscape while there might be many yet to be discovered. This paper looks at one such unique cultural landscape of Majuli Islands located in Brahmaputra River in Assam. Majuli Island has been in the tentative list of becoming an UNESCO World Heritage under the cultural landscape category since the year 2004. This research paper studies the various conservation strategies used in the case of Majuli Island with a comparative study of Bali's Subak System.

## 2. Research Objectives:

This research paper's objectives are stated as follows:

- To understand the heritage, environmental and cultural importance of both the sites.
- To study the opportunities and threats faced by these sites.
- To understand the stakeholders involved, their role and approach in the process of conservation.
- To study the framework of actions proposed and implemented to conserve them.
- To compare and critically analyse both the cases.

## 3. Research Methodology:

The methodology undertaken in this paper is that of

1. Literature and Findings aiding in the study are based on any existing management/ conservation plans, charters, and similar documents along with other supporting articles, research papers.
2. Investigation and evaluation by the process of understanding and comparing the urban conservation methods, frameworks and controls taken, along with stakeholders involved in place for these two cases.
3. Recommendations and Conclusion through strategies and policies for effective management, conservation and for increased social engagement amongst locals for Majuli Island.

## 4. Literature Review:

### 4.1 Case of Majuli Islands:

Majuli Island, which is infamously known as cultural capital of Assam, is also the largest freshwater mid-river deltaic island in the world. Located in upper reaches of Brahmaputra River, the island has a population of 1.6 Lakhs. Majuli has been an abode of Assamese Vaishnavite culture, and is also a biodiversity hotspot and has rich ecology with rare breeds of flora and fauna.



Figure 1: Majuli island (Source: <https://indianetzone.wpcostaging.com/tag/island/>)



#### 4.1.1 Geography of Majuli:

The island was created when the Brahmaputra River and several of its tributaries occasionally changed their path. There are references on Majuli Island that state that the island was once made up of thirteen chaporis, or small islands, that were connected by boat routes between the Lohit and Dihing rivers. According to the census of 1971, the geographical area of the island (including some Chars or Chapori area) was 1250 Sq. km, which over the years was reduced to only 421.65 Sq.kms in 2001, and the latest area is that of 352 Sq.km. [1] [2]

#### 4.1.2 Culture of Majuli Islands

There are a total of 243 small and large villages that call Majuli Islands their home. It is the home of Assamese Vaishnavite faith and culture, which are kept alive in Sattras, or Vaishnavite monasteries. The Sattriya Dance, an Indian national classical dance style, originated in the Majuli Sattras. The Majuli Cultural Landscape Region Act of 2006 recognises 31 Sattras.

It is commonly inhabited by the Mishings, the Deoris, the Sonowal Kacharis, the Ahoms and the Nepali Communities. Various cultural activities in the river island of Majuli can be viewed and understood in the categories of acting, mask-making, writing manuscripts, music, festivals, boat building, fishing, handicrafts, weaving, and bamboo crafts. [1] [2]



Figure 2: Cultural heritage of Majuli (Source: <https://unemployers.com/majuli-a-cultural-haven-in-the-heart-of-brahmaputra/>)

#### 4.1.3 Threat to Majuli Islands:

Majuli Islands had a surface area of approximately 1250 sq.km. before the earthquake in 1950, as per various reports. [1] The earthquake gave result to active erosion process of the land mass of the Islands. As a result, it increased a threat to the island and it's the rich natural and cultural heritage. Along with the flora and fauna, sociocultural fabric, and human demographics, the island's biodiversity has also been impacted. The island's cultural legacy was inevitably impacted by the necessity to relocate one-third of the Sattras to the north and south banks of the Brahmaputra. The physical aspects of culture, such as the usage of contemporary building materials and theatrical and dance costumes, are also being impacted by the adaptation to modern lifestyle and its many customs. Time and events, however, have not altered the fundamental idea of the cultural legacy that the Sattras symbolise. [1] [2]

#### 4.2 Case of Bali's Subak System:

The cultural landscape of Subak System of the province of Bali, Indonesia, was added to the list of World Heritage Sites in 2012. The inscription acknowledged the importance of Bali's Subaks, which are groups of farmers who jointly oversee the irrigation systems of the famed rice terraces and water temples. Since the

subak system, which dates to the 12th century, is still in use, this is the only Southeast Asian World Heritage Site with a living cultural environment.

The five rice terraces and the water temples on them make up Bali's cultural landscape, which spans 19,500 hectares. The cooperative subak water management system, which consists of canals and weirs, is centred on the temples. Included in the scenery is the largest and most beautiful architectural structure of its kind on the island, the 18th-century Royal Water Temple of Pura Taman Ayun.

#### 4.2.1 Geography of the landscape:

Bali's terrain is defined by a chain of volcanoes that have produced rich soil and a humid tropical climate that make it the perfect location for crop growth. Because the rivers' water has been directed into canals for land irrigation, rice can now be grown on both mountain terraces and flat areas of land. Over the course of the past thousand years, rice, the water that feeds it, and subak have altered the terrain and are essential to religious life. The rice paddies receive their water from springs and canals, which passes past the temples. A group of subaks manage water resources jointly, with a focus on water temples. [6]

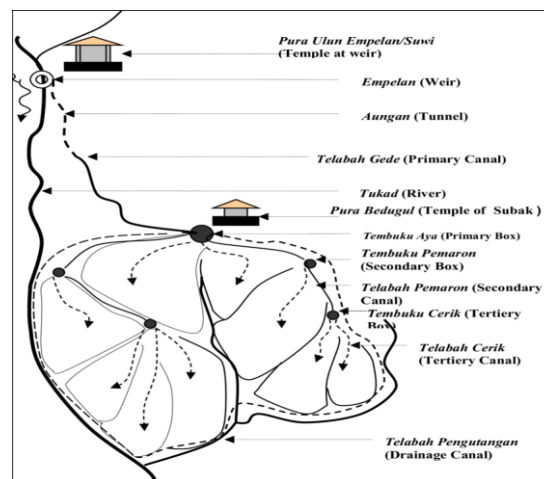


Figure 3: (Source: [https://www.researchgate.net/figure/Subak-irrigation-scheme-14\\_fig1\\_331778399](https://www.researchgate.net/figure/Subak-irrigation-scheme-14_fig1_331778399))

#### 4.2.2 Culture and philosophy:

The Balinese philosophical concept of Tri Hita Karana is embodied in the subaks. This principle examines three causes of goodness, aiming to establish harmony among humans (pawongan), between the human world and nature (palemahan), and between the human world and the spiritual realm (parahyangan). According to the Ministry of Culture and Tourism and the Government of Bali Province, the subaks "give spiritual meaning to the governance of the rice terrace ecology" as a tangible embodiment of this ideology.

In Balinese culture, rice is considered a divine gift, and temple culture includes the subak system. By a complex web of rites, sacrifices, and creative presentations, the groups of water temples that support the subak landscape's water management seek to maintain a balanced relationship with the natural and spiritual worlds. These distinctive Balinese water temples date back thousands of years, and their inspiration comes from a variety of old religious traditions, such as Austronesian cosmology, Vajrayana Buddhism, and Saiva-siddhanta and Samkhyā Hinduism. [5, 6]

#### 4.2.3 Threats to the cultural landscape:

The terraced environment is extremely susceptible to many social and economic shifts, including modifications in farming methods and heightened demands from tourists. Moreover, the diverse locations' environments are

delicate and under threat from development, especially those related to tourism. For each of the five sites, the visual environment stretches beyond the perimeter and, in many cases, even beyond the buffer zones. [6, 7]

## **5. Comparative Analysis of Both Cases:**

After the brief introduction and understanding about both the cases, the analytical comparison is carried out by evaluating various parameters of the conservation process carried out or proposed in both the cases.

### **5.1 Majuli Islands, Assam:**

#### **5.1.1 UNESCO World Heritage Listing:**

Government of India has been advocating for Majuli to be declared a UNESCO world Heritage Site to preserve this socio-culturally rich island. The Archaeological Survey of India (ASI) submitted the nomination Dossier of the island in 2004 under the cultural category as per the 2002 WHC Operational Guidelines. Majuli was shortlisted in the World Heritage Site (WHS) Tentative List at the 28th Annual Session of the UNESCO World Heritage Committee (WHC), held at Suzhou, China. [1, 3]

#### **5.1.2 Conservation Action Plan proposed:**

Brahmaputra Board was to carry out measures and should bring reclaimed land under social forestry. Government agencies should come forward to provide financial support to the locals and NGOs. All antiquities, manuscripts, heritage buildings should be documented and preserved. The available potential to develop the river island as one of the religious and cultural tourism destinations should be investigated. The Majuli Cultural Landscape Region (MCLR) Act, 2006 has mandated the MCLMA to integrate development and heritage for the protection of heritage resources of MCLR through education, awareness, understanding of the cultural significance and ensuring a sustainable and positive development trend. [2] [4]

#### **5.1.3 Governing Bodies involved:**

The Brahmaputra Board has carried out major protection works since 2004 for the island and has been successful in controlling the high amount of erosion in some way. Majuli Cultural Landscape Management Authority (MCLMA) was set up as a statutory body under the Majuli Cultural Landscape Region (MCLR) Act, 2006. The other majority of work is actively carried out by various NGOs to create awareness and take steps to conserve the environment and culture with the help of locals. Following is some of the NGOs: MIPADC (Majuli Island Protection And Development Council), MIARDS (Majuli Island Agriculture & Rural Development Society), Kalabhumii Majuli Association, Majuli Tourism Development Society, etc. [2, 4]

#### **5.1.4 Participation of Locals:**

The island is continuing to remain the hub of socio-religious activity. The Sattras being socio-religious institutions, work for welfare of people of Majuli as well as Assam. The institutions are dependent on agriculture which is self-sufficient in nature. Sattras principles and activities facilitate the various communities for their assimilation with their colourful cultural life. The Namghar is not a community prayer hall but also plays a catalytic role in fostering the spirit of sharing and caring among the people. It acts as the village councils and plays the most significant role in matters of local self-governance.

The practice of socio- cultural life of people, by which they conserve the traditional knowledge system or thought process with its environment and biodiversity, is a rare practice in the day of modernization and globalization. The lifestyles of the inhabitants who are closely related with nature and Sattriya cultures make the life simpler, helping to keep the island away from pollution. [2] [4]

### **5.1.5 Implementation Of Proposed Action/ Management Plan:**

Work was started by the Brahmaputra Board in January 2004 in 4 phases. The total expenditure incurred in these 4 phases up to October, 2017 is Rs.185.88 crore. Major works carried out under these schemes includes raising and strengthening of 96.25Km embankment with breach closure at 24 locations.

Due to raising and strengthening of 96.25 km of existing embankment, the entire area of Majuli Island within the embankment is now secured from floods unless there is breach in the embankment. Implementation of the anti-erosion and pro- siltation measures such as RCC porcupine, bank revetment and spurs, the situation of Majuli Island has now reversed in most areas. Works carried out by NGOs with locals and encouraging tourism and the culture of the island. [1, 2, 4]

## **5.2 Subak System, Bali:**

### **5.2.1 UNESCO World Heritage Listing:**

In 2012, the cultural landscape of Indonesia's Bali province was inscribed as a UNESCO World Heritage Site. The inscription of it as a World Heritage Site was the result of more than a decade's collaboration by public- and private sector actors, academia, NGOs, and other supporters. They envisioned a broad, participatory and inclusive management system for the site, involving government agencies at different levels, village leaders, and the subaks themselves.

### **5.2.2 Conservation Action Plan proposed:**

The Provincial Decree of 2008 provided the wide legal foundation for property protection. The Government of Bali and the Regencies of Bali have devised a particular legal framework for the establishment of the Bali Strategic Area. The five sites—including their agricultural and forest ecosystems, as well as their physical and intangible cultural heritage—have their conservation and spatial planning officially codified by this agreement. The Bali Provincial Government has approved a management plan. It establishes a management structure designed to prevent unwarranted development and maintain customs such as the Subak system.

### **5.2.3. Governing Bodies involved:**

The Government of Bali and Regencies of Bali have played major roles in formulating a framework. The Governing Assembly of Bali Cultural Heritage was created. The Assembly includes representatives from different government departments and empowers subak community members to jointly undertake a major role in the management of the sites. To foster links between Ministries with an interest in the property, two inter-Ministerial Committees have been put in place, under the Coordination of the Ministry for People's Welfare. In 2013, at the request of the Government of Indonesia, SEI (Stockholm Environment Institute) launched a two-year project to support the development of a participatory and effective management structure for the site.

### **5.2.4. Participation of Locals:**

The ingredients for a successful farmer-led management system are already available, in the form of the subaks and their leaders, the pekasehs. The subaks have their own rules and a process of decision-making that is recognized by members. They are deliberative and decide by consensus. The farmers are observed to be eager to get involved, to work to maintain their practices and rituals, prevent land conversion, and ensure that there continues to be enough farm labour for the rice terraces. They are well prepared for the challenges of the World Heritage Site, as they have well- established democratic governance practices, and they have shown that they are capable managers of their landscape.

### **5.2.5 Implementation of Proposed Action/ Management Plan:**

A partnership between the Govt. of Bali and SEI, known as the Governance Transition project, was developed to contribute to the design of an effective and participatory management of the cultural landscape in Bali. The project was implemented in phases (see below figure), adapting to evolving conditions. Many people in these communities have little information about the World Heritage Site and its implications for the villages and their inhabitants. The village leaders lack and need to have technical guidelines from local government and other officials on how to manage and link up the activities in their subaks with the new World Heritage Site scheme. Land use change is an ongoing challenge in the area of the World Heritage Site, with farmland increasingly being sold and converted to non-farm uses. This trend is driven largely by rising tourism, and may have been accelerated by the inscription.

## **6. Key Results and Findings:**

1. The government's lack of documentation, insufficient steps to prevent erosion, and lack of cultural preservation have rendered the Majuli Islands unworthy of inclusion on the UNESCO Heritage Site registration. However, Bali, the first Indonesian cultural landscape to be inducted into the UNESCO World Heritage List, is still having trouble putting its management plan into action. The sites are not legally and correctly administered, and the nomination leaders' designs have not been carried out. [3, 5]
2. In Majuli Islands, although the locals and NGOs and smaller bodies are actively working, a broader perspective and vision is required to be drawn by the Central or State Govt. and integrate all the small institutions to focus and achieve the larger goal. The Bali cultural landscape is observed to be struggling with efficient management of various stakeholders or authorities. Resolving these issues will require political will and engagement at all levels of government and – just as important – meaningful participation by all key stakeholders, particularly the subaks. [2, 4, 6, 7]
3. In case of Majuli Islands, the man-made elements have been observed to have changed the island's drainage pattern and negatively impacted the river's regime, leading to aggregational, exacerbated flood conditions and erosion of the riverbank. It is therefore having a significant effect on the river island's human ecology and physical landscape. The UNESCO-approved Detailed Management Scheme and the finished interpretive design framework must be appropriately implemented in the case of Bali's cultural landscape. There is also a dire need to create awareness about the landscape, its importance and how the locals can be integrated with the authorities to safeguard it. [2, 4, 6, 7]
4. In both cases, what is lacking is active participation of relevant government agencies along with locals. Engaging them all is important. In the case of Bali's cultural landscape, the farmers and locals need effective mechanisms to participate in the site management, and real, sustained attention to their needs, such as an adequate supply of water, and support for organic farming practices. Bali also desperately needs a cogent water policy that addresses conflicting demands while safeguarding important water sources, like as the highland lakes that support the subaks in many areas, from overexploitation and degradation. In addition to their responsibilities for managing World Heritage Sites, they also offer a more comprehensive viewpoint for them to understand how cultural and environmental issues are linked with others and need to be addressed in a harmonious way. [2, 4, 6, 7]

## **7. Conclusions and Solutions:**

From this detailed study and comparative analysis, following conclusions can be made:

Majuli Islands: Although there have been many measures to save the river island of Majuli, the government and its bodies have somehow failed to control the situation after the 1950s. The Brahmaputra River basin has become ecologically imbalanced because of sedimentation due to accelerated soil erosion, which has been

caused by human-made factors. It is up to us to either accept the situation by letting the region face its extinction or have an interdisciplinary approach to combat the flooding situation and erosion. It is important to have a broad vision for the future of the island and an approach that includes structural, sustainable, and non-structural measures to solve the problem of flooding and flood. In order to coexist with nature, we must build harmoniously in order to safeguard the future of the river island of Majuli.

Majuli holds a unique range of demographic, cultural, religious, and natural resources which are of its kind. With the privilege of being one of the biggest river islands of the world, a proper marketing and communication network of tourism activity needs to be investigated which can bring radical changes in the field of tourism with locals' support.

***Bali Subak System:*** Bali is the first cultural landscape in Indonesia to be listed as a UNESCO World Heritage Site, and it is still struggling with implementation of its management plan. The sites being naturally abundant in value and locals support are not seeing the right efforts taken for its conservation. Establishing a community-based monitoring system is crucial since it allows for learning as well as assisting managers and stakeholders of World Heritage Sites in tracking the efficacy and efficiency of their activities. Above all, the fate of Bali's cultural landscape largely rests on how well Indonesia's appropriate government institutions enable the farmers to protect and manage the legacy they have created. A common conclusion can be drawn that both the cases are historically, culturally and environmentally rich with a huge potential to be developed into successful cultural landscape conservation sites. It can be done if right measures are taken in documenting, understanding, and evaluating the ancient systems which were and are still sustaining the sites. These practices can offer more efficient solutions rather than implementing modern and unsuitable practices.

Another important aspect that should be focused on should be the engagement of locals in all practices right from management to conservation to creating awareness because the locals are the ones who will continue the living culture and heritage of the sites.

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Rescuing Post-War Social Housing Blocks through Adaptive Reuse: A Case Study of Delhi and Mumbai

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## Abstract:

*India is officially the world's most populous country. We are also in a time where the real estate market and cost of living is at an all-time high, recession and climate change is on the horizon and new construction is not sustainable or cost effective. This research conference abstract sheds light on the critical situation faced by pre- and post-war social housing blocks in India that have the potential to reduce this housing crisis. These are currently under threat of demolition, both by neglect and through cooperation to accommodate new infrastructure developments. The study emphasizes the need for a concerted effort by the conservation fraternity to address this issue. It highlights the cases of Delhi and Mumbai, where significant portions of mass housing from both the pre- and post-war periods have already been demolished. The conservation community has primarily and lackadaisically focused on mapping and documenting the historical significance of only monuments that can be iconic. They have actively neglected the urgency of preserving these social housing blocks.*

*This research proposes an alternative approach that would enable conservation architects and designers to salvage a portion of the historic mass housing blocks originally constructed by both the Central Government of India and private entities. By implementing a distinct methodology incorporating subtle interventions and adaptive reuse, housing blocks in areas like Khotachiwadi, Sarojini Nagar, and R.K. Puram can serve as successful pilot projects for rescuing India's pre- and post-war housing stock from imminent demolition.*

*The key aim is to minimize the demolition of these structures, allowing architects and conservation professionals to integrate subtle interventions and adaptive reuse strategies that enhance the living conditions and compatibility of these homes with contemporary needs.*

*Finally, this paper aims to assess and recommend cost-effective, sustainable solutions to modify the existing pre- and post-war social housing stock.*

**Keywords:** *post-war; social housing blocks; adaptive reuse; conservation; demolition*

## 1. India and the many homes within:

India is an ancient land, home to many dynasties across multiple centuries. And over the course of time, several housing typologies have been developed, catering to the needs of the people in that day and age. One of the most noticeably viable and popular housing typologies were the social housing blocks or colonies that developed post-war in a colonially ruled India. A majority of this social housing was developed in the metro cities like Delhi and Mumbai (then Bombay). By conservation standards in India, many if not most of the housing stock belonging to this housing typology can be considered as heritage. Given that such real estate still stands without much ado, and in fairly good health, it is a sad day indeed when we witness that these

housing blocks are currently under threat of demolition, both by neglect and through cooperation to accommodate new infrastructure developments.



Figure 1: Mumbai: A city of contrasts (Source: <https://www.brixel.in/post/sustainable-redevelopment-of-slums-and-squatter-settlements>)

Officially, India is the world's most populated nation. The current GDP growth of India is projected to be 7.2% (FY 2022-23), 6.3% (FY 2023-24), and 7.8% (Q1 2023-24) in the first quarter of 2024. (ET Online, 2023) We live in a period when the cost of living and real estate are at record highs, the economy is in a state of flux due to climate change, and new development is neither economically viable nor sustainable. (Gandhi, 2023) Given the advancements in technology, many manual jobs are getting automated, thereby putting additional pressures on the costs of living. Layered on top of these issues is the climate change crisis coupled with the need for sustainable living in order to have a cleaner and greener future. The conservation community has primarily and lackadaisically focused on mapping and documenting the historical significance of only monuments that can be iconic. They have actively neglected the urgency of preserving these social housing blocks. Given that affordable housing is the need of the hour for a developing nation like ours, it would be foolish to ignore such viable housing options, conserving them, giving them a new lease of life in favour of new infrastructure development, which is both unsustainable as well as expensive. But in order to better understand the situation at hand, it is prudent to first understand the historical context behind such social housing blocks.



Figure 2: Incremental Housing, Belapur, Navi Mumbai (Source: [https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a606-10-low-cost-housing-in-india/#google\\_vignette](https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a606-10-low-cost-housing-in-india/#google_vignette))





Figure 3: Tara Housing, Delhi (Source: [https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a606-10-low-cost-housing-in-india/#google\\_vignette](https://www.re-thinkingthefuture.com/rtf-fresh-perspectives/a606-10-low-cost-housing-in-india/#google_vignette))

## 2. A Historical Context:

The historical context of post-war social housing in India is deeply intertwined with the nation's post-independence development trajectory. After gaining independence in 1947, India faced an immense challenge of accommodating its rapidly growing urban population. The period following World War II witnessed a surge in urbanisation as rural-to-urban migration intensified, creating a pressing need for affordable housing in burgeoning cities. In response to this housing crisis, the Indian government initiated ambitious social housing projects, especially during the 1950s and 1960s, to provide shelter to the economically disadvantaged. Influenced by modernist architectural principles, many of these housing complexes were designed as utilitarian, high-rise structures to maximise space efficiency and accommodate a large number of residents. These post-war social housing projects played a crucial role in addressing the acute housing shortage of the time and remain significant for their historical and architectural value, making them a crucial part of India's urban heritage even though they have lost their original function in their current dilapidated state.

Research on post-war social housing conservation and demolition in India is a critical field of study that explores the dynamic relationship between preserving historical housing stock and the pressures of urban development. It delves into the multifaceted challenges faced by policymakers, architects, and conservation professionals in balancing the need for affordable housing with the preservation of cultural and architectural heritage. This research examines the economic, social, and environmental impacts of both conservation efforts and demolition practices, shedding light on the consequences of these choices for vulnerable populations and urban sustainability. Ultimately, it underscores the importance of finding a delicate equilibrium between heritage preservation and urban progress in the context of post-war social housing in India.

Unfortunately, this is a nascent field with little or no research being carried out in this critical field. This is true in the case of both Delhi and Mumbai, where research and conservation efforts are directed towards buildings of archaeological importance rather than on public importance. Even worse, social housing projects as a whole have been deemed a failure, the most famous one in India amongst them being the Aranya Low-cost Housing, Indore. (Post-occupancy study of Aranya Housing Project) (Kumar, 2020) Part of this failure can be attributed to the classist, casteist social stigma attached to such projects.

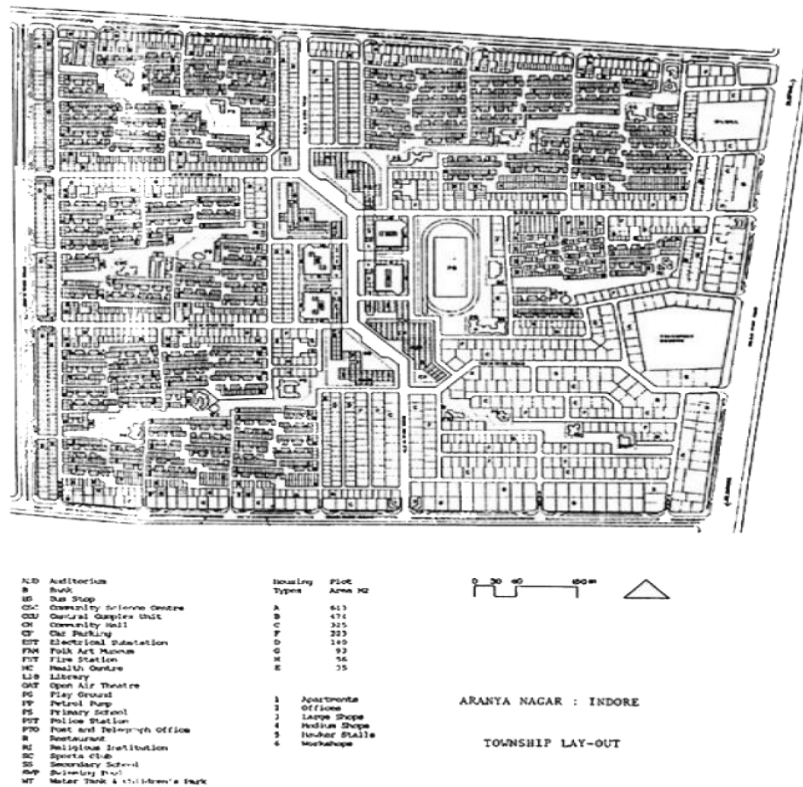


Figure 3: Aranya Township Master Plan, as proposed by Ar. B. V. Doshi (Source: <https://architecturez.net/doc/az-cf-166248>)

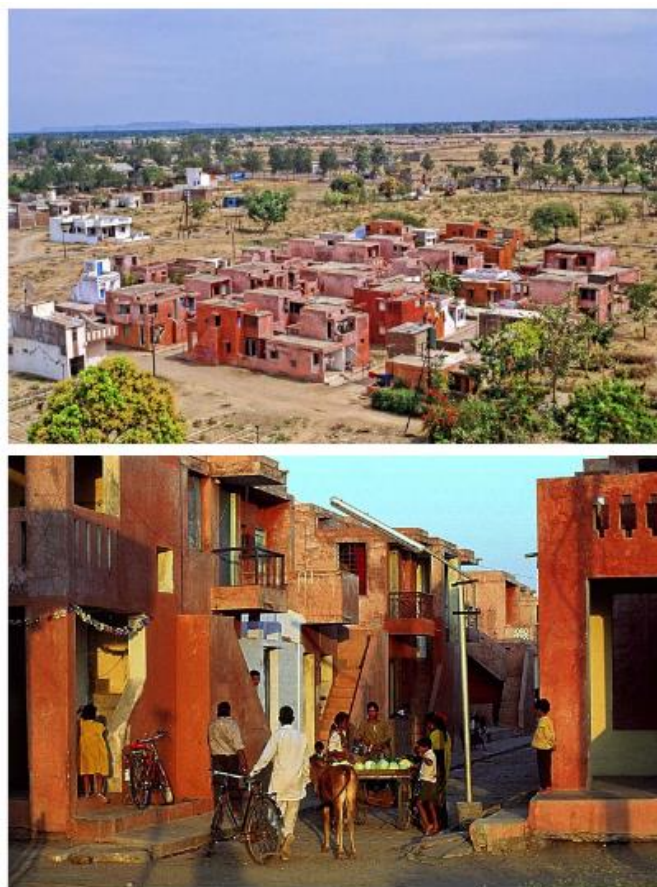


Figure 4: Aranya Township, Indore Today (Top and Bottom Right) (Source: <https://www.sangath.org/projects/aranya-low-cost-housing-indore/>)

### 3. A Global Perspective:

This narrative however, is very different globally. Lacaton & Vassal, renowned French architects, have been recognized for their innovative approach to conservation in preserving post-war social housing worldwide. Their work has redefined the field of architecture by addressing contemporary challenges, including climate and ecological emergencies, as well as social needs. In fact, the Pritzker jury lauded their architecture for its blend of strong forms and ethical convictions, emphasising the architects' commitment to improving lives through their designs.



*Figure 5: Anne Lacaton and Jean-Philippe Vassal, French Architects (Source: <https://metropolismag.com/profiles/lacaton-vassal-pioneered-strategy-saving-france-social-housing/>)*

One of the most striking examples of their pragmatic conservation approach is seen in their work on public housing in France. In contrast to the prevailing trend of demolishing and rebuilding, Lacaton & Vassal demonstrated that it was possible to redesign, expand, and upgrade existing flats within the same budget. Their projects in Paris and Bordeaux, such as the transformation of Tour Bois le Prêtre and the Grand Parc estate, showcased their ability to extend and enhance the environmental performance of ageing housing blocks while allowing residents to remain in place during the renovations. This cost-effective and sustainable strategy challenges the wastefulness of demolition, emphasising the preservation of energy, materials, and historical significance, while also minimising negative social impacts. (Wainwright, 2021) Similar such examples can be found in different parts of the world.



*Figure 6: The Tour Bois le Prêtre (2011) – Before intervention (Source: <https://metropolismag.com/profiles/lacaton-vassal-pioneered-strategy-saving-france-social-housing/>)*



Figure 7: The Tour Bois le Prêtre (2011) – After intervention (Source: <https://metropolismag.com/profiles/lacaton-vassal-pioneered-strategy-saving-france-social-housing/>)

#### 4. The Significance of the Case Studies Selected:

To analyse the historical significance of post-war social housing in Sarojini Nagar and R K Puram in India, a combination of research methods and data sources were employed. Historical records, government documents, urban planning literature, and architectural archives were extensively reviewed to gather historical data related to the construction, design principles, and development context of these housing colonies. This archival research provided insights into the broader historical and urban planning context of post-independence India, shedding light on the goals and motivations behind the creation of such housing.



Figure 8: Demolition and tree-felling at Sarojini Nagar (Source: <https://indianexpress.com/article/cities/delhi/activists-oppose-tree-felling-in-sarojini-nagar-nbcc-says-had-court-clearance-5532826/>)

In addition to archival research, field studies and on-site observations were conducted in Sarojini Nagar and R K Puram. This involved site visits to both housing colonies, where visual documentation and verbal interaction with long-term residents and local historians were conducted to gather oral history and personal experiences related to these housing developments. This qualitative data added a rich layer of contextual understanding to the research. The criteria for selecting Sarojini Nagar and R K Puram as case study areas were influenced by their historical significance and representative characteristics of post-war social housing in India.

These colonies were among the earliest and most iconic examples of planned social housing developments in the country, embodying the principles of modernist architecture and town planning that were prevalent during the post-independence period. Their namesake associations with prominent Indian leaders, Sarojini Naidu and Dr. Rajendra Prasad, added historical and cultural significance to these sites. Furthermore, the geographical

location of these colonies within the national capital, Delhi, made them illustrative of urban development trends in a rapidly growing and evolving metropolis. As such, Sarojini Nagar and R K Puram were chosen as case study areas due to their historical, architectural, and urban planning significance, making them representative of the broader context of post-war social housing in India. (Mehrotra & Sabikhi, 2002) (Ministry of Housing and Urban Affairs, Government of India) Similarly, in Mumbai, Matias Echanove, an Urbanologist and co-creator with the Urbz Collective along with the students at the Tata Institute of the Social Sciences, did an on-ground field study of the chawls located in Khotachiwadi, as part of a weeklong studio. These chawls are form an intrinsic part of the Khotachiwadi eco-system, and are based on community based social housing systems that have existed in Mumbai since pre-independence times. (Echanove, 2011) These chawls are a built expression of Jane Jacobs' observations "Eyes on the Street" which were a part of her seminal book *The Death and Life of Great American Cities*. (Jacobs, 1961)



*Figure 9: Koliwadi in Girgaon, Mumbai (Source: <https://critmumbai.files.wordpress.com/2011/10/house-types-in-mumbai-final.pdf>)*

## **5. The Critical Situation of Pre- and Post-War Social Housing Blocks:**

The current status and condition of social housing blocks in India vary widely, reflecting the country's diverse urban landscape. While some older social housing complexes have aged gracefully and continue to provide stable housing, many others face significant challenges. A substantial portion of these structures is in need of repair and modernization, with issues ranging from deteriorating infrastructure and poor maintenance to overcrowding and inadequate amenities. Moreover, these housing blocks often struggle to meet the evolving needs of India's urban population, making it imperative to consider adaptive reuse and revitalization strategies.

Social housing blocks in India confront a multitude of threats, foremost among them being neglect and the looming spectre of demolition for new infrastructure projects. Neglect manifests in the form of insufficient maintenance and a lack of investment in basic amenities, leading to substandard living conditions for residents. Meanwhile, the rapid pace of urbanisation has triggered the demolition of social housing blocks to make way for modern developments, displacing vulnerable communities and erasing vital pieces of urban history. These threats not only exacerbate the housing crisis but also undermine the social fabric of communities that rely on these structures for shelter and support.

Urgency surrounds the need to address the predicament of social housing blocks in India. With the country's urban population swelling and affordable housing in high demand, the preservation and revitalization of existing social housing is a pressing concern. The alternative—a cycle of neglect and demolition—risks exacerbating the housing crisis and erasing valuable cultural and architectural heritage. Moreover, these housing blocks represent an essential element of social stability, providing a safety net for vulnerable populations. Recognizing the urgency of this issue is critical to ensuring that these structures can continue to serve their essential function of providing affordable and dignified housing for India's urban citizens.

## 6. The Cases of Sarojini Nagar, R. K. Puram, and Khotachiwadi:

The post-war social housing complexes constructed in Sarojini Nagar and R K Puram in India after the 1950s hold profound historical significance within the country's urban development narrative. Emerging in the wake of India's independence and a period of heightened urbanisation, these housing projects symbolise the nation's commitment to providing equitable housing solutions for its growing urban population. Designed and built during an era influenced by modernist architectural principles, these complexes represented a departure from traditional urban planning and aimed to address the pressing housing crisis of the time.

Sarojini Nagar and R K Puram, with their innovative high-rise designs, marked a shift towards more efficient land use in rapidly expanding cities like Delhi. They showcased the government's determination to uplift economically disadvantaged communities by providing them with safe, stable, and affordable housing. Moreover, these housing projects served as a tangible representation of the post-independence vision of modern, planned urban centres. Over the decades, they have evolved into integral components of Delhi's urban fabric, witnessing historical and societal transformations while continuing to provide shelter for countless residents. Today, their historical significance lies not only in their architectural and urban planning elements but also in their representation of India's post-independence aspirations for social equity and inclusive urban development. (Delhi Development Authority) (Mehrotra & Sabikhi, 2002) (Ministry of Housing and Urban Affairs, Government of India)



Figure 10: Habib Rahman CPWD housing 1954 (Source: <https://architecturez.net/file/36300517-1038890722946989-1707732374743154688-o-jpg>)



Figure 11: Rahman Type Flats' in June 2018 (Source: <https://architexturez.net/file/36316932-1038890142947047-3247879643901984768-o-jpg>)

Similarly, built predominantly of wood and brick, these load bearing, ground + 1 or ground + 2 chawls located at Khotachiwadi, Girgaon, Mumbai, were constructed around a central courtyard. Typically made up of single or double room tenements, they used to have a common bathroom facility. These chawls were meant to house the workers and their families that worked in the mills and industries that dotted Mumbai's skyline in pre-independence and post-independence India. With fixed rents based on the Maharashtra Rent Control Act of 1947, these chawls today are dying a slow and painful death, as most owners are unable to meet the maintenance needs of these chawls. This is also true of other similar chawl systems that are spread across the state of Maharashtra. (Echanove, 2011)'

## **7. Subtle Interventions and Adaptive Re-use - a novel approach to preserving social housing blocks:**

In the context of rejuvenating post-war social housing for the demands of today, the approach is one of transformation and innovation rather than demolition or wholesale replacement. The essence of this strategy is to reinvigorate existing structures, honouring their historical significance while ensuring they remain relevant and functional in our modern era. Crafting a novel strategy for repurposing post-war social housing to meet contemporary needs is thus the need of the hour that needs to be addressed. The following are some of the ways we have identified by which we can indeed craft this strategy:

### **7.1 Adaptive Reuse:**

Instead of tearing down these structures, they will be adaptively reused. The existing building's structural integrity and layout will be preserved as much as possible while adapting interiors to contemporary requirements. This approach minimises waste and maintains a connection to the past.

### **7.2 Spatial Transformation:**

To accommodate changing demographics and lifestyles, the interior spaces will undergo a significant transformation. Cramped and outdated apartments will be reconfigured to create more open and flexible living spaces, making the most of the available square footage.

### **7.3 Energy Efficiency:**

Modernising the building's infrastructure is essential to reduce energy consumption and environmental impact. This includes installing energy-efficient HVAC systems, upgrading insulation, and incorporating renewable energy sources where feasible.

#### **7.4 Inclusivity and Accessibility:**

Ensuring that these rejuvenated housing units are accessible to a wide range of residents is crucial. Incorporating universal design principles will make the housing more inclusive, catering to people of all ages and abilities.

#### **7.5 Community Spaces:**

Create communal areas within the housing complex to foster a sense of community among residents. These spaces can include shared gardens, recreational areas, and gathering spots, encouraging social interaction and a sense of belonging.

#### **7.6 Mixed-Use Development:**

Integrate mixed-use elements, such as retail spaces or small businesses, within or adjacent to the housing complex. This not only adds convenience for residents but also contributes to the vibrancy of the neighbourhood.

#### **7.7 Preserve Architectural Heritage:**

Maintain and celebrate the architectural heritage of these post-war social housing projects. Incorporate design elements that pay homage to their historical significance while seamlessly blending with contemporary aesthetics.

#### **7.8 Smart Technology:**

Implement smart technology solutions to enhance the quality of life for residents. This includes smart home systems, security features, and sustainable building management systems.

#### **7.9 Sustainability:**

Focus on sustainability by using eco-friendly materials and construction practices. Additionally, promote eco-conscious behaviours among residents, such as recycling programs and energy-saving initiatives.

Engage the Community: Involve the local community in the decision-making process and design discussions. Incorporate their input to ensure that the repurposed housing meets the specific needs and aspirations of the residents and the neighbourhood as a whole.

### **8. Potential Benefits to this new approach:**

The novel strategy for repurposing post-war social housing to meet contemporary needs offers a multitude of benefits that are not only environmentally friendly but also economically feasible and contextually appropriate. By prioritising adaptive reuse and sustainable practices, this approach significantly reduces the environmental footprint associated with demolition and new construction, leading to a decrease in waste generation and carbon emissions. Moreover, it promotes sustainability by modernising the housing units with energy-efficient systems and materials, which not only lowers operational costs for residents but also contributes to long-term resource conservation.

Importantly, this strategy is economically feasible, as it optimises the use of existing structures and minimises the need for substantial financial investments in new developments. Furthermore, it maintains the contextual appropriateness of these post-war housing complexes within their neighbourhoods, preserving their historical



significance while ensuring they remain functional and relevant for today's communities. In essence, this multifaceted approach harmonises environmental responsibility, financial viability, and contextual sensitivity, making it a compelling and holistic solution for revitalising post-war social housing.

## **9. The Role of Architects and Conservation Professionals:**

Throughout their journey of the last few decades, French architects Druot, Lacaton, and Vassal have showcased how architects can play a pivotal role in ensuring that adaptive re-use and conservation can be successfully implemented on post-war social housing blocks. They have not only refrained from demolition, removal, or replacement but have consistently adhered to a philosophy of addition, transformation, and reuse. Their remarkable real-world experiments in revitalising Modernist housing across Paris, Saint-Nazaire, and Bordeaux have gotten them some well-deserved acclaim. (Huber, 2016)

In each instance, they successfully rejuvenated cramped and poorly lit apartments, ushering in newfound light, ventilation, and innovative functionalities. Their interventions harnessed the buildings' vertical potential and inner spaces, encompassing the installation of new elevators, enhanced plumbing systems, and the incorporation of habitable glass facades that embraced panoramic views. These architects recognized that in order to withstand the influences of ever-changing consumer preferences and ideological shifts, preserving this cultural heritage demanded an authentic embrace of its modernity and a commitment to its continuous evolution." (Huber, 2016)

## **10. Cost-Effective and Sustainable Solutions:**

Assessing the economic feasibility of the proposed conservation approach reveals a promising outlook. This strategy's emphasis on adaptive reuse and sustainable upgrades minimises the high costs typically associated with demolishing and constructing entirely new housing complexes. By repurposing existing structures, significant savings are realised in terms of both construction expenditures and time.

Furthermore, the incorporation of energy-efficient systems and materials not only lowers ongoing operational costs for residents but also enhances the long-term economic sustainability of these housing units. The potential for reduced utility bills and the attraction of environmentally conscious residents can contribute to a healthier financial bottom line. Altogether, this approach presents a cost-effective solution for modifying pre- and post-war social housing stock, aligning with economic prudence while delivering sustainable, contemporary living environments.

## **11. Recommendations and Future Directions:**

This innovative strategy for reusing post-war social housing not only respects the historical significance of these structures but also transforms them into vibrant, sustainable, and inclusive communities that can thrive in the contemporary world. It's a holistic approach that recognizes the value of the past while embracing the possibilities of the future.

The importance of preserving social housing blocks cannot be overstated. These structures are not just buildings; they are the physical embodiment of social responsibility and a testament to the commitment of governments to provide affordable housing for their citizens. By preserving these housing blocks, we honour the past efforts to create safe and stable communities for vulnerable populations. Additionally, these buildings often occupy strategic locations within cities, contributing to urban resilience and sustainability. Demolishing them would not only result in a tremendous loss of resources but also disrupt established communities, leading to social disintegration. Thus, preserving social housing blocks is not merely an architectural concern; it is a fundamental ethical obligation to ensure housing equity and social cohesion in our cities.

Adaptive reuse plays a pivotal role in addressing the housing crisis in India in the 2020s. With a rapidly growing population and urbanisation on the rise, the demand for affordable housing has never been greater. Instead of solely focusing on new construction, adaptive reuse leverages existing structures to create housing solutions that are both cost-effective and sustainable. India's historical and architectural heritage provides a rich resource for such endeavours. By repurposing old buildings, particularly those with historical or cultural significance, we can simultaneously address the housing shortage and preserve our cultural legacy. This approach not only reduces the environmental impact associated with new construction but also revitalises urban neighbourhoods, fostering a sense of community and belonging. In the midst of a housing crisis, adaptive reuse offers a pragmatic and socially responsible solution that aligns with India's rich cultural heritage and the need for affordable, accessible housing in the 2020s.

Detailed feasibility studies from an economic, environmental and infrastructure perspective needs to be carried out before carrying out large scale demolition of post-war social housing in India. To advance the cause of preserving social housing blocks in India, policymakers should consider implementing a multifaceted approach.

First and foremost, clear regulations and incentives should be put in place to encourage the adaptive reuse of these structures. Tax benefits or grants could be offered to property owners and developers who choose to repurpose social housing blocks instead of demolishing them as is done in many parts of the world. Architects and conservation professionals should collaborate closely with local communities to ensure that the adaptive reuse projects respect the historical and cultural significance of these buildings.

Additionally, it is essential to invest in research and development to identify innovative and sustainable techniques for repurposing social housing blocks effectively. Training programs and capacity-building initiatives can empower architects and conservation experts to specialise in this unique field. Ultimately, a comprehensive strategy that integrates legal, financial, and community-driven approaches will be key to preserving these crucial social assets.

Future research on social housing conservation in India should focus on several critical areas. Firstly, there is a need for in-depth studies that assess the social and economic impact of adaptive reuse projects in different regions of India. These studies should examine the effects on housing affordability, community cohesion, and the preservation of cultural heritage. Secondly, research should explore sustainable building materials and technologies specifically tailored for social housing block rehabilitation. This includes innovative approaches to energy efficiency, water conservation, and waste reduction within these structures. Thirdly, interdisciplinary research initiatives should be encouraged to promote knowledge sharing between architects, urban planners, historians, and sociologists, fostering a holistic understanding of the challenges and opportunities in social housing conservation. Finally, ongoing monitoring and evaluation of existing adaptive reuse projects will provide valuable insights into long-term sustainability and inform best practices for future endeavours. This collective effort will contribute to the development of a robust framework for social housing conservation in India, ensuring a brighter, more sustainable future for these vital urban assets.

### **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Bibliometric Analysis using R Package as an Evaluation Method to Identify Research Gap in Assessing Sustainability of Cultural Heritage

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## Abstract:

*India is known for its rich built and cultural heritage since ages. Today, cities like Ahmadabad and Jaipur are declared heritage cities and are recognized by UNESCO as well. A study of cultural heritage of such cities can help to achieve the goals of sustainable development.*

*This paper aims to present a bibliometric analysis which focuses on the trends and patterns in scientific study related to assessment of indicators of sustainability in cities with cultural heritage.*

*283 Scopus indexed publications under this domain were identified using the keywords 'cultural heritage', 'Sustainable Development', 'Assessment' published in the time period 1991-2022 have been included in this study. By extracting the database and using R-Studio, an open-source platform, specifically 'Biblioshiny' package and its Web API, the bibliometric analysis has been conducted. In factorial analysis, the proximity distance among the words representing a common goal is another focal point of this research.*

*With the help of the features like word cloud, word growth, trend topics, co-occurrence network in 'R-Studio', the connection, interrelation and gap in the research identified. With the help of bibliometric analysis, this paper tries to do analysis of the current research and focus on the research gap. The paper attempts to present the result by indicating correlation between different studies carried out worldwide with in the selected timespan in above topics with the help of scientific analysis.*

*The scientific analysis and review of literature leads to form a research question with reference to the identified research gap.*

*Research design for developing framework of sustainability for heritage cities and can be proposed further based on the research questions identified through above study. Social implications will be studied further by involving stakeholders' participation during surveys.*

**Keywords:** cultural heritage; sustainable development; assessment indicators

## 1. Introduction:

Bibliometric analysis is a scientific computer-assisted review methodology that can identify core research or authors, as well as their relationship, by covering all the publications related to a given topic or field. It is an open-source tool for quantitative research in bibliometrics. Bibliometric analysis which provides microscopic overview of a large amount of literature in terms of identifying authors, Journals, organizations and countries working on the research area. (Mishra & Muhuri, 2020)

India is one of the richest countries in the world in terms of built and cultural heritage and a great number of heritage cities still remain preserved. The cultural heritage of such cities is a resource for sustainable development, which must be utilized to achieve the sustainable development goals. JnNURM (Jawaharlal Nehru National Urban Renewal Mission, 2005-2014) not only focuses on the Urban Renewal and infrastructure development but also on protection and developments of Heritage precincts which was an attempt for improvement in systems of sustainable planning and governance. This leads to a need of assessment of indicators of development in a cultural and heritage town. (INTACH, 2015)

With reference to above need for study this bibliometric analysis focuses on the trends and patterns in scientific study related to assessment of indicators of sustainability in a cultural town. While analysing bibliographic data, many questions arise such as, how to search? What to include and how to restrict selection criteria for the database? Moreover, how to interpret the analysis with the help of bibliographic data? This paper is divided into four sections. In the first section, previous reviews are discussed. In the second section, a research question is developed for the analysis of bibliometric analysis. In the third section, methods and tools are discussed for this research. In the fourth section, the study of the bibliometric result explained through the main information, relevant words, sources, and themes of this research. (Mishra & Muhuri, 2020)

## **2. Former reviews on assessment of sustainability of heritage cities and its allied fields:**

Former reviews include study of literature of research carried out for most large Heritage Towns like Mylapore, Tamil Nadu in India born with a clear urban structure, of a sacred inner core and commercial and residential outer cores. However, the city continued to outgrow its framework without time, resources, or thought to evaluate its urban plan. The analysis of patterns in such towns planning will reveal the weaknesses of the city's framework, especially near the Heritage zones. Land use planning follows no order or structure. (Mishra & Muhuri, 2020) The only planning that happens naturally is the existence of religious necessities closer to the central temple and other heritage structures. Another review published by UNESCO i.e. 'Training Module 5-management of historic cities' which says that Conservation and development are not mutually exclusive; they should, and can, be part of a single planning process. The document emphasizes on the need for studying the indicators and evolution of the heritage cities before proposing frameworks. It is also suggested that under the auspices of City Administration a Heritage & Conservation Cell in the Development Authority and Municipal Corporation should be created, and specific by-laws formulated for the development and preservation of heritagescapes with active participation from stakeholders. (Iamandi, 2009)

Identified methodology through literature is multi-criteria decision making specifically for heritage buildings. Bibliometric analysis for MCDM carried out in the studies for values assessments. However, all these analyses are not done by considering a systematic evaluation of literature; instead, those are done according to the judgment of the researchers. Research gap found with the reviews suggests lack of development of assessment tools and methods to measure indicators of development in heritage cities. (Partha Sarathi Mishra, 2020)

## **3. Methods and Tools:**

### **3.1 Research Question:**

In this section, the research question is formulated to examine the current state of literature. This process is also known as a scoping study that is developed by Arksey and O' Malley. This scoping study is designed to examine the magnitude, range, and variety of activities for the research in a particular field. These activities are a systematic review of variables, research outcomes, and identifying the research gap in the current literature. (Partha Sarathi Mishra, 2020). Hence, the research question for this paper is to explore the literature for detecting the state of the study for assessment of indicators of sustainable development in cultural heritage towns utilizing quantitative analysis and statistics to describe patterns of publications within a given period and body of literature.

### **3.2 Research Design and Search Query:**

The search query has been developed with the help of Boolean operators like AND, OR, NOT. This search query is dealing with the metadata of any research article. The metadata is the data, which is a combination of

titles, abstracts, authors, journals, affiliations, year of publication, and references used in the article. The timespan for the research query selected is from 1991-2022. The search database that has been chosen for this research is Scopus which deals with content types serial publications that have an ISSN (International Standard Serial Number) such as journals, book series and conference series, or non-serial publications that have an ISBN (International Standard Book Number) such as monographs or one-off conferences. Language for the documents selected is English only. Search query was carried out on the date 20.02.2022. Details are shown in Table 1. (HaoWang, August, 2021)

### 3.3 Bibliometric Query:

Concerning the relevant words for the research questions, it relied on Scopus databases to make a bibliometric database for the methods of assessment of sustainability of cultural heritage cities. The details of inclusive criteria in a stepwise manner are shown in Table 1.

*Table 1: Details of Inclusive criteria (Source: Author)*

Search Criteria	Scopus Documents in Numbers
TOPIC: ("Cultural Heritage" AND "SUSTAINABLE DEVELOPMENT" AND "ASSESSMENT") Timespan: All years. Indexes: SCI-EXPANDED, SSCI, A&HCI.	283

### 3.4 Tools and Techniques:

By extracting the database from the Web of Science and using R-Studio, an open-source platform, specifically 'Biblioshiny' package (Aria and Cuccurullo, 2017) and its Web API, the bibliometric analysis has been conducted.

## 4. Analysis of Result:

### 4.1 Analysis of the Dataset:

The dataset is a set of scientific production of the research articles in a given period, i.e., from the last two decades 1991-2022. The total number of documents that have been extracted is 283, and the total number of authors that contributed to this study is 885. All the other information related to the dataset is given in Table 2.

Table 2: Analysis of the Dataset (Source: Author)

<b>MAIN INFORMATION ABOUT DATA</b>	
Description	Results
<b>MAIN INFORMATION ABOUT DATA</b>	
Timespan	1991:2022
Sources (Journals, Books, etc)	167
Documents	283
Average years from publication	5.3
Average citations per documents	11.33
Average citations per year per doc	1.663
References	12351
<b>DOCUMENT TYPES</b>	
Article	176
Book	6
book chapter	13
conference paper	65
conference review	5
data paper	1
editorial	1
Review	16
<b>DOCUMENT CONTENTS</b>	
Keywords Plus (ID)	1718
Author's Keywords (DE)	951
<b>AUTHORS</b>	
Authors	885
Author Appearances	947
Authors of single-authored documents	51
Authors of multi-authored documents	834
<b>AUTHORS COLLABORATION</b>	
Single-authored documents	58
Documents per Author	0.32
Authors per Document	3.13
Co-Authors per Documents	3.35
Collaboration Index	3.71

The search of literature can be carried in Scopus with different ways like document search, Author search Affiliation search, Advanced search, Refine results, Language interface. This analysis is done based on 'document search' with the option of 'keywords. The Bibliometric analysis done using 'Biblioshiny' a app providing a web-interface for bibliometrix in R Studio. Biblioshiny in R Studio supports in easy use of the main features of bibliometric like Data importing and conversion to data frame collection, Data gathering using Dimensions, PubMed and Scopus APIs collection and also in Data filtering. Keyword plus field is applied for document analysis. (Partha Sarathi Mishra, 2020)

#### 4.2 Annual Scientific Production:

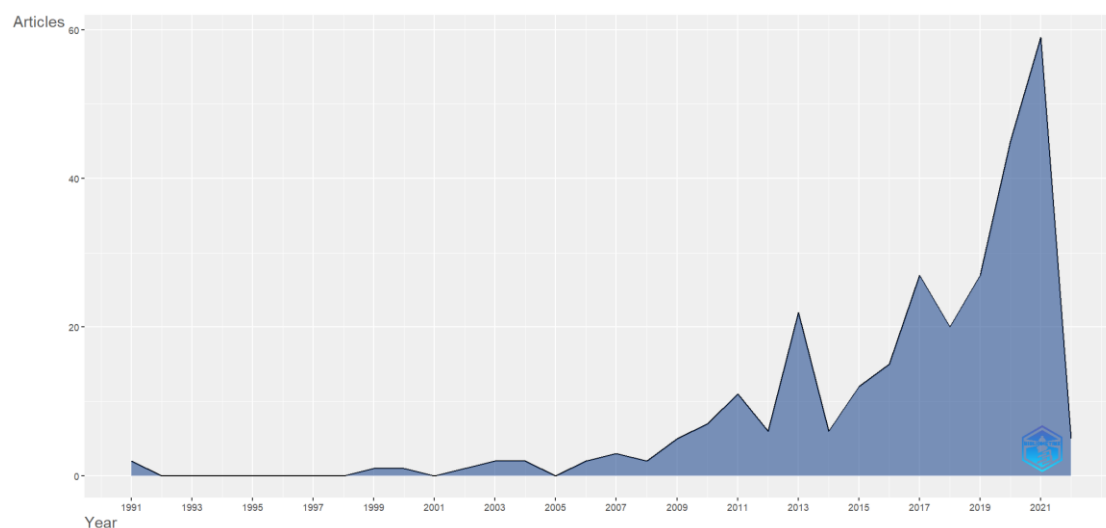


Figure 1: Annual Production Rate (Source: Author)

Annual Scientific Production graphs (figure 1) generated in analysis shows that the articles for the topic shows gradual increase in the number since 1991 to 2012 but the articles no. increased considerably with a sudden rise from 2013 to 2021. The no. of articles in the year 2021 are 59 from the total articles 283. Which shows the increased awareness in the heritage conservation and sustainable development studies.

#### 4.3 Analysis of Relevant Words:

Words are extracted from the Scopus Database written by them. Analysis like factorial analysis of words, word-cloud, and frequency of growth of words have been used for this research.

##### 4.3.1 Factorial Analysis:

The factorial analysis is responsible for the clustering of words which are from a common area of research and are collected from a similar area of articles. In this research, correspondences analysis (CA) is applied to form the clusters. By using the proximity distance among the words representing a common goal are the focal point of this research. (Krishnamoorthy, 2009)



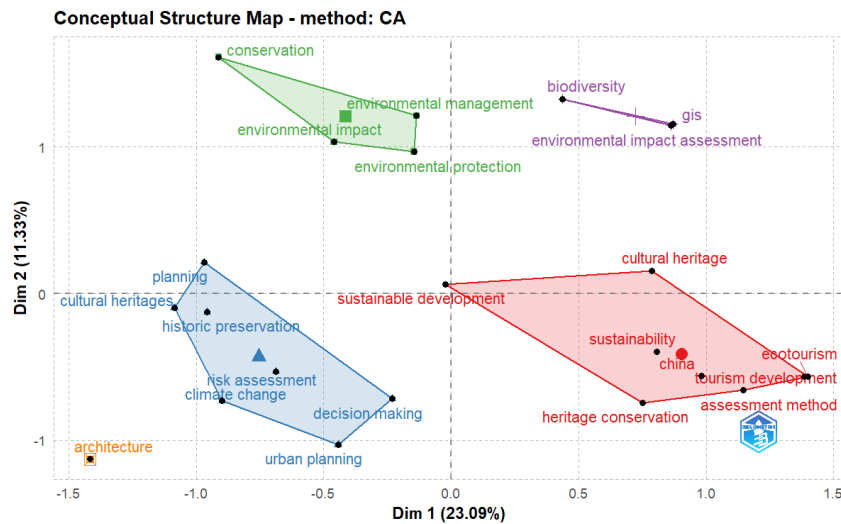


Figure 2: Factorial Analysis (Source: Author)

In Figure 2 , four factors are observed as each factor showing a specific pattern for clustering into a particular group.

1. Cluster 1: Cultural Heritages, Planning, Historic Preservation, Risk Assessment, Climate change, Decision making, Urban Planning
2. Cluster 2: Conservation, Environmental management, Environmental protection, Environmental impact.
3. Cluster 3: Biodiversity, GIS, Environmental Impact Assessment.
4. Cluster 4: Sustainable Development, Cultural Heritage, Sustainability, China, Eco Tourism Development, Assessment Method, Heritage Conservation.

With the help of these clusters, four major areas can be defined, and those areas can be treated as the new research areas having sustainability of a cultural Heritage as the base area of research. ‘Risk Assessment in Urban Historic preservation,’ ‘Environmental Impact during Environmental management and protection in conservation,’ ‘Environmental Impact Assessment and mapping of Biodiversity using GIS as a tool,’ and other clusters can be defined accordingly. In these ways, new areas of research can be developed.

### 4.3.2 Word Cloud:

This analysis is evolved as the most recent text mining purpose. The intensity of the colour and the size of the text can represent the level of importance. Text mining is done to identify the most relevant words for the evaluation of sustainability of Cultural Heritage.



Figure 3: Word Cloud-Keyword Plus (Source: Author)

Cultural heritage, historic preservation, risk assessment, sustainability, heritage conservation, decision making, planning are the words found to be the most used words for the evaluation of sustainability of Cultural Heritage.

By combining these words, the different themes of research, especially the current trends, can be predicted better; than relying on the researcher’s judgments or assumptions.

**4.3.3 Word Growth:**

The most relevant words used in this research can be identified with the help of the word growth per year. By using these words, a new set of phrases can be developed for the evaluation of sustainability of Cultural Heritage new research on as a broad domain. (Partha Sarathi Mishra, 2020)

In Figure 4, ‘Sustainable Development,’ ‘Cultural Heritage,’ ‘Risk assessment,’ and ‘Heritage conservation’ words are most recently on a priority basis. Therefore, for example, ‘The method of assessment of sustainable development in cultural heritage conservation’ can be a new topic for the research under the domain of sustainability of Cultural Heritage. Cumulate Occurrences with reference to years shows that above words in word growth are frequently used after 2007 more.

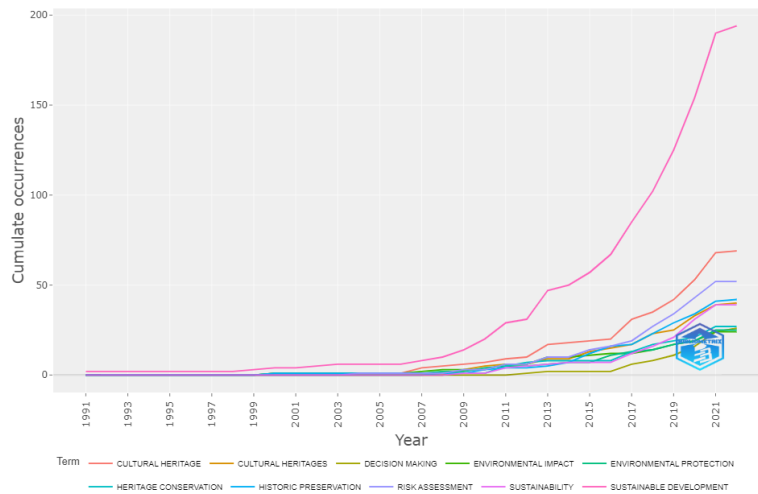


Figure 4: Word Growth- Keyword Plus (Source: Author)

**4.3.4 Trend Topics:**

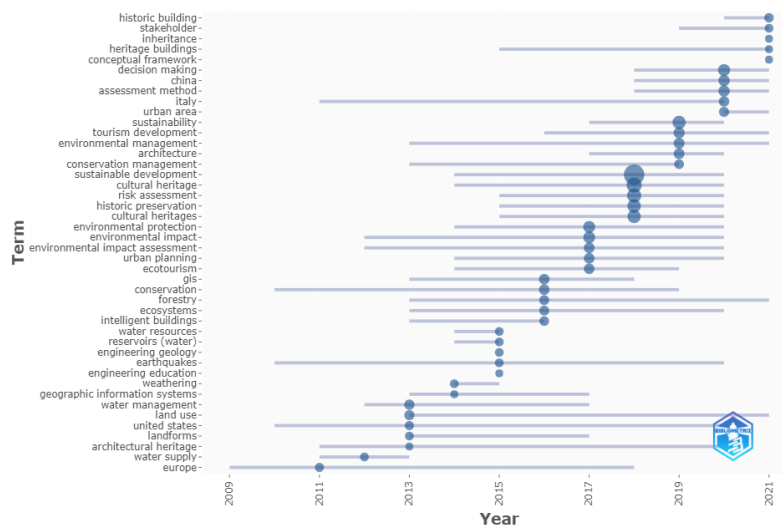


Figure 5: Trend Topics (Source: Author)

Figure 5 shows the changing trends in topics in the heritage studies. As the graph presents current trend topics are historic building, stakeholder, heritage buildings, decision making, assessment method, sustainability. The research can include above topics as the current trend and need.

### 4.3.5 Co-occurrence Network:

The level of appearance of the words in the whole database extracted from the Scopus can be concluded as the most relevant words or the connector words in the fields of sustainability of Cultural Heritage. The size of the circle and text size is depended upon the number of times they have appeared in the dataset. All the words are known as the nodes, and the connecting line between them is known as edges. Larger the size of the circle and text size and the connected line between them give the level of importance.

In Figure 6, three clusters are formed from the most relevant words. Different colours signify different clusters, and this clustering process is developed with the help of factor analysis. Cluster one with red colour is having words like Sustainable development, cultural heritage, sustainability, heritage conservation, assessment method etc. Within a cluster, these words are showing a common goal to represent a particular theme and are present in the distinctive articles showing mostly.

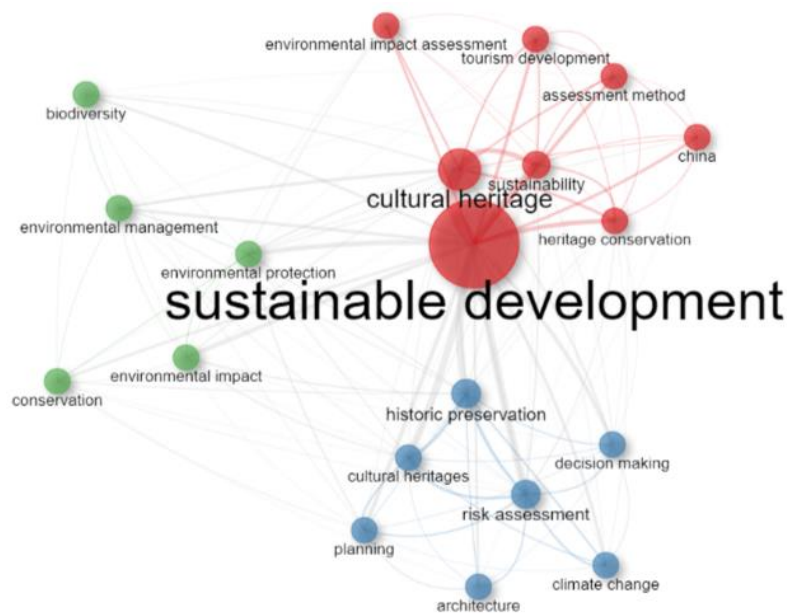


Figure 6: Co-occurrence Network (Source: Author)

### 4.4 Analysis of Sources:

In this research, the ‘Sources’ means a total number of documents, i.e., 283 in numbers, which includes research articles, conference proceedings paper, and review papers related to the architectural heritage. In this section, the most relevant sources, core sources, the collaboration between countries, and most cited countries have been analysed for various purposes. The details analyses are explained in the below sub-sections. (Mishra & Muhuri, 2020)

#### 4.4.1 Most Relevant Sources:

By analysing all the documents, the most relevant source can be identified with the help of the number of documents that have been published by the journals within the given dataset.

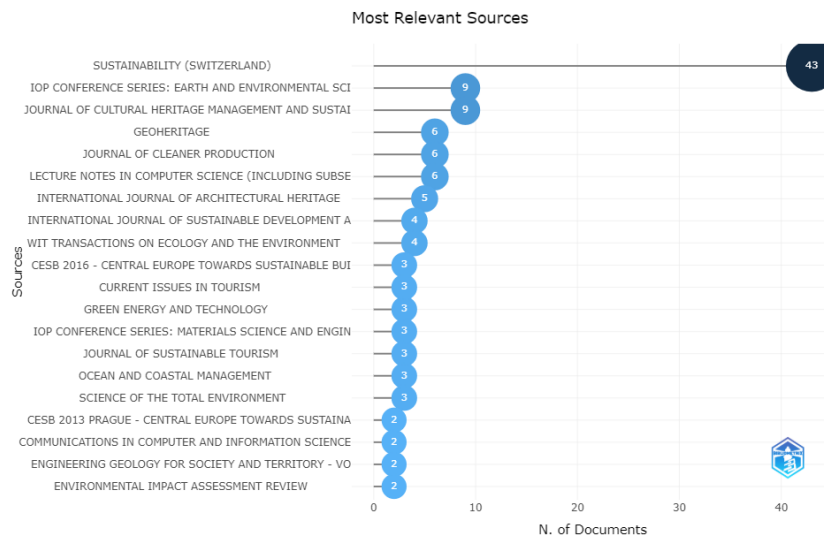


Figure 7: Most Relevant Sources (Source: Author)

It has been found that ‘Sustainability (Switzerland),’ ‘IOP Conference Series: Earth and Environmental science,’ and ‘Journal of Cultural Heritage management and sustainability,’ are the most relevant journals in the field of architectural heritage for finding out the methods for evaluating it.

**4.4.2 Core Sources of Journals:**

With the help of Bradford’s Law of Source Clustering, most relevant sources of documents are identified concerning the frequencies of the articles in those particular journals. “If the journals are arranged in descending order of the number of articles they carried on the subject, then successive zones of periodicals containing the same number of articles on the subject form the simple geometric series. (Galabi, 1979). It has been found that are the core area journals that ‘Sustainability (Switzerland),’ ‘IOP Conference Series: Earth and Environmental science,’ and ‘Journal of Cultural Heritage management and sustainability’ where the maximum number of articles are published for the methods related to the broad domain.

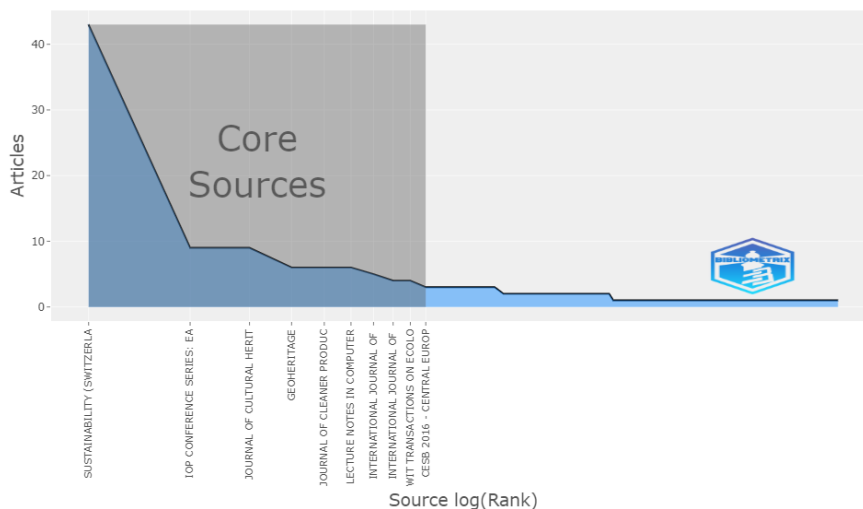


Figure 8: Source Clustering through Bradford’s Law (Source: Author)

**4.4.3 Authors Collaboration:**

The collaboration among the countries can be possible with the help of the authors producing articles in the same area of research. In Figure 8, the MCP means multiple country production, and SCP means single country production. Countries like UK, Italy, China, Netherlands, India are producing research articles with collaboration, whereas Spain, Poland, Greece are producing articles on self-basis. It is also noted that countries are preferring Collaboration like MCP than SCP for producing articles in sustainability of cultural heritage.

The social structure provides collaboration between different countries with the help of researchers in specific areas how the researchers are collaborating in a specific pattern that is the theme of this paper. Authors are writing in the same institution, the same field of area, from the same country that needs to find out for future collaboration in the new area of research in the same domain. This structure also educates the new researcher to collaborating with those authors who are already doing similar kinds of research.

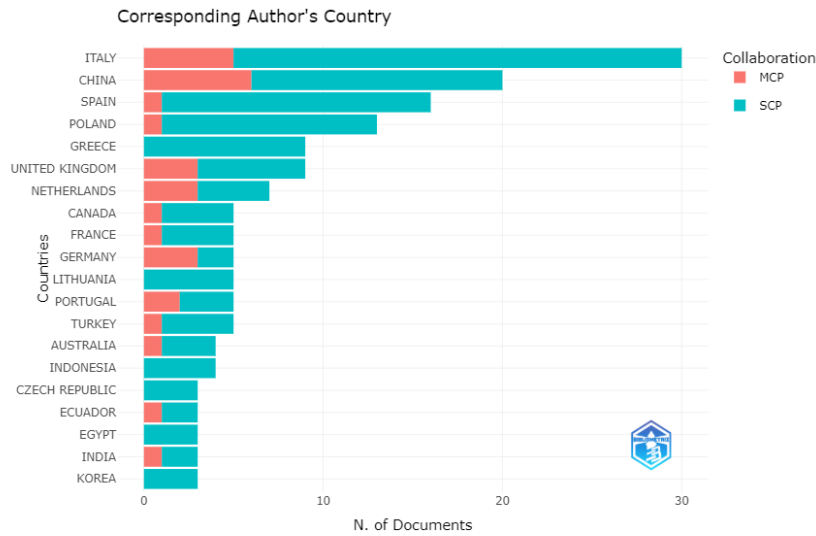


Figure 9: Authors Collaborations (Source: Author)

#### 4.4.4 Collaboration Network:

Form the Scopus dataset and best 20 countries, collaboration has been observed in Figure 9. Major collaborations have been observed with the countries Italy and Spain in this collaboration network analysis. The figure shows that Italy has collaborations with Canada, Norway, USA, France, Greece, Denmark. Whereas Spain has collaborations with Germany, Portugal, UK. India has only collaborations with Iran.

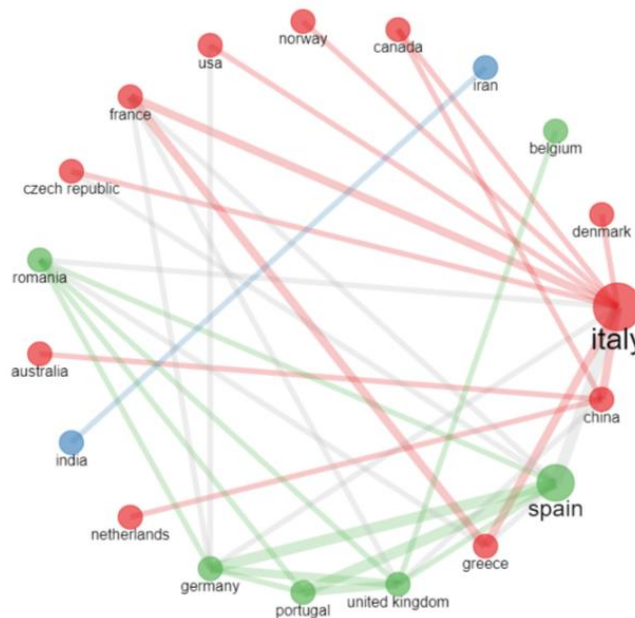


Figure 10: Collaboration Networks between Countries (Source: Author)

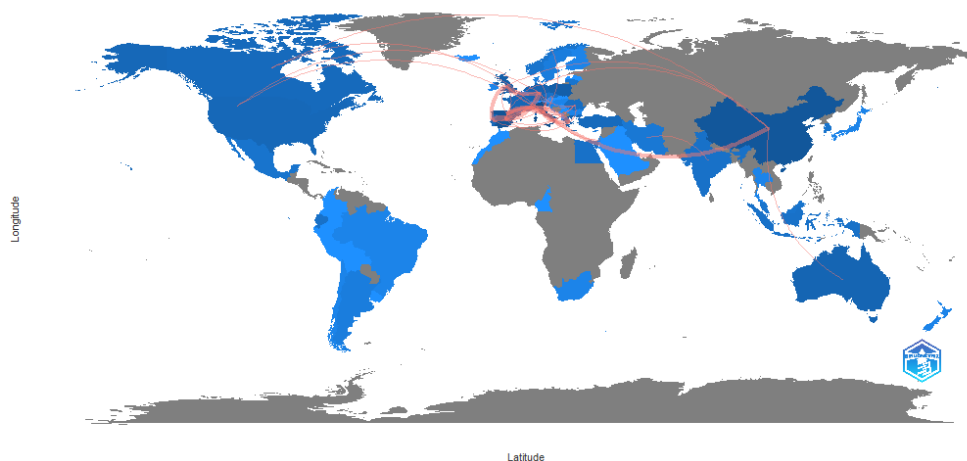


Figure 11: Countries Collaboration Map (Source: Author)

In Figure 10b, the world map showing the blue coloured map, which represents the level of collaboration among the countries. (Mishra & Muhuri, 2020) Darker the colour more is the collaboration in the field of sustainability of cultural heritage research. The lines are showing the collaboration between countries. Stronger the line stronger is the collaboration.

#### 4.5 Analysis of Themes:

##### 4.5.1 Thematic Map:

In the conceptual network analysis, a thematic map is a mixed-use approach, and it plots to access the functioning of the centrality and density of the themes. ‘Centrality’ can be described as the level of the importance of the theme, and Density can be described as the measurement of centrality.

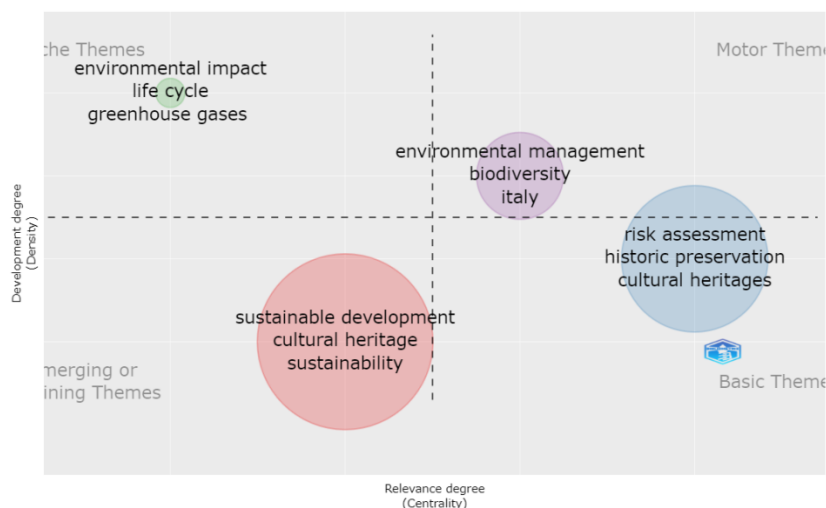


Figure 12: Thematic Map- Keyword Plus (Source: Author)

This graph has four quadrants representing different themes for research of sustainability of cultural heritage. They represent different themes as:

- Right Bottom: Basic and core theme
- Right Top: Current research themes
- Left Top: Highly developed theme or isolated themes
- Left Bottom: Emerging themes Similar to the co-occurrence network

This thematic map also has the size aspects. Bigger the size of the circle bigger is the density, and the placement of the circle represents how far it is from the centrality and density origin.

From thematic map it has been concluded that:

- Underlying and core theme: Risk assessment, Historic preservation, Cultural heritage
- Current research theme: Environmental Management, Biodiversity.
- Highly developed theme: Environmental impact, life cycle, Green House Gases
- Emerging theme: Sustainable Development, Cultural Heritage, Sustainability

These different themes can be concluded from the Scopus dataset and can be focused on the current themes and emerging themes for the future development to find research gap.

## 5. Conclusions:

With the help of bibliometric analysis, this paper tries to find out the analysis of relevant words, sources, and themes associated with the evaluation of sustainability of cultural heritage. From the Scopus database, a list of 283 documents is selected with the help of Boolean operators for this research. Analysis of the main information shows that the evaluation of sustainability of cultural heritage itself is an emerging field of research. (Mishra & Muhuri, 2020). By analysing the conceptual structure map, the evolution of a particular theme can be identified. This particular research is ranging from 1991 until the data extraction from the Scopus. The pick in this graph shows that from the last five years' various themes related to the evaluation of sustainability of cultural heritage are published rapidly. Further, analysing the relevant words, with the help of word cloud, and factorial analysis, different themes of research are identified on a cluster basis. These clusters are giving the ideas of words having similar meanings that are published in similar articles are co-related with each other, and from them; different themes can be generated. (Mishra & Muhuri, 2020). Analysing the themes with the help of thematic map analysis, the base or core, current or ongoing, saturated or isolated, and emerging or future themes for the evaluation of sustainability of cultural heritage are identified. Many other related documents written in different languages were not possible to consider as part of this research. Despite the limitations, the findings and the method can be useful to the research community for the initial stage of judicial search not only in the specific domain but in any field.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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**TRACK 5:  
BUILT ENVIRONMENT  
AND LANDSCAPE**

BNCA Conference Proceedings 2023



# Analyzing the Potential of Urban Open Spaces to Combat Heat Stress: Case Jalgaon, India

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## **Abstract:**

*Long-term changes in temperature and urbanization are referred to as climate change. Climate change adaptation, mitigation activities, and risk reduction are all part of urban climate change resilience. Recognizing the responsibility of quickly increasing urban areas and the uncertainty associated with urban greenery, as well as building urban green spaces, is one strategy to close the climate change gap. Heat stress is a significant cause of weather-related human mortality. As temperatures continue to rise as a result of climate change, green lanes for thermal transformation should be established.*

*The issue is that, due to the increasing prevalence of this environmental health concern, assessment methodologies based on meteorological data must be enhanced. Jalgaon has a hot semi-arid climate that borders on tropical wet and dry, with an average temperature ranging from 35 to 40 degrees Celsius. To comparative analysis of urban spaces in Jalgaon.*

*This study is focused on analyzing the potential of urban open spaces to combat heat stress. Because of high temperature greenspace and green corridor should be compere to cool down temperature of city. Method of research is comparison of case study and some variables like temperature, wind speed, wind direction, relative humidity and radiant energy should be measured with a 5 in 1 environmental meter and design parameters were studied of the open space.*

*Mapping and site visit of each park was done at three different times of the day to study design considerations and microclimate measurements were done. Analysis of microclimate, design parameters and overall feel of the atmosphere was noted. The material pallet, plant pallet and visual character also contribute to maintaining microclimate. The conclusion of study is analyzing and help to understand various factors affecting the heat.*

**Keywords:** *environmental meter; heat stress; Jalgaon city; urban heat island*

## **1. Introduction:**

At the turn of the 20th century, the population of urban India was only 25.85 million, accounting for 10.84 percent of the nation's population in 1901, but it grew to 285.35 million, accounting for 27.78 percent of the total population in 2001, with natural growth accounting for roughly 60% and migration and expansion accounting for the remainder.

India's urban population grew by 91%, from 286 million in 2001 to 377 million in 2011. For the first time since independence, the rural population increase has exceeded the rural population increase of 90.5 million. It is expected to reach 550 million, or 42% of the total population, by 2030.

The urban heat island effect has the following causes (Oke, 1987; Santamouris, 2001):

## Analyzing the Potential...

1. Absorption of short-wave radiation from the sun in low albedo (reflection) materials and trapping by multiple reflections between buildings and street surface.
2. Air pollution in the urban atmosphere absorbs and reemits longwave radiation to the urban environment.
3. Obstruction of the sky by buildings results in a decreased long-wave radiative heat loss from street canyons. The heat is intercepted by the obstructing surfaces, and absorbed or radiated back to the urban tissue.
4. Anthropogenic heat is released by combustion processes, such as traffic, space heating and industries.
5. Increased heat storage by building materials with large thermal admittance. Furthermore, cities have a larger surface area compared to rural areas and therefore more heat can be stored.
6. The evaporation from urban areas is decreased because of 'waterproofed surfaces' – less permeable materials, and less vegetation compared to rural areas. (Oke, 1987; Santamouris, 2001).

There has not been lot of study on what the changing trends are in the designing of urban green spaces and how these changes affect the microclimate of its neighbourhood.

Microclimate can be measured by following parameters wind direction, wind speed, temperature, relative humidity and radiant energy.

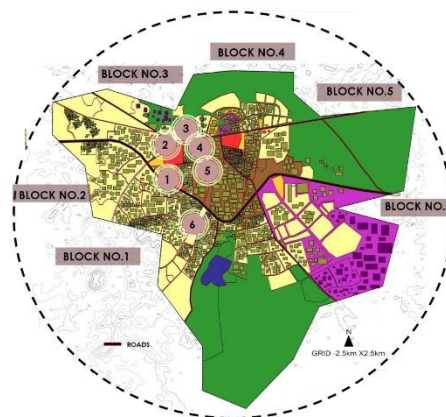


Figure 1: Map of Location of Garden in Jalgaon development plan (Source: Author)

A study of changes in design concepts can be conducted to determine how they affect the microclimate of the area.

Understanding these effects will lead to design considerations for any urban green space to achieve optimum microclimate and, as a result, will assist any city in controlling climate change.

Jalgaon lies in semi-arid region with hot & dry climate with average rainfall.

In Jalgaon District, the average annual rainfall is around 690 mm and the temperature can range from 10 to 48 degrees Celsius, making it a diverse climate with scorching summers of up to 45 degrees Celsius. Scope of the study is the urban green spaces in Jalgaon city. Because Jalgaon have heat stress effect that temperature is high in Jalgaon city.

Limitation for research paper was time period which allows to measure temperature and find conclusion. Also, to conduct informative research on the topic of heat required team. Also, some data is taken from research paper, journals, books, NGOs, Toolbox.

## 2. Methodology:


For primary data collection six garden in different areas were selected. Heat stress will be measured from all these instrumental readings and relationship between streets and microclimate will be analysed. Through this study we can derive various polices for heat stress and plant selection criteria which help in maintaining microclimate.

For the analysis we used the instrument name as 5 in one environmental instrument. Microclimate is measured during morning 8 am, afternoon 1 pm and evening 6 pm to understand how temperature change throughout the day.

The whole study is to prove that urban spaces designed by a landscape architect in any era using the right kind of material and plant pallet will always help maintain microclimate cooler and more comfortable for users throughout the year.

Relevant literature is studied in order to using tool that is 5 in one environmental instrument and conclusion studies conducted in various areas.

*Table no.1: Tool Information (Source: Internet)*

Tool information	
<p>The 5-in-1 Environmental Level is a phenomenal multi-purpose measure that can operate as a sound level meter, light meter, anemometer, humidity meter, and temperature. A backlit LCD group displays current, maximum, and minimum values and has a data-hold function.</p>	

### 3. Data collection:

There are some gardens and street selected which joints to garden are selected they are,

- Bahinabai Garden
- Dr. Babasaheb Ambedkar Garden
- Rose Garden
- Parik Park
- Mahatma Gandhi Garden
- Bhaunche Udyan

With the 5 in one environmental instrument the reading is taken these parks are in different location some have fixed activities like jogging, kids play area, open gym, and other social activities.

Microclimate is measure during morning 8 am, afternoon 1 pm and evening 5pm to understand how these temperature changes throughout the day. Every park has study points outside the garden on street to measure temp and paraments.

#### 1. Bahinabai Garden:

The first location selected is from Jalgaon but its nearby highway. The temperature measurement is done through the instrument on 25 April 2023. This garden derives its name come from Bahinabai, Bahinabai Chaudhari was a Marathi language poet from Jalgaon district of Bombay State, India. This is situated almost parallel to highway.

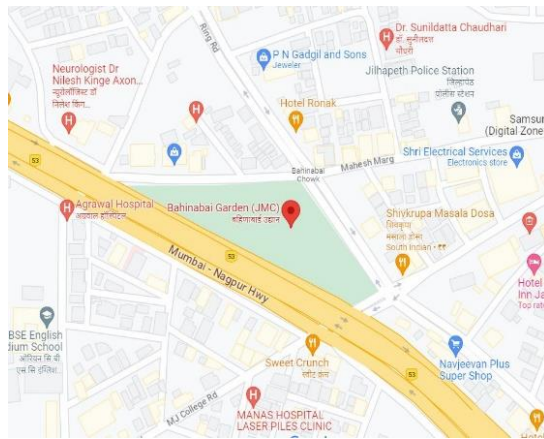


Figure 2: Google Image of Bahinabai Garden (Source: Internet)

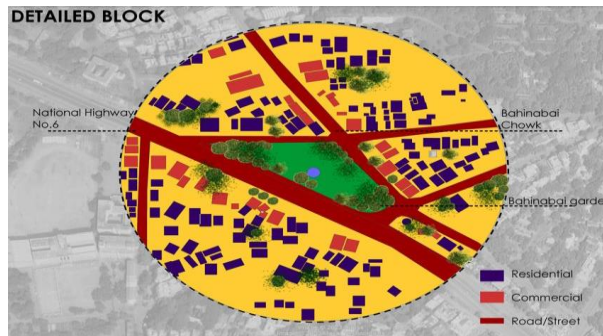


Figure 3: Details surrounding of Garden (Source: Author)

Activities: -Joggers Park, kids play area.

Visual Design: -This garden has tall old trees surrounding the park. Grill fence is mandatory because its nearby highway and the visual connectivity.

Maximum land covers with canopy of peripheral tress. Paver blokes are uses on for path.

Plant and material pallet: -Maximum tall trees.

Table no.2: Characteristics of the garden (Source: Author)

Width of the street	6M
Typology of building	Commercial and residential
Green cover (%)	30%
Built Up Density	40%
Vehicular density	High (Because of main road and one side highway)
Types of Materials	Paving blocks, bench
Type of vegetation	Moderate and canopy trees

## 2. Dr. Babasaheb Ambedkar Garden:

The second location selected is from Jalgaon but its nearby residential and commercial area. The temperature measurement is done through the instrument on 25 April 2023.

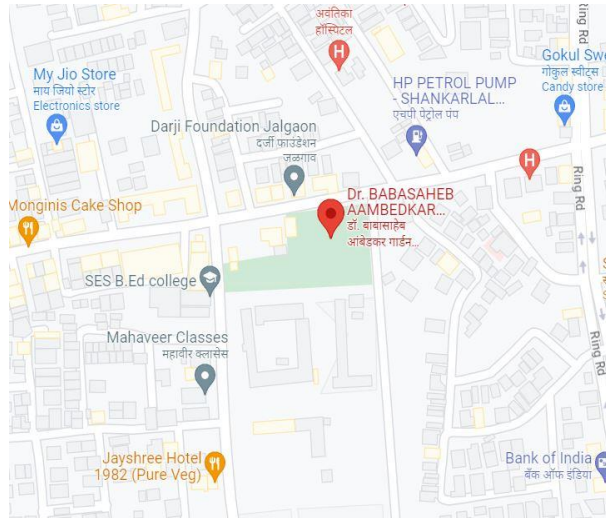


Figure 4: Google Image of Bahinabai (Source: Internet)

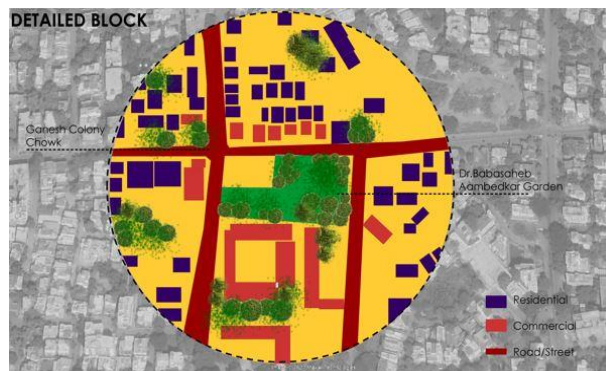


Figure 5: Details surrounding of Garden (Source: Author)

Activities: -Joggers Park, kids play area have 2 equipment's.

Visual Design: -This garden has tall old trees surrounding the park. There is only one fencing at the entry.

Paver blokes are uses on for path.

Plant and material pallet: -Maximum tall trees.

Table no.2: Characteristics of the garden (Source: Author)

Width of the street	9M
Typology of building	Commercial
Green cover (%)	23%
Built Up Density	40%
Vehicular density	High (Because of main road and one side highway)
Types of Materials	Paving blocks, bench
Type of vegetation	Tall trees

### 3. Rose Garden:

The third location selected is centre of Jalgaon city but its nearby residential and commercial area. The temperature measurement is done through the instrument on 25 April 2023.

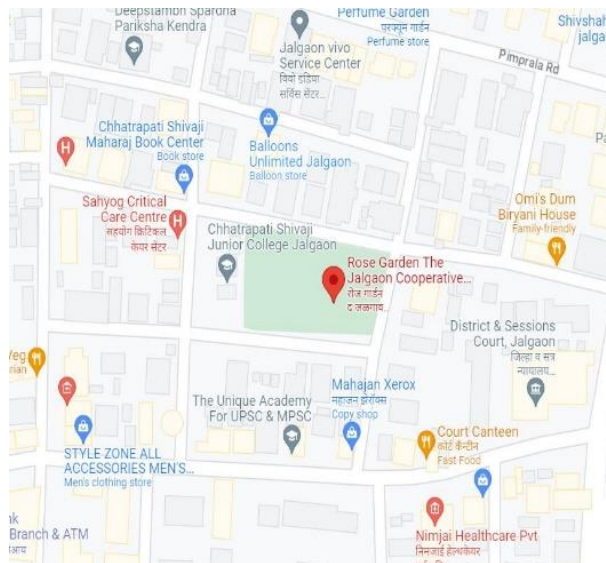


Figure 6: Google Image of Rose Garden (Source: Internet)

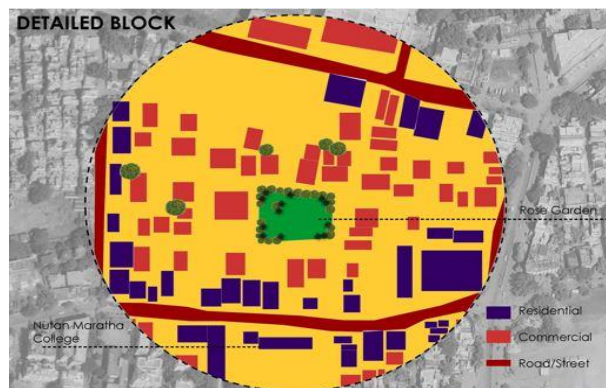


Figure 7: Details surrounding of Garden (Source: Author)

Activities: -Joggers Park, kids play area have 2 equipment's.

Visual Design: -This garden has tall old trees surrounding the park. There is only one fencing at the entry.

Paver blokes are uses on for path.

Plant and material pallet: -Maximum tall trees.

Table no.3: Characteristics of the garden (Source: Author)

Width of the street	5M
Typology of building	Commercial and residential
Green cover (%)	15%
Built Up Density	60%
Vehicular density	Medium
Types of Materials	Paving blocks, bench
Type of vegetation	Medium type tree

#### 4. Parik Park:

The third location selected is centre of Jalgaon city but its nearby residential and commercial area. The temperature measurement is done through the instrument on 26 April 2023.



Figure 8: Google Image of Parik Garden (Source: Internet)

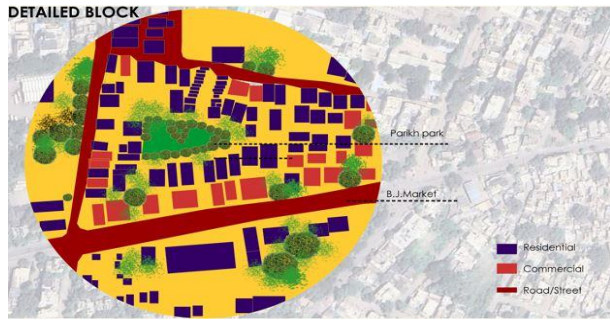


Figure 9: Details surrounding of Garden (Source: Author)

Activities: -Running track, kids play area have 2 equipment's.

Visual Design: -This garden has tall old trees surrounding the park. There is only one fencing at the entry.

Paver blokes are uses on for path.

Plant and material pallet: -Maximum tall trees.

Table no.4: Characteristics of the garden Source:( Author)

Width of the street	5M
Typology of building	Commercial and residential
Green cover (%)	15%
Built Up Density	60%
Vehicular density	Medium
Types of Materials	Paving blocks, bench
Type of vegetation	Medium type tree



## 5. Bhaunche Udyan:

Bhaunche Udyan project has been developed a few days back. Children love to come to this place in garden. And it is one of their favourite places. The main feature of this park is the variety of children play area, open gym, jogging track. And the main attraction of this place is the temple here with mild sound system in garden. This garden is name on owner of Jain irrigation.

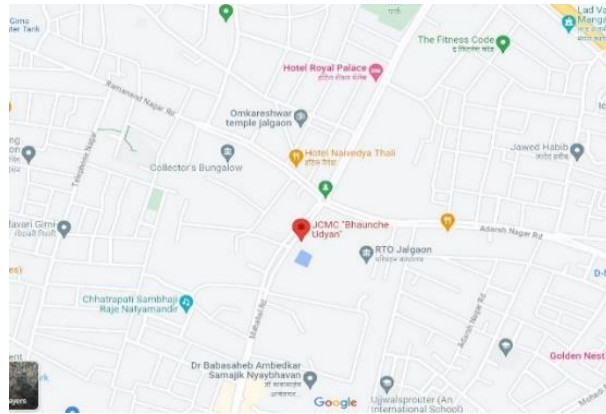


Figure 10: Google Image of Bhaunche Udyan Garden (Source: Internet)

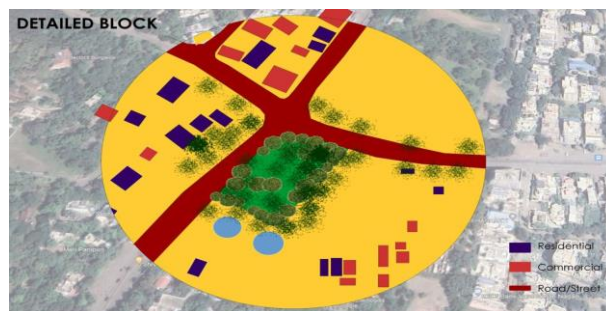


Figure 11: Details surrounding of Garden (Source: Author)

Existing landscape characters:

1. Soft scape in garden - Green Lawns, panting, shrubs, flowerbed
2. Hard scape in garden-Pavements, children play equipment's
3. Shaded area due to tress- Medium sized trees
4. Seating in garden-Bench, Open Amphitheatre, Lawn
5. Material pallet: -Lawns, paver block, concrete
6. Planting plate in garden-Native plant with shrubs, trees.
7. Water feature: -Water fountain
8. Width of the street in front from garden-12M
9. Air Qualities-Good

## 6. Mahatma Gandhi Udyan:

Mahatma Gandhi Udyan is very beautiful and very famous in the central part of the city near Navin Bus Stand. The park has beautiful colourful flower gardens along with innovative activities for children to play. The park is located in the heart of the city, and that's why its remains crowded with tourists. Display of different varieties of flowers and plants adds to its beauty. Photography lovers shouldn't forget their cameras as there are so many corners in the garden that are worth a capture.

*"You must be the change you wish to see in the world,"*: Mahatma Gandhi

The S.A.G.E. Coalition manages the garden, but works with many community groups and volunteers to ensure its maintenance. Situated near the Jalgaon bus stand. The park continues to be filled with visitors because it is in the centre of the city. Its attractiveness is enhanced by the display of many flower and plant kinds.



Figure 12: Google Image of Mahatma Gandhi Udyan Garden (Source: Internet)

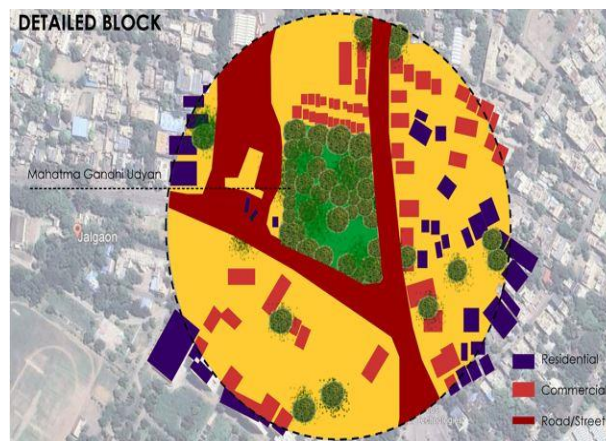


Figure 13: Details surrounding of Garden (Source: Author)

#### 4. Key findings :

After observing the design considerations for each park microclimate measurements were taken at 5 points to understand how microclimate of each park is different. Following are readings taken on site.

##### Temperature Readings taken from garden :

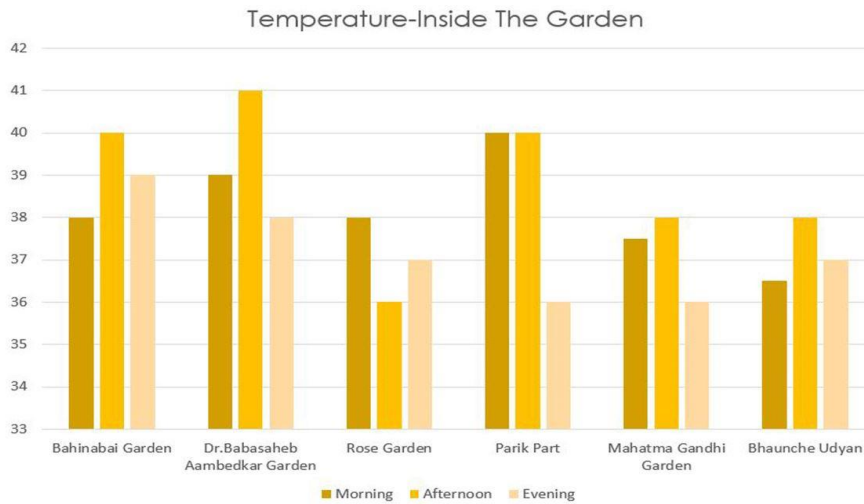


Figure 14: Temperature Readings taken from garden (Source: Author)

The maximum temperature reported at all places is 41 degrees, which, along with the strong wind speed and relative humidity, makes this neighbourhood feel rather cold.

In some gardens, the afternoon sun is scorching, and a cool breeze through the lofty canopy cools down as it reaches ground level. The temperature of Dr Babasaheb Ambedkar Garden is 41 degrees Celsius because there are less trees, and it is lower in the evening.

The temperature in Bhaunche Udyan and Mahatma Gandhi Garden is cooler than in other gardens due to the trees and proper plantation. The buffer zone and over all plantation of this park makes it 2 degrees cooler than surrounding area although paving material is used on all sided still it gives cool feeling to users.

##### Humidity readings taken from garden :

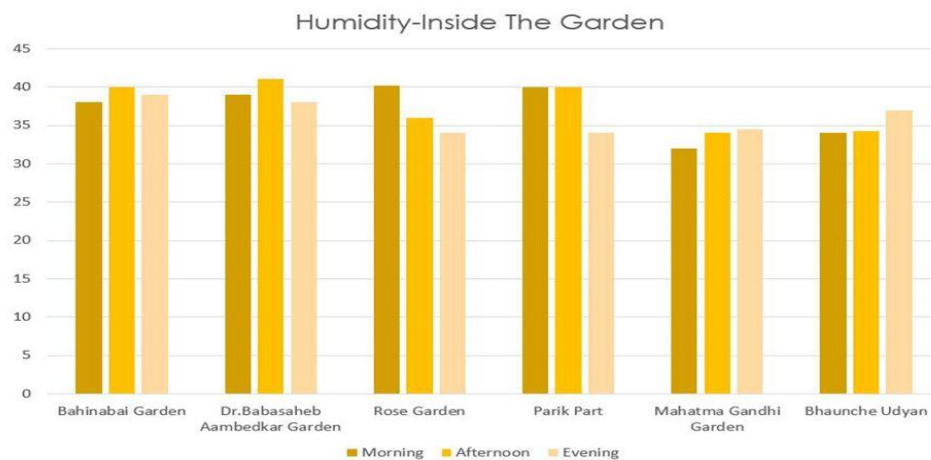


Figure 15: Humidity Readings taken from garden (Source: Author)

Some of the relative humidity is high due to higher lawn areas. Visual connectivity is not present and hence passer-by cannot see this garden from outside. It is surrounded by low building in wind direction and hence strong winds can be observed at some points. There are small trees and big lawn areas but no high shady trees. But the relative humidity is same to all the garden.

### Wind speed readings taken from garden :

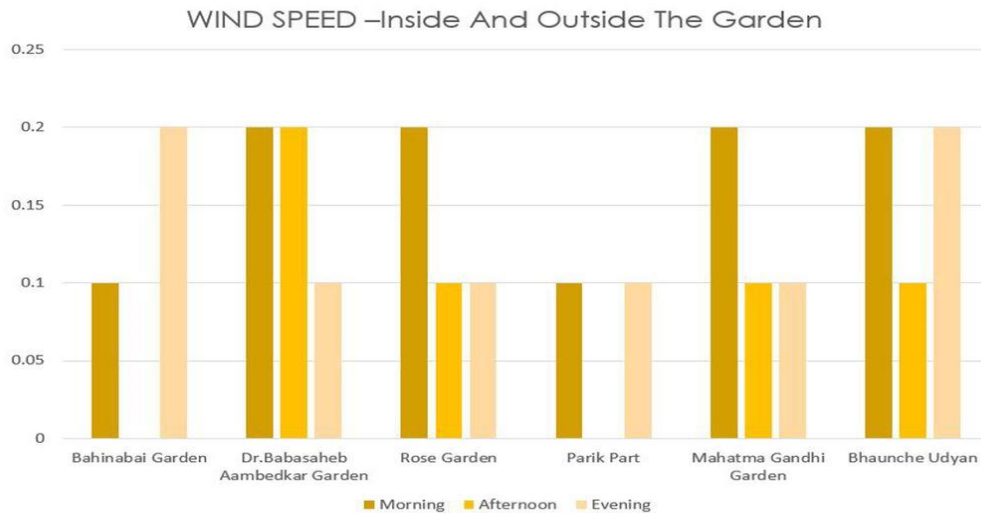


Figure 16: Wind Speed Readings taken from garden (Source: Author)

Wind speed is observed at only certain spots due to high rise buildings but the wind is cool during afternoons also. The buffer zone between park and road not only acts as barrier for children protection but also helps in cooling winds and regulating the temperature. Strong winds are experienced but they are hot during day and cold at night as wind doesn't filter through trees to cool down. The buffer zone between park and road not only acts as barrier for children protection but also helps in cooling winds and regulating the temperature.

## 5. Conclusion:

Urban heat island is now one of the important problems in the rapidly growing cities as a part of global warming. But In Jalgaon conclusion is showing that gardens in Jalgaon there are exceptional of one garden there are comfort in gardens. Following is some recommendation form research done on Jalgaon 6 gardens.:-

1. Compound wall can be chain linked fence for visual connectivity. This way the urban green space can attract more public.
2. There should be buffer zone between park and road specially if there is a main road adjacent to it.
3. Use of shady native trees to be used in this buffer zone so that wind flowing through park and in
4. Neighbourhood are cooler even in afternoon times.
5. Paving material used in the park can be replaced with permeable paving materials which will help to drain and absorb rain water to contribute to rain water harvesting.
6. Buildings around this urban green space in the direction of wind should be small so that wind flow is optimum.
7. Buildings should not have excess use of glass as glass will reflect sunlight and that reflected sunlight can be harsh on this green space.
8. A proper native plant palette should be selected with the involvement of horticulturist or landscape architect.
9. Large canopy trees should be planted to create a shaded road and peripheral of garden.
10. Existing trees around the pathways of garden should be protected and trees should be planted.
11. Use of heat aspirant materials should be preferred and impervious surface should be avoided.
12. Roadside planting should be done in the streets to prevent street canyon effect.

13. Climate maps should be created in cities.

To summarise, microclimate and landscape design of urban green open space are interconnected. Older parks have older trees that provide more ecological services than newly planted trees.

### **Acknowledgement:**

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I wish to thank our principal sir Dr. Sudir Chavan for constantly motivating us through the process. Last but never least, I sincerely thank my family, my parents, and my friends for believing in me and providing endless support. Specially my husband for unconditional support and encouragement to pursue my interest.

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### **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# Identifying Barriers in Implementing Blue-Green Infrastructure in Landscape Practice, case Pune

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## **Abstract:**

*Blue-Green Infrastructure (BGI) is a crucial approach within the realm of Nature Based Solutions (NBS), aimed at effectively managing services in cities while promoting sustainability. By expanding the scope of Ecosystem Services (ES), BGI implementation enhances living situation and mitigates the adverse consequences of changing climate in both urbanized and non-urbanized/rural areas. BGI plays a pivotal role in the design and planning of these regions, neutralizing their negative impacts.*

*The evolution of Blue and Green Infrastructure (BGI) serves as a modification and adaptation strategy aimed at crafting resilient neighbourhoods capable of withstanding internal and external factors, especially those associated with climate change.*

*As the Blue-Green Infrastructure (BGI) concept is relatively new, numerous landscape architects, urban planners, and planners for rural areas lack familiarity using the potential barriers that probably arise in the process of implementation and lifespan of BGI projects. This lack of awareness leads to challenges for professionals working on BGI solutions, particularly when executing these solutions on-site. Consequently, some professionals exhibit reluctance in adopting BGI solutions due to the problems they encounter during implementation.*

*Pune, being at the forefront of landscape architecture development, acknowledges the potential advantages of incorporating BGI solutions as a fundamental aspect of landscape design. To gain a comprehensive understanding of the grassroots challenges faced by landscape architects, architects and allied field professionals, during the implementation of BGI, this research initiative was initiated.*

*This paper aims to gain a comprehensive understanding and identification of the key barriers that BGI projects may encounter. This understanding will assist landscape architects, environmental agencies, communities, and other BGI planners in assessing the challenges they may face.*

**Keywords:** *blue green infrastructure; barriers; nature based solutions; bgi solutions; sustainability*

# 1. Introduction:

Blue-Green Infrastructure addresses to the integration of natural, elements i.e. Organic elements, such as green spaces and water bodies, into metropolitan environments. It is an innovative approach that aims to provide multiple benefits, including flood management, improved air quality, and enhanced aesthetics.

BGI solutions significantly enhance urban resilience by increasing cities' capacity to withstand and rebound from various pressures, such as urban stressors and temperature changes, through strategies like green infrastructure and climate-adaptive designs.

However, like any other concept, blue green infrastructure also faces certain obstacles that hinder its widespread implementation. Identifying barriers to the implementation of Blue-Green Infrastructure is crucial for creating sustainable and resilient cities. These barriers can come in various forms, including physical, technical, institutional, legal, regulatory, managerial, political, monetary, and social factors. Overcoming these barriers requires a multifaceted approach that involves decision makers, communities, and stakeholders working together to find innovative solutions.

The primary objective of this paper is to gain a comprehensive understanding of the significant barriers that BGI (Blue-Green Infrastructure) projects may encounter. This understanding is crucial for communities, environmental organizations, and other BGI planners to assess and prepare for potential challenges. To achieve this goal, we have developed a barrier identification framework through systematic interviews with landscape professionals and a thorough review of existing literature. In this paper, we outline the creation of this framework, acknowledging that both known and unknown barriers could impact BGI implementation and its overall potential.

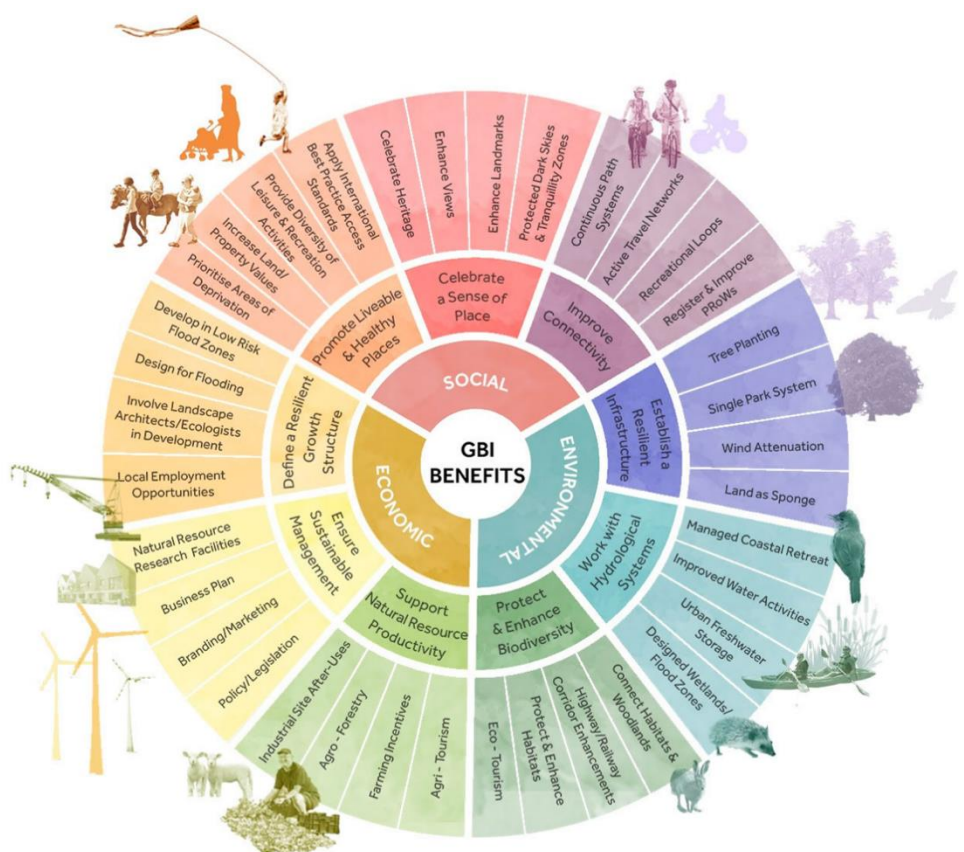


Figure 1: GBI benefits (Source: <https://in.pinterest.com/pin/480477854008623873/>)

## 2. Need of the Topic:

Blue-Green Infrastructure (BGI) is gaining significant momentum as among the most innovative and effective approaches to managing temperature change and climate change-related events. With its ability to mitigate urban heat and manage storm water, BGI has proven to be a game-changer in urban planning. However, despite its potential, many rural and urban planners are still unfamiliar with the barriers they might face while implementing BGI projects. This lack of knowledge has made some hesitant to adopt BGI solutions.

To achieve this, systematic reviews and interviews were conducted in order to build a structure and framework that will let BGI planners evaluate the most likely threats to BGI Project while implementing it on site and also throughout its lifecycle.

## 3. Aim:

To identify the barriers in implementing BGI, the case of Pune.

## 4. Scope and Limitations:

- The scope of this research includes the study of the concept of nature-based solutions as BGI. Understanding aspects of BGI in spatial, functional, environmental, and ecological ways.
- This research also includes the study of barriers to implementing BGI at sites associated with Professional Landscape Architects.

## 5. Literature Review:

- In the past decade, a number of green and blue infrastructure approaches have been put forward that are taking into account the multiple scales of landscape planning, as well as the gradients between urban and rural areas. While BGI has advanced in various aspects, there's a risk of neglecting the importance of considering different scales when we focus too much on single-scale nature-based solutions (NBS).- (Nature-based solutions as nodes of green-blue infrastructure networks: A cross-scale, co-creation approach Johannes Langemeyer a,b,\* , Francesc Baró,c,d, a)
- Blue and Green Infrastructure (BGI) as part of NBC is considered to be one of the most nature-friendly measures to manage urban flood risk. Such infrastructure can combine water management and green infrastructure to maintain natural water cycles and enhance environmental and urban renewal. BGI solutions provide a multidimensional increase in the resilience of cities to urban pressures, and for counteracting the negative effects of climate change.
- Blue and Green Infrastructure (BGI) integrated into Natural-Based Solutions (NBC) is a nature-friendly approach to urban flood risk management, combining water management and green elements to maintain natural water cycles and enhance urban renewal. BGI increases city resilience against urban challenges and climate change effects. Its popularity has grown, leading to improved urban drainage design. There's a rising demand for eco-friendly solutions that restore natural stormwater absorption and retention closer to its source. BGI's applicability is expanding, supported by growing evidence of environmental, social, and health benefits. This makes BGI an effective flood risk management tool and enhances urban public spaces, including plazas, squares, and parks, while promoting inclusivity, sustainability, and water management solutions in urban planning and design.
- (Assessment of Blue and Green Infrastructure Solutions in Shaping Urban Public Spaces—Spatial and Functional, Environmental, and Social Aspects Kinga Kimic 1,\* and Karina Ostrysz 2)



- 19 BGI solutions that act as representatives of a wide group of Urban Landscape Objects (ULOs)—the diversity of storm water retention structures and systems introduced in cities that can be used in shaping urban public spaces. The selection of cases was made based on a literature review. They include 12 BGI solutions applied on the surface, 4 applied undergrounds, and, 3 applied above the surface (see Table 1)

*Table - 01. Division of BGI solutions related to their location (Source: Author)*

<b>Location</b>	<b>Type of BGI Solution</b>
<b>on the surface</b>	runoff troughs grassed swales infiltration trenches vegetated swales (street-side) bioretention basins grassed retention and infiltration basins rain gardens wetland ponds surface water reservoirs retention and infiltration water reservoirs water squares permeable/pervious pavements
<b>underground</b>	infiltration wells infiltration boxes structural tree root cells underground water reservoirs
<b>above the surface</b>	blue roofs green roofs green walls

- Blue-green infrastructure solutions
- Runoff troughs, Grassed swales, Vegetated swales, Infiltration trenches, Bioretention basins Grassed retention and infiltration basins, rain gardens, wetland ponds, surface water reservoirs, water squares, permeable/ pervious pavements, infiltration wells, infiltration boxes, structural tree root cells, underground water reservoirs, blue roofs, green roofs, green walls
- (Assessment of Blue and Green Infrastructure Solutions in Shaping Urban Public Spaces—Spatial and Functional, Environmental, and Social Aspects Kinga Kimic 1,\* and Karina Ostrysz 2)

## 6. Methodology:

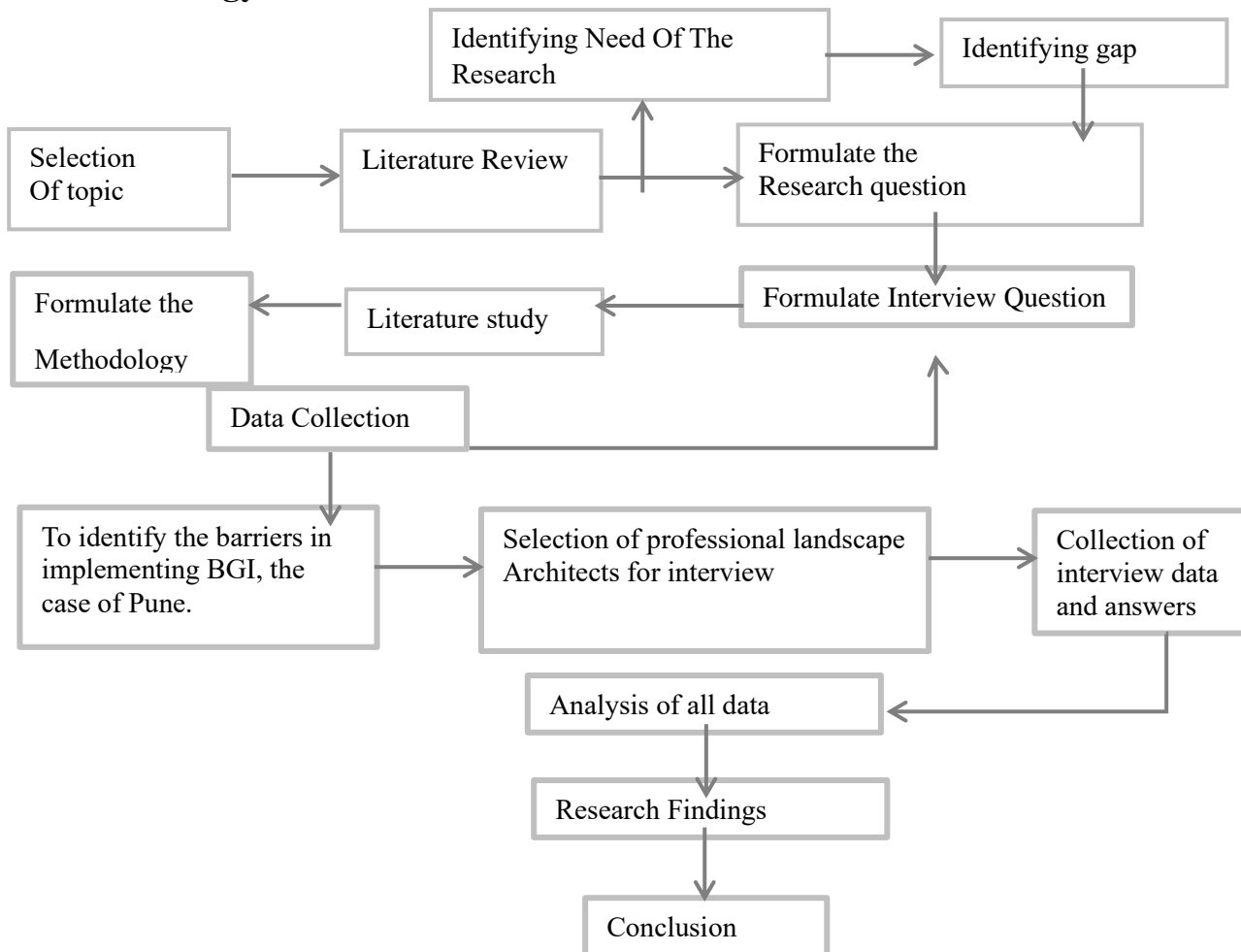


Figure 2: Methodology (Source: Author)

### Blue Green Infrastructure (BGI) And 19 Solutions Identified:

Blue-Green Infrastructure (BGI) give one all every single key mostly based on nature, resolution (Nature Based Solution) approaches to the property of management of storm water in the cities, in co-occurrence with Increasing the range of scheme Services (ES). For the primary purpose of ensuring adequate living circumstances and mitigating the adverse impacts of temperature change, the adoption or execution of BGI is essential in all methods of planning and developing highly urbanized regions. Nineteen BGI solutions that were recognized and valued in relation to the following three crucial aspects—social, environmental, and spatial and purposeful—supported the literature review. Please refer to table 01 stated above for BGI solutions. The evaluation's findings came from addressing the grading system and made it possible to identify BGI solutions with high, Enhancing the functionality and appeal of urban spaces requires a multifaceted approach to solutions. Acutely aware of the need to develop and plan in order to build the best possible BGI implementation in relation to the aforementioned components of reshaping urban public spaces, using the information provided. In terms of creating sustainable urban public places, medium or low value. A holistic approach is necessary to maximize the potential of studied BGI Solutions to enhance the functionality and appeal of urban settings.

In order to make the implementation of BGI solutions as effective as feasible in connection to the aforementioned components of creating urban public spaces, conscious planning and designing should make use of the knowledge offered.

### Blue Green Infrastructure (BGI) Barriers:

BGI can be a useful and efficient strategy in mitigating the risk of catastrophic natural disasters while simultaneously addressing the depletion of natural resources that negatively impacts ecosystem service delivery and, consequently, human well-being. But a number of obstacles may prevent BGI from being successfully implemented, which would limit its ability to address a number of urgent global environmental, social, and economic issues.

## 7. Observations and Findings :

02. Age  
20 responses

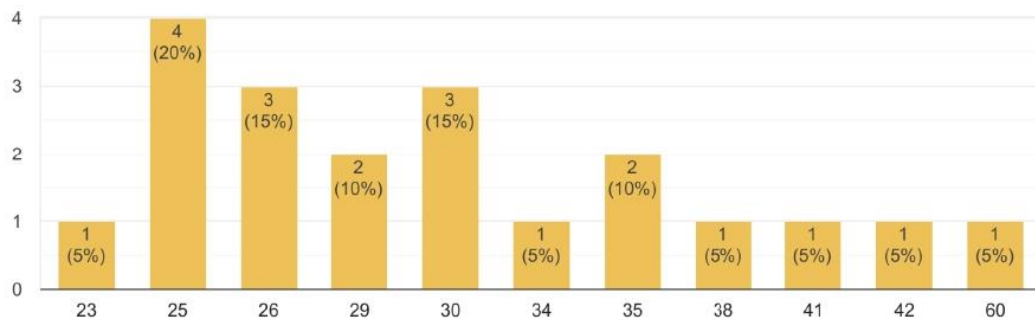


Figure 2: Age Response (Source: Author)

03. Profession  
20 responses

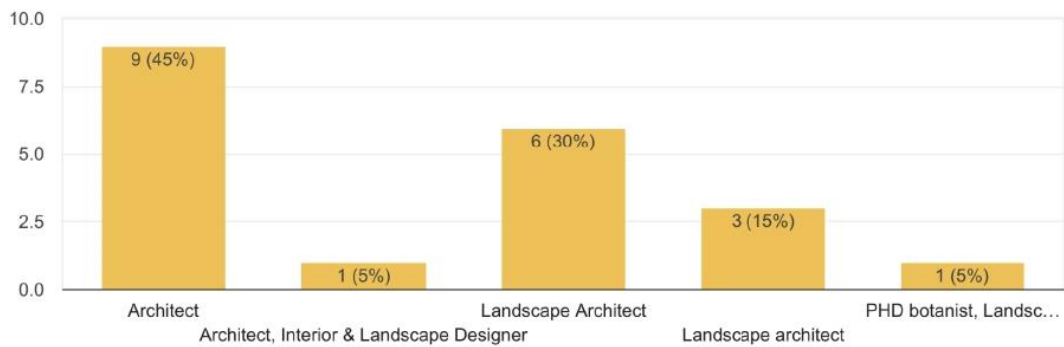


Figure 3: Profession response (Source: Author)

06. What are the aspects you chose nature based solutions for a particular site?  
7 / 20 correct responses

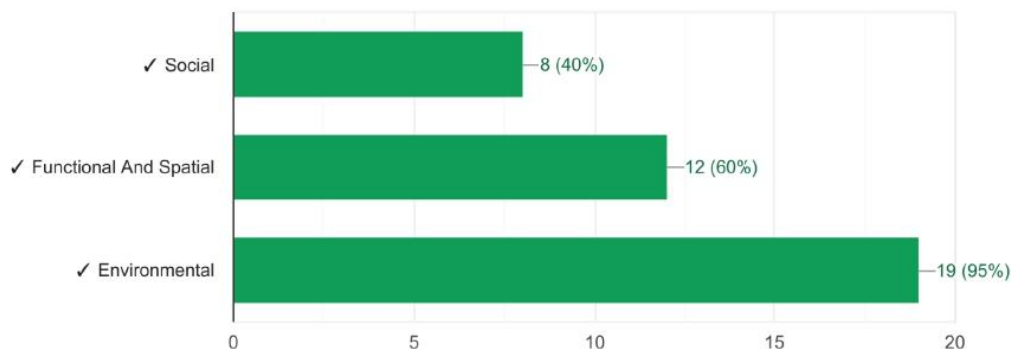


Figure 4: Nature based solutions responses (Source: Author)

Out of total interviewers/ professionals from age 20 to 30 age group people are most likely to use BGI solutions for betterment of site. About 95 % of professionals are using Environmental aspect as a key to choosing or preferring for BGI solution implementation.

07. Where do you use the nature based solutions for sustainable planning of a site (scope of site / scale of site as residential then which bungalow, appartments, if public then where) ?  
20 responses

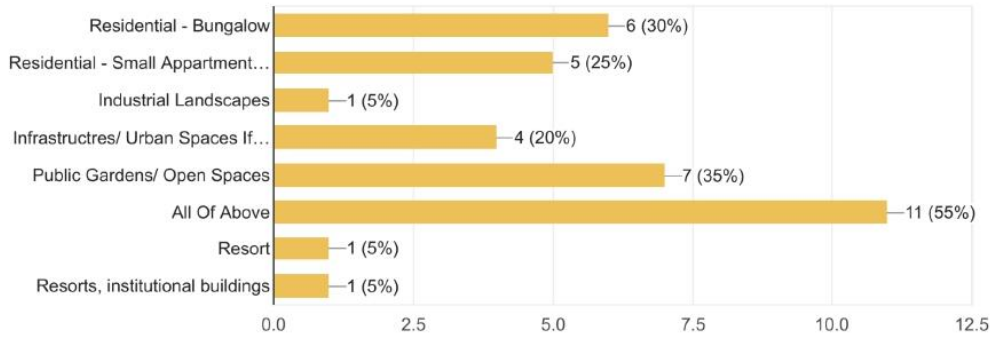


Figure 5: (Source: Author)

09. How much time a site takes to show the results of nature based solutions' effectiveness?  
20 responses

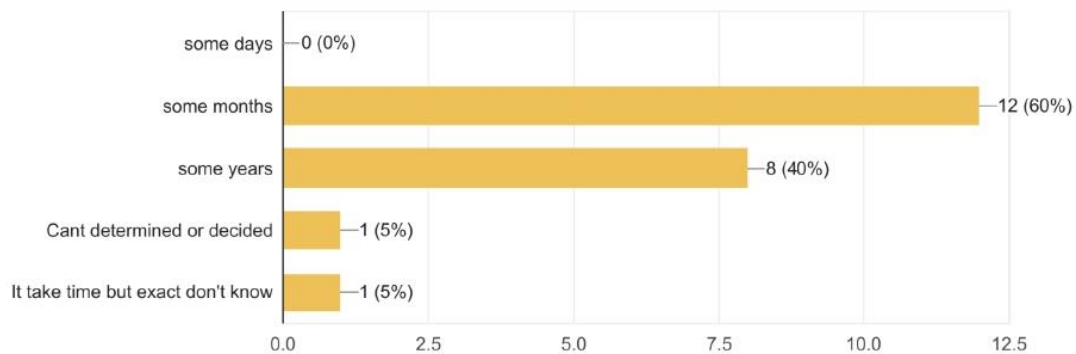


Figure 6: (Source: Author)

Out of total interviewer's/ professionals from age about 55% of the people are using BGI to all type of scales such as residential bungalow, small apartments, industrial landscapes, infrastructure, urban spaces, public gardens, resorts, institutional buildings, etc. Most used solutions by this professional are rain gardens, grassed swales, infiltration trenches, and wetland ponds, permeable / pervious pavements this helps to conclude that the scope of site or area of site can't be a barrier to blue green infrastructure implementation.

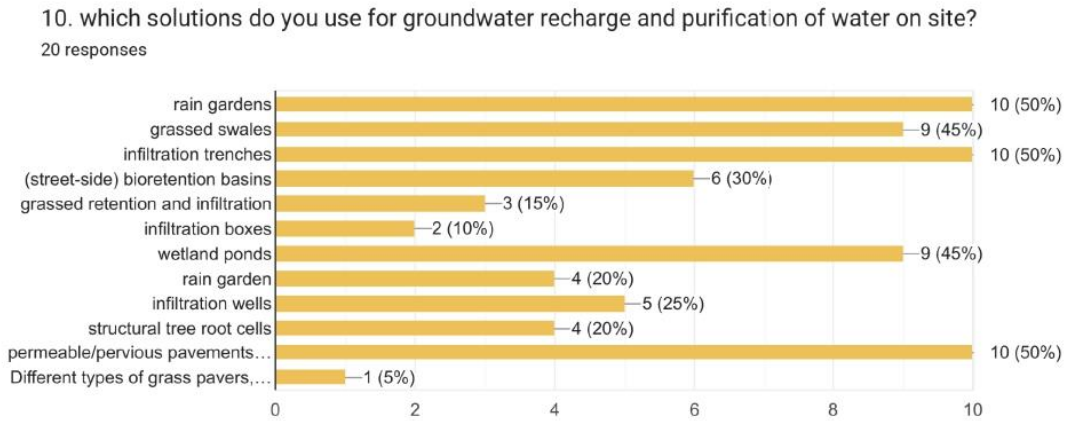


Figure 7: (Source: Author)

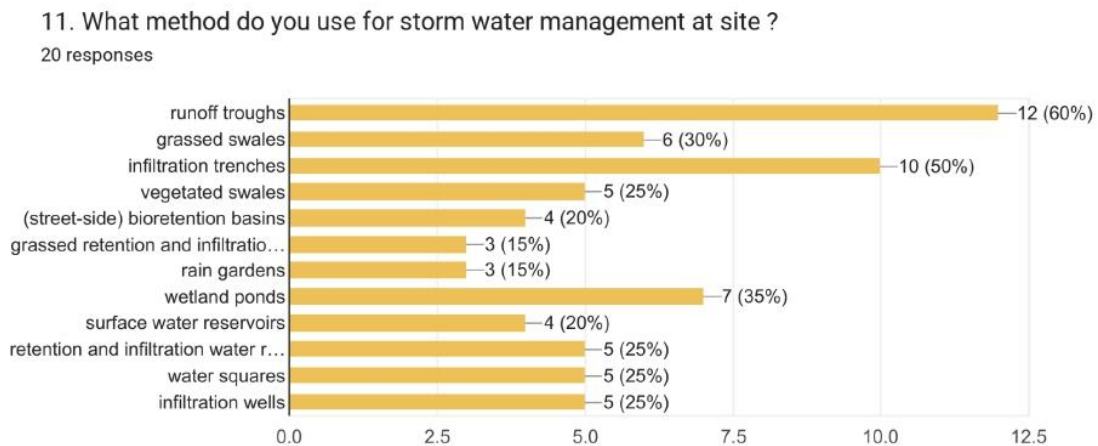


Figure 8: (Source: Author)

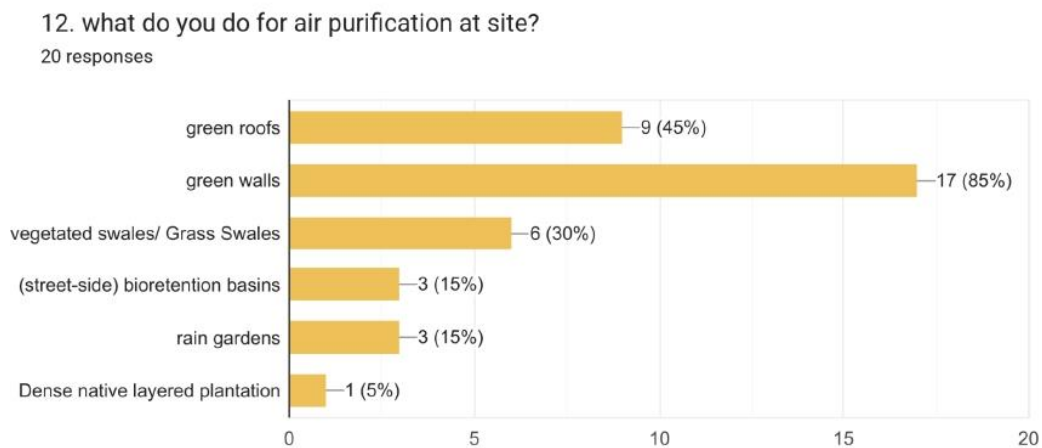


Figure 9: (Source: Author)

13. Rain water harvesting is executed? how?

20 responses

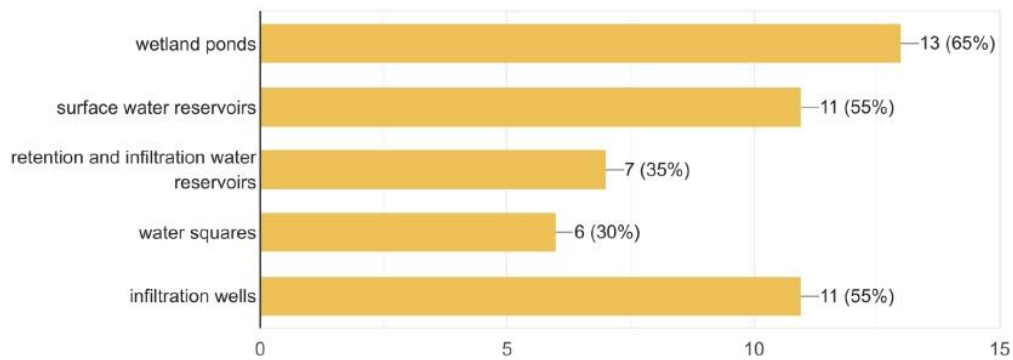


Figure 10: (Source: Author)

Out of total interviewer's/ professionals from age about 60% of the people are using runoff trough as a solution to storm water management at site other solutions are also used effectively. Green walls are the majorly used solution to air purification at site. Wetland ponds are the majorly used solution to rain water harvesting at site.

14. What are the nature based solutions you give for the increasing of green cover and effective noise absorption on site?

20 responses

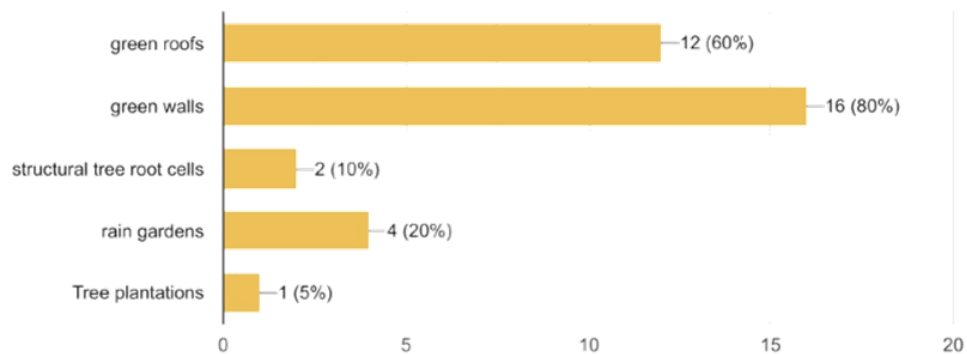


Figure 11: (Source: Author)

15. Which solutions give effective increase in the biodiversity at site?

20 responses

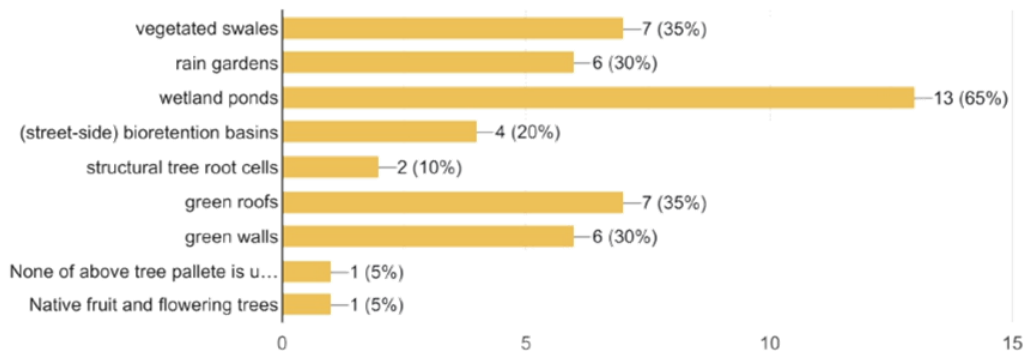


Figure 12: (Source: Author)

17. Which solution is preferred and on what selection criteria for protection and stabilization of soil on site ?

20 responses

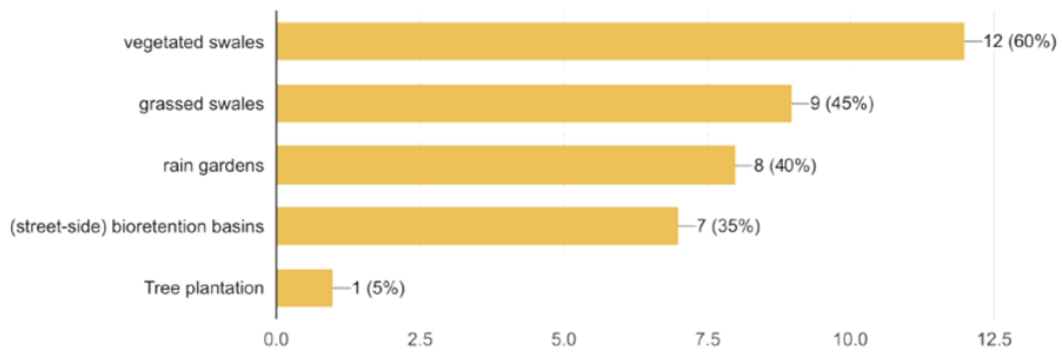


Figure 13: (Source: Author)

Green walls green roofs are the solutions used effectively for increasing green cover and noise absorption that suggests that it might be happening with high raised buildings which lack of outdoor space and overcoming this site condition professionals are choosing variety of BGI solutions. Wetland ponds is the majorly used solution to increasing biodiversity.

For soil protection professionals are mostly inclined towards vegetated swales and grassed swales.

19. What are the barriers you have experienced while implementing the nature based solutions to services at any particular site?

20 responses

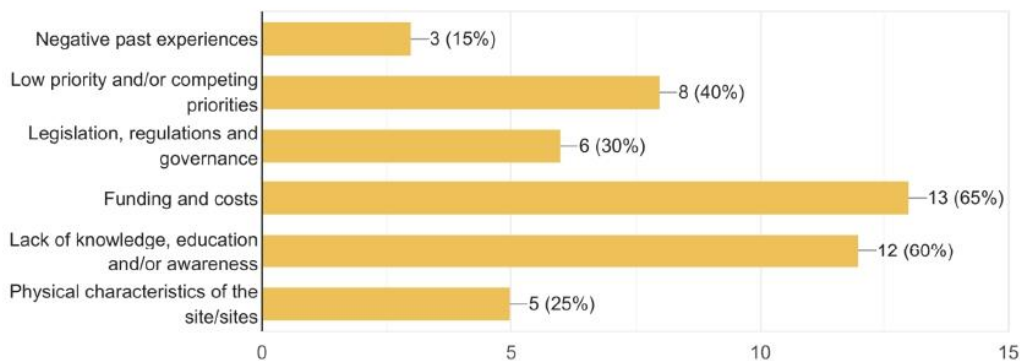


Figure 14: (Source: Author)

From the statistics we can understand that barriers identified to blue- green infrastructure BGI are more prominently funding costs , lack of knowledge, education and / or awareness, low priority and/ or competing priorities.

## 8. Key Findings:

- **Space Constraint**

Though 95% professionals are using BGI, space available on site is the main barrier identified. As we can see the most prominent BGI solutions used are blue roofs green roofs, and green walls this indicates the selection criteria is space available at/on site.

- **Client Satisfaction**

Past negative experience about the satisfaction of working of BGI Solution implemented on/at site is the barrier identified.

- **Lack of Awareness**

Lack of education, knowledge and awareness in clients is the barrier identified.

- **Cost and Maintenance**

Funding and costs are the barrier identified just because the initial cost of implementation is high as compared to the long term economics.as for maintenance skilled labours are needed leads to increased cost.

- **Aesthetics**

As the look of site after executing / implementing BGI solutions might not be as finished as other solutions. So finished site aesthetics are not appealing so a hindrance for BGI.

## 9. Conclusion:

A growing number of people are realizing that BGI works well for both mitigating climate change and climate-related incidents. BGI is still used far less commonly than conventional gray infrastructure, though. This is partly because there are a variety of obstacles that can prevent a BGI from growing. We were able to determine the obstacles to putting blue-green infrastructure into reality with the aid of this poll.

This paper presents data which gives an idea of barriers identified by professionals while implementing the BGI. The survey suggests that funding and cost and lack of education, knowledge and/or awareness is the greatest hindrance to BGI implementation. The need is to tackle these barriers. This can be achieved through giving prior knowledge to clients and helping, and educating them with BGI solutions and their effectiveness. This research can be suggested to the rest of the cities of India so that barriers faced by the professionals from different cities can be analyzed and more conclusions to the solutions of these barriers can be identified with the help of those research and it might help other professionals from different cities as each city is facing a unique and individual set of problems. And global phenomenon can be set up with respect to India using Blue-Green Infrastructure (BGI) as a solution to problems faced by the city.

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## Conflict of Interest:

The authors have no conflict of interest to declare.



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# Aligning Architectural Pedagogy with the Global and National Goals for Sustainable Rural Development

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## **Abstract:**

*Architectural works in material form leave a deep impact on socio-cultural and economic life of the people. Architecture is not only about constructing buildings but also about understanding people, their behavior and designing spaces that are inclusive, economical, sustainable and resilient, and all these factors have direct relation with the development. In these lines, the architectural academia has potential to align pedagogies with national goals. This study envisages the quantum of research work done on the relating the sustainable development with education through a bibliometric analysis. It also attempts to relate the Sustainable Development Goals (SDGs) and G-20 agenda and existing policy framework of Government of India (GoI) with a generalized content of architectural education. The future development of this research is suggested in the form of design of the framework to study and analyze the present landscape of architectural education and working out the easily implementable measures to attach the architectural academia to the developmental education.*

**Keywords:** *sustainable built environment, sustainable development, architectural pedagogies, developmental education*

## **1. Introduction:**

Prime Minister of India, Shri Narendra Modi's emphasized statement "Nation First" in his speech on the occasion of Independence Day on August 15th 2023, gives an indication to education systems to align the pedagogies with national development. The democracy encompasses enabled citizens who have intellect, voice, involvement, inclusion to foster a democratic culture (Ardito-Barletta, 1990). Education is meant to encourage people to consider their accountability for the multifaceted repercussions of their decisions and behaviour from multicultural, global, and future-focused perspectives (Bjorn Stensaker, 2011). It can contribute to national development by building of values and attitudes (Ramos & Schleicher, 2018), leadership qualities (Schweinfurt et al., 2018), and service learning ("Chapter 6," 2010) along with knowledge and skill development. Education for building up attitudes and values is something that is needed for rural development (RD) and it has been emphasized in the world education system (OECD, 2018).

Quality education is one of the SDGs 2030, and education has been considered as one of the major mediums to achieve sustainability. The key to accomplishing the SDGs is the education that can cultivate sustainable values, attitudes, and behaviours in the next generation of global citizens. The primary aim of Global Citizenship Education (GCED) is nurturing respect for all, building a sense of belonging to common humanity

and helping learners become responsible and active global citizens. UNESCO's work in this field is guided by the Education 2030 Agenda and Framework for Action. Notably Target 4.7 of the Sustainable Development Goals (SDG 4 on Education), states, "ensure that all learners are provided with the knowledge and skills to promote sustainable development, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development". Ministry of Education, GoI, has come up with NEP 2020 that focuses on holistic development of child and quality education. The inclusion of the SDG 4, is clearly visible in NEP 2020, along with the other developmental parameters. Even before commencement of NEP, the ministry had given thought to connect the rural areas with educational institutes through "Unnat Bharat Abhiyan (UBA)". Under this the higher educational institutes (HEIs) are guided to adopt five villages in the district where they are located. In this process of adoption, they are supposed to attach their academic, research or extracurricular activities with developmental aspects of the adopted villages. A number of engineering institutes have come up with the technological solutions for farming, and rural infrastructure that improve the quality of life of the villagers. The institutes depending on their area of expertise have explored the areas of contribution and have also come up with a number of innovative and implementable ideas for the rural areas (Success Stories, 2023). With this background it becomes important to investigate that "how can architectural education contribute to the sustainable development of rural areas?" In order to investigate this question, the study attempts to establish the relationship between the present development agenda (SDG 2030, G20) of RD and architectural academia (Opoku, 2016).

## **2. Need of the study:**

Over the years, experts have tried to connect the purpose of education with various kinds of development, and the development has been studied in connection with urbanization as well. In the context of India, 65% of its population and geographic area is rural. Inclusion of sizable rural villages as urban settlements in 2011 was a major factor in the increase in India's urban population between 2001 and 2011 (RADPFI Guidelines, 2016) as the population and population density had been considered as major factor in differentiating urban and rural areas. The Indian economy is proportionately developed with urbanization (Nguyen, H.M. and Nguyen, L.D. 2018). However, the development parameters defined by UNDP although are beyond the economic growth (Ravi Chopda, et al.). Hence, even if the settlements have become "Urban", the rural areas and urban agglomerations areas both lag behind in terms of a number of developmental aspects. The nation has a major challenge to deal with the sustainable developmental aspects in the growing phase of urbanization (Narayan, 2018), The remote rural areas are struggling for development (Mathur, 2014), and the rural areas near city are suffering from adverse effects of urbanization. And, these being aspect of society, culture, economy and spatial planning, can be addressed by architecture and planning education.

## **3. Methodology:**

Bibliometric analysis was used to investigate the present status of the available researches on the developmental education and alignment of sustainable developmental education with architectural academia. The commonalities of framework of SDG 2030, and G-20 agenda with the generalized content of architectural syllabus is tabulated in a matrix. This exercise was done to identify the specific potential of architectural academia to contribute towards national developmental activities, and finally the next scope of research is indicated.

#### 4. Literature review:

An exercise was done to find the research works worldwide on the similar objectives. List of journals on Scopus, and Web of Science was found out. There are 152 journals that focus on various aspects of developmental education including, cogent education, education inquiry, research in learning technology, engineering education, pedagogies and architectural academia, etc. Research works are done on these subjects, however, for this study, there was a need to filter the topics specifically on linking the architectural pedagogy for RD in India. The broader category was identified as “Sustainable Development and Architectural pedagogy”. The literature search started with the key words “Higher education and sustainable development” and then slight changes in the keywords were done to find out the overview of researches happened in the similar areas. Table 1 represents the overview of available researches on various topics in this line. After reaching till 10th row of this table, the further filters were applied based on inclusion and exclusion criteria in the available Peer-reviewed journal papers, books, papers. The included titles in the key words were “leadership development”, “Rural Development”, “Higher education”, “Architectural Education”, “Learning theories”, “Syllabus of Architectural education”, “Sustainable Design Education”, “socio-cultural”, “development, economic development”, “global citizenship”, “interdisciplinary studies”, “collaborative learning”, “need for changes in curricula”. The studies happened after year 2010 onward and of the developing countries were included. As UBA has encouraged the HIEs to establish the connection with rural areas by academic works, leadership and service learning, these key words have also kept in the inclusion criteria. The exclusion criteria were- Engineering education, any discipline other than architecture and planning, architectural pedagogy on varied topics like basic design, drafting tools, design workshops, Urban heritage and conservation, Urban design, advanced building systems, high rise structures, smart cities, urban development, online education post covid, AI VI, learning style, interior design, building performance analysis, campus design, structural system, art and design education, craft education, history of architecture, School design, Landscape design, etc. Another criterion of exclusion was the studies done in developed countries.

#### Observations of the present researches:

The architectural pedagogies in the world did focus on sustainable development, however none of such documented researches were found from India. The studies found under the title of “Sustainability in Architectural Education” focus more on sustainability aspects of stand-alone buildings and campuses. Architectural education in India is yet to touch upon the sustainable development, RD and national development. Also, the focus of documented researches from Indian academia primarily has remained limited to knowledge and skill development. Sensitization towards nation as a whole, and responsible citizenship and contributing towards it through the knowledge, skills and leadership (Kshitij & Sinha, 2017),(Stobie, 2017) (Denicke-polcher, 2020), has not been primarily considered by architectural academia in India. A number of institutes in India have attached UBA with their academic, research and extra-curricular activities, and there are research publications based on this. However, there were no studies found from architectural academia on this matter. These statistics indicate the need of inclusion of these matters in architectural academia and the following section highlights the areas through which the possibilities are explored by the author.

#### Relating the world and national agenda of RD with Architectural Education:

Focus of policy planning in India is about identification and management of resources and energy for survival and sustenance of human life (URDPFI Guidelines, 2015). As per the Ministry of Rural Development (MORD), the objectives include measures of expanding opportunities for livelihoods by building housing and infrastructure for development. The ministry aims towards enhancement of rural India's standard of life (MORD, 2023). The SDGs 2020 have direct or indirect connection with the BE. The thoughtful planning,

design, construction, operation and management of BE in the rural areas are related with sustainable development goals to a great extent. The NITI Ayog, GoI is already working on the set goals and many of them have commonalities with SDGs. Table 2 gives an overview of alignment of national goals with SDG and potential of attaching a generalized content of architectural education is identified.

*Table 1: Quantum of research works on Sustainable development and Education for Built Environment (BE Source: Web search done by the author on Google Scholar, Scopus, and Web of science in July- August 2023)*

Sr. No.	Topic	Available research works
1	Higher education for sustainable development	5120000
2	Education for rural development (in all disciplines)	5100000
3	Sustainable development of rural areas in developing countries	3710000
4	Sustainable development of rural areas in developing countries through education (in all disciplines)	3050000
5	Architectural education in India	340000
6	Higher education for developmental leadership in developing countries	1530000
7	Architectural pedagogy for rural development rural "India "(anywhere in the text)	28,100
8	Architectural pedagogy for national development (world)	198000
9	Sustainability in "architectural education"	18400
10	"Bibliometric review" education for sustainable development	16900
11	"Bibliometric review" architectural education for sustainable development	4,520
12	Architectural pedagogy for service-learning sustainable OR development OR through OR education "rural India" (anywhere in the text)	1730
13	Education for rural development (by relevance)	1040
14	Unnat Bharat Abhiyan	398
15	Built environment rural "Unnat Bharat Abhiyan"	203
16	"Architecture education", "Architectural pedagogy" service OR learning "India"	134
17	Service leaning in engineering colleges in India	100
18	"Incorporation of sustainability" "architectural education"	90
19	Allintitle: service learning in architecture	83
20	Sustainable development of rural areas in developing countries source: Scopus	82
21	International journal of education and development rural OR development "architectural education for sustainable development "	32
22	Sustainable development of rural areas in developing countries India source: Scopus	34
23	Sustainable development of rural areas in developing countries India " planning" source: Scopus	25
24	Allintitle: education for rural development in developing countries	1
25	Allintitle: higher education "leadership for development"	1
26	"Service-learning program" Unnat Bharat Abhiyan	5
27	Allintitle: architectural education for sustainable development "architectural education for sustainable development "	4
28	"Architectural pedagogy" India "rural India"	3

29	Architectural pedagogy for national development in India	0
30	Architectural pedagogy for rural development in India	0
31	Architectural pedagogy for sustainable development in India	0

Table 2: Commonalities between SDG 2030, G 20, the policies of the Indian government, and content coverage of architecture and planning Education

Sr. No.	SDG 2030	G20 (Debroy, 2023)	The Indian government department and their policies	Relation with generalized content of architecture academia
	<b>SDG 1- No poverty</b> <b>SDG 2- Zero hunger</b> <b>SDG 8– decent work and economic growth,</b> <b>SDG 9- Industry, innovation and infrastructure,</b> <b>SDG 11- Sustainable Cities and communities</b>	Both the SDGs and the G20 agenda prioritize promoting sustainable economic growth and development. They aim to reduce poverty, improve living standards, and create opportunities for all. G20 frameworks highlight the importance of inclusive and sustainable industrialization. They encourage the development and adoption of cleaner technologies, responsible business practices, and innovation to drive economic growth while minimizing negative environmental and social impacts. Infrastructure development, sustainable and resilient infrastructure investments to support economic growth, job creation, and social development.	<b>MORD, RADPFI</b> guidelines <b>Ministry of Agriculture</b> <b>Ministry of Commerce and Industries</b> Startup India, Atmanirbhar Bharat, Made in India <b>Ministry of Housing and Urban Development</b> <b>Ministry of Finance</b>	<ul style="list-style-type: none"> <li>Spatial planning of the villages to promote the economic activities through agricultural and industrial development and economic development</li> <li>Design education for cottage industries, innovations and arts, crafts and traditional occupations by providing conducive BE</li> <li>Promoting the spaces to accommodate the traditional occupations, innovations and technical upgradation of sustainable traditional methods of construction</li> </ul>
	<b>SDG 3- Good Health and Well-being</b>		<b>Ministry of Health-</b> National Health Mission, Swachh Bharat Abhiyan, <b>Ministry of Rural Development-</b> PMAY G, National Rural Water Drinking Program	<ul style="list-style-type: none"> <li>Villages, neighbourhoods and buildings offering healthy environment for human life</li> <li>Provision of BE for public health, Sports facilities, toilets, sanitation, solid waste management</li> </ul>
	<b>SDG 4- Quality Education</b> <b>SDG 10- Reduced inequalities</b> <b>SDG 5- Gender Equality</b>	G20 agenda seeks to ensure equal access to education and healthcare. G20 agenda recognize the critical role of gender equality and women's empowerment in achieving sustainable development. They seek to promote women's economic	<b>Ministry of Education</b> - NEP 2020, Sarva Shiksha Abhiyaan, Universal accessibility to education, UBA <b>Ministry of Culture</b> - Ek Bharat Shreshtha Bharat, Craft Council of India	<ul style="list-style-type: none"> <li>Designing educational infrastructure for the areas deprived of education.</li> <li>Making educational infrastructure accessible to all</li> <li>Supporting (adding up) the present</li> </ul>

		participation, address gender-based discrimination and violence, and ensure equal access to education and healthcare.	<b>Ministry of Social Justice and Empowerment-Sugamya Bharat</b> <b>Ministry of Women and Child Development</b>	<p>education system with the knowledge base that we have by converting it into a user-friendly language</p> <ul style="list-style-type: none"> <li>• Design spaces that provide equity in gender and safety to women and children</li> <li>• BE for skill building and empowerment of women</li> <li>• Design of spaces that provide equity in gender and safety to the women and children</li> </ul>
	<b>SDG 6- Clean Water and Sanitation</b>		<b>Ministry of Jalashakti,</b> Department of Water resources, River Development and Ganga Rejuvenation <b>Ministry of Health-</b> Swach Bharat Abhiyan, awards for clean cities, <b>Ministry of Housing and Poverty Alleviation-</b> PMAY G, PMAY U, SRA	<ul style="list-style-type: none"> <li>• Spatial planning for the settlements and communities along river.</li> <li>• Riverfront development in villages</li> <li>• Restoration and Rejuvenation of traditional water resources in villages</li> </ul>
	<b>SDG 7- Affordable and clean energy</b> <b>SDG 13 Climate action</b> <b>SDG 15 Life on land</b> <b>SDG 14 Life below water</b>	the urgency of addressing climate change and promoting environmental sustainability. They advocate for measures to reduce greenhouse gas emissions, promote renewable energy, conserve natural resources, and protect biodiversity.	<b>Ministry of Power,</b> Bureau of Energy Efficiency, ECBC, <b>Ministry of New and Renewable Energy Resources (MNRE)-</b> <b>Environment and forest, and State Environmental Committee,</b> GRIHA,	<ul style="list-style-type: none"> <li>• Site planning to accommodate passive strategies of climate conditioning and reduced energy requirements.</li> <li>• Building designs to be climate responsive and reduced energy consumption. Building integrated energy generation system and less dependency on grid for power supply.</li> </ul>

## 5. Findings and discussions

The exposure about programs run by various ministries of GoI can be considered in the architectural pedagogy, as these programs have a number of common points with the BE. In order to align the SDGs and rural development aspects with architectural academia, the issues of the rural development can be framed in the form of exploratory studies with introduction to the context of the issue and government policy's framework. For example, Industry, Innovation and Infrastructure are connected with circular economies, and the knowledge of building construction materials and technologies can be shared with this background. And in these lines the design education can also emphasize on design of the structure that have application of these materials and technologies. Similarly, all these contexts can be introduced in various parts of syllabus teaching. The present documented studies do not include cases of Indian architectural education having focus on rural sustainable development, but there are numerous studies available from the other developing countries, which can be good sources of information and guidelines for the next investigations in the present education system. This paper indicates the possibility of integrating the context of development with a generalized content of architectural academia. However, the nation is diverse. There are more than 471 colleges of architecture that follow various syllabi (Counc. Archit., 2023). And hence the syllabus and academic scenario of all these universities will have to be looked upon in the designed framework. This study opens up a clue for the next investigation, i.e., designing of an analytic framework to study the present architectural academia and finding out the possibilities where this sector of education be efficiently linked with the national agenda of rural development.

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# 06

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## **TRACK 6: BUILT ENVIRONMENT AND ECOLOGY**

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# Investigating diversified role of urban forests in Smart Cities Mission

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## Abstract:

*Trees and green spaces are important for improving the living conditions in cities. The smart city mission (SCM) promotes clean and sustainable development. Urban green cover in smart cities not only includes planting trees for beautification, but is diversified by adopting biological measures as innovative environmental engineering solutions in infrastructure development. The study aims to investigate the connection between the themes in the planning of smart city and suggests appropriate smart environmental engineering solutions (nature based), which will foster the development of urban forest and mitigate the stress in the city climate. The paper follows a review based approach. Understanding of urban forest is developed through literature review and case study. The study of the existing policy framework of the SCM, adopted for mitigating climate, is done to correlate and integrate the urban green cover and the various nature based solutions that can be used for effective smart city planning. Each indicator of the smart city has a component of urban green embedded in it, if one adopts the green engineering measure to fulfil it. Integrating green solutions with existing infrastructures results in increasing the urban green cover which is in a devalued state today. The findings will contribute to broadening the knowledge base for urban planners, policymakers, and environmental engineers, facilitating the creation of greener, healthier, and more resilient cities. The scope of study is limited to the urban green cover and smart city mission framework. The benefits of urban forest are manifold. When urban forest is placed at the highest priority in design and management of urban areas, the green infrastructure developed will provide a range of ecosystem services and protect biodiversity in urban settings. The urban green spaces offer opportunities for a wide range of activities, help to foster active healthy lifestyles, and contribute to social interaction by creating opportunities for people of all ages to interact.*

**Keywords:** urban forest; smart city framework; green infrastructure, environmental engineering solutions.

## 1. Introduction:

### a. Background

The world is being increasingly urbanised. Based on the future projections, the present millennium may rightly be termed as the urban millennium. (Chaudhry & Tewari, 2010, 625-634). As per National Census 2011, Maharashtra has the highest urban population in India of more than 5 crore — the highest among any state. Urban population in the state is rising at about 10 lakh per annum, and it was envisioned that by the 2022 almost half of Maharashtra's population of about 13 crore would be urbanized.(KPMG, 2011)

The consistent rise in population recorded in the past and the projections indicating more influx of population to the urban areas, the government of Maharashtra has considered this factor and allocated 3.8% of its total expenditure in the annual financial budget 2023-24, towards urban development (Maharashtra Budget, 2023-24).

The cities face complex infrastructure challenges and environmental degradation due to rapid urbanisation and climate change risks. Therefore, it is imperative that cities undertake sustained actions to prepare for and develop their ability to thrive in the changing environment. (Cities Readiness Report, 2021)

It is imperative for cities in the state to manage urbanisation well, to achieve their full potential on three important fronts – liveability, economic-ability and sustainability (Making a City Smart, 2021). With the developmental challenges that the cities are facing, the government of India launched the SMART city mission under the ministry of housing and urban affairs(MoHUA), in 2015, to lay guidelines for holistic city development and a comprehensive and sustainable infrastructure.

Studies have worked on the convergence between Sustainable Development Goals (SDGs) and the development of Smart Cities. SDG 11 aims to, “Make cities and human settlements inclusive, safe, resilient and sustainable”. The SDGs represent a major multilateral effort to shift the stakeholders’ attention toward more sustainable and resilient pathways to growth and development (Anna Visvizi et al., 2021).

## **2. Understanding the Smart City Mission (SCM):**

The objective of the Mission is to promote cities that provide core infrastructure, clean and sustainable environment and give a decent quality of life to their citizens through the application of ‘smart solutions’.

The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a lighthouse to other aspiring cities. The core infrastructure elements in a Smart City would include:

- i. adequate water supply,
- ii. Assured electricity supply,
- iii. Sanitation, including solid waste management,
- iv. Efficient urban mobility and public transport,
- v. affordable housing, especially for the poor,
- vi. Robust IT connectivity and digitalization,
- vii. Good governance, especially e-Governance and citizen participation,
- viii. Sustainable environment,
- ix. Safety and security of citizens, particularly women, children and the elderly, and
- x. Health and education. (Smart Cities Mission Statement & Guidelines, 2015)

A unique feature about the smart city mission is the competitive approach adopted for selection. Each city aspiring to be in the SCM had to send proposals stating their intent and action plan for the same. The innovative approach adopted by cities for smart and sustainable development is considered for selection. With this process Maharashtra has 8 no. of declared smart cities, which are Solapur, Nagpur, Pune, Nashik, Thane, Aurangabad, Kalyan-Dombivali, Pimpri-Chinchwad. SCM has the potential to transform the way cities are managed in India. It makes cities more liveable, sustainable, and prosperous.

### **a. Climate Smart Cities Assessment Framework:**

The diverse elements included in the SCM need a unique measuring and assessing system which will have varied parameters .The smart city mission considers a sustainable environment in the city as one of its core infrastructure elements. With a vision to build climate actions in cities, The National Institute of Urban Affairs (NIUA) with support from the MoHUA has established the Climate Centre for Cities (C<sup>3</sup>). C<sup>3</sup> is an assessment Framework that aims to support cities in driving climate actions. It is a first-of-its- kind self-assessment framework on climate-relevant parameters with an intent to provide a roadmap to Indian cities towards mainstreaming climate actions within current and future policies, programs and projects. ClimateSmart Cities Assessment Framework (CSCAF) was formulated with focus on indicators across 5 sectors: (See Figure 1)

1. Energy and Green Buildings;
2. Urban Planning, Biodiversity and Green Cover;



Urban Planning, Green Cover and Biodiversity	Energy and Green Buildings	Mobility and Air Quality.	Water Management	Waste Management.
Rejuvenation and Conservation of Water Bodies and Open Areas	Electricity Consumption of the City	Clean Technologies Shared Vehicles	Water Resources Management	Waste Minimization Initiatives Undertaken by the City
Proportion of Green Cover	Total Electrical Energy in the City Derived from Renewable Sources	Availability of Public Transport	Extent of Non-Revenue Water	Extent of Dry Waste Recovered & Recycled
Urban Biodiversity	Fossil Fuel Consumption in the City	Percentage of coverage of Non-Motorized Transport (NMT) network (pedestrian and bicycle) in the city	Extent of Non-Revenue Water	Construction & Demolition (C&D) Waste Management
Disaster Resilience	Energy Efficient Street Lighting in the City	Level of Air Pollution (Monitoring)	Flood / Water Stagnation Risk Management	Extent of Wet Waste Processed
City Climate Action Plan	Promotion of Green Buildings	Clean Air Action Plan (Planning and Implementation)	Energy-Efficient Water Supply System	Scientific Landfill Availability & Operations
	Green Building Adoption		Energy-Efficient Wastewater Management System	Landfill/ Dumpsite Scientific Remediation

Table 2: Table showing 5 sectors of CSCAF and the highlighted cells indicate the possible sub indicators where a/n environmental solution could be adopted during planning. (Source: Compiled by authors)

The first Indicator, Urban Planning, green cover and biodiversity is directly related to the amount of green cover, urban forest cover in the city.

Table 1 indicates that sincere efforts and consistency in planning will be required for Urban Planning, Biodiversity and Green Cover. The research paper is primarily focussing on finding the potential to achieve more green cover in the urban planning process. These green covers are also termed as urban forests.

### 3. Urban Forest:

Urban parks and gardens (or urban forests) can rightly be called as green infrastructures that are responsible for various environmental, social and educational benefits to human society. (Chaudhary, Pradeep & Tewari, V.,2010) In broader terms, urban forests are regarded as the entire forest area influenced by the urban population. In a more restricted sense, urban forestry relates to trees and woodlands and emerging woodlands on vacant and derelict land. (Kuchelmeister, G.,2000) Urban forests thus include a number of environs such as green belts, parks and gardens, zoological parks, forest reserves, commercial and industrial green belts, avenues and boulevards.

### 3.1 Benefits of Urban Forest:

#### 3.1.1 Environmental Benefits:

1. **Cleaning of air:** Plants help in removal of pollutants from the air, they are effective sinks for pollution. A 30 m belt of trees has been found to intercept almost all dust in the air. (Kuchelmeister, G., 2000)
2. **Reduction in air temperature:** Trees, shrubs and other vegetation help to control temperature extremes in urban environment by modifying solar radiation
3. **Noise Reduction:** Trees help both by absorbing and refracting or dissipating noise such as that produced by the heavy vehicular traffic.
4. **Water Conservation :** Urban forests help in the protection of water supply, wastewater treatment and storm water management. Reusing city wastewater not only recharges aquifers but also reduces the demand exerted on scarce water reserves
5. **Soil conservation:** Trees, shrubs, herbs and climbers are very helpful in soil conservation and in preventing landslides in fragile ecosystems involving steep-terrain, lesser-vegetation and heavy seasonal rains, thereby reducing the vagaries of human settlements (Brown WJ., 1991)

#### 3.1.2 Social Benefits:

1. **Aesthetic quality improvement:** It is the aesthetic and recreational value of trees, forests and parks that is directly identified by most urban dwellers in the developing and developed countries alike. Trees fulfil certain psychological, social and cultural needs of the people (Dwyer JF, Schroeder HW and Gobster PH., 1991).
2. **Employment:** Tree planting, especially in urban parks/gardens and boulevards, can be labour-intensive and provide work opportunities for local people
3. **Education:** Easily accessible trees, shrubs and woodlands act as a vital resource for both formal and informal learning.
4. **Recreation:** Urban parks and gardens greatly enhance outdoor recreation.

The 74th Amendment of the Indian Constitution in 1992 envisages urban forestry, protection of the environment and promotion of ecological aspects as legitimate responsibilities of the elected urban local bodies. The subject of urban forestry has been envisaged as the responsibility of the municipal authorities. (Chaudhary, Pradeep & Tewari, V.,2010)

## 4. Case study of Nashik:

Nashik being at the crossroads of urban transformation, the city has a unique opportunity to cater to sustainable and resilient development. A total of 267.48 Sq.km of area is under the Nashik Municipal Corporation(NMC) administrative jurisdiction. According to the 2011 census NMC population is 14,86,053 people.



Figure 2: Map of Nashik city showing the 6 divisions. (Source:NMC Web GIS)

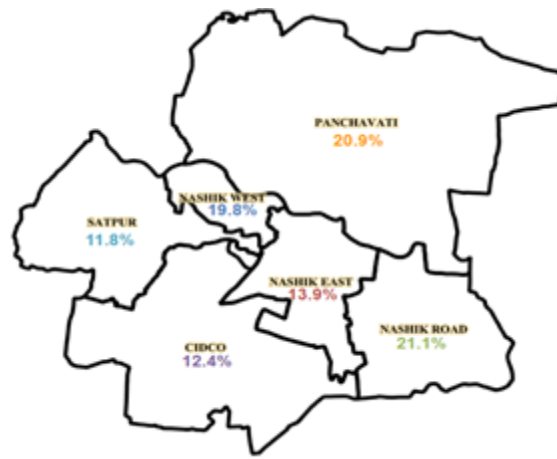


Figure 3: Map showing division wise green spaces (Source: Compiled by authors)

Name of division	Total Area (Acres)	Green Area (Acres)	(Green area/ Total area) x 100(in percent)
Panchavati	27062.98	69	0.25%
Nashik Road	7969.14	69.5	0.87%
Satpur	8777.18	39	0.44%
Cidco	14411.18	41	0.28%
Nashik East	5920.39	46	0.77%
Nashik West	2288.2	65.5	2.86%

Table 3: Percentage of green covers area wise. (Source: Compiled by authors)

The Garden Report published by NMC, states that a total of 330 acres of land is under parks and gardens. This area is divided among 429 small and big gardens. A majority of these gardens are developed and maintained by the NMC.

Nashik west region has a maximum which is close to 3%, area under gardens with respect to the total division area. This is because the Nashik Right Bank Canal is reclaimed in certain parts and converted into a jogging track. Photograph 1 shows the views of reclaimed canals as jogging tracks.



Figure 4: Nashik Right Bank Canal



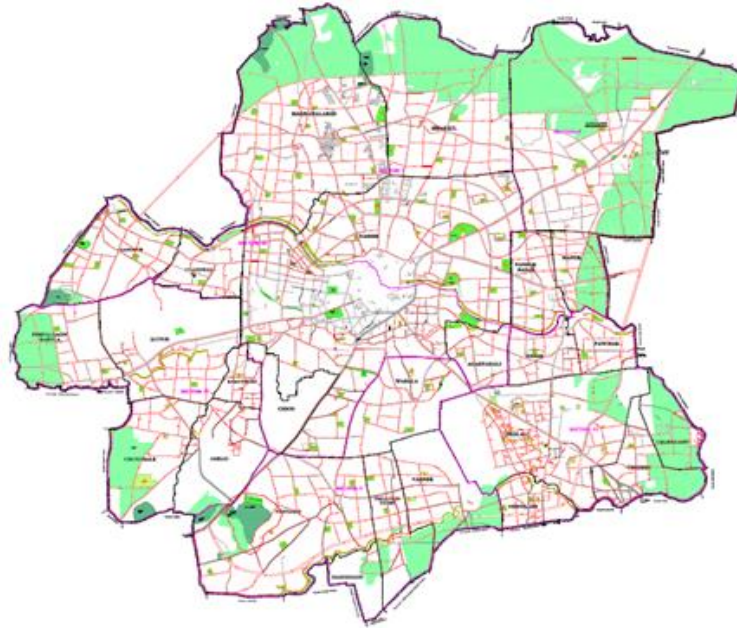


Figure 5: Map of Nashik showing area under Gardens and Playgrounds, Green belt, Forest and Agriculture. (Source: Draft Revised Development Plan, Nashik)

It is observed from the above Map 3 that agricultural areas are still retained at the periphery of the city. But the area under garden spaces in the city limits is comparatively low. Only 0.49% of the city area is under planned garden cover. “The smart city challenge Stage 2” proposal claims that Nashik has about 40% of the land green and is strategically located which includes the agricultural areas. The authors have observed that out of 40% greens, the agricultural cultivation within city limits is 33%. The actual developed urban green for gardens and the plantations around the main road network and the colony park form the remaining 7% of the green cover. URDPFI guidelines recommend 1.2 to 1.4 Ha of green space per 1,000 population. According to which Nashik city should have 1,783 Ha of green cover based on the 2011 census population. Currently Nashik city has 133.5 Ha of land under green cover, excluding agriculture area.

According to the World Health Organization (WHO), each city is recommended to provide a minimum of 9 sq.m. per capita of accessible, safe and functional urban green space. The Urban Regional Development Plans Formulation and Implementation (URDPFI) guidelines, 2014 recommend 10 to 12 sq.m. of open space per person. Chennai and Pune have a meagre 0.81 sq.m per capita and 1.4 sq.m. per capita of green cover, respectively (Anshul A ,2022, February 12). The available green space in Nashik per person is 0.7 sq.m. per capita, this alarmingly low that the prescribed international and national standards.

#### a. Potential of increasing the green cover area in Nashik:

There is a complex network of canals and rivers going through Nashik city. These canals are the natural drains of the city. Natural slopes of the topography direct the rain water to these canals, where rainwater can be collected and percolated by developing certain details such as green pavers, bioswales to retain the surface runoff. Rainwater runoff comes with a good amount of silt carried by the water which is deposited on these canal lands. As a result, these canals are fertile grounds for vegetation. The Nashik municipal corporation has taken efforts to convert these canals into jogging tracks. These jogging tracks and cycle tracks act as lungs of the city, giving the city the much-needed green infrastructure as well as a place of respite for the citizens, providing a 3-fold benefit of environmental, social and psychological. But the full potential of the canals is not utilised.



Figure 6: Canal network in Nashik. (Source:NMC Web GIS)

There are 3 main canals in Nashik namely a. Nashik Right Bank Canal b.Nashik Left Bank Canal c. Alandi Canal (See Map 4).

The Canal ‘a’ (Nashik Right Bank Canal) is 32 km in length. Out of which some part is reclaimed and converted into a jogging track. If the other canals also developed smartly more green cover could be developed.

Road side plantation and the plantation at the road divider is not considered under the plantation area under the garden. These divider plantations and roadside plantations are potentials for further increasing the green cover in the city. The Arterial, Sub arterial and collector roads have a potential to either have planned road side plantation or divider plantation (See Map 5). This is a potential for increasing green cover in the city. These plantations serve not only to shade but to mitigate air pollution, sequester carbon, and reduce heat island effect.



Figure 7 : Road network in Nashik.(Source: Comprehensive traffic & transportation plan for Nashik, 2017)

## 5. Environmental Solutions / Nature based solution:

The UN Report for the G20 Italian presidency defines nature based solutions as a collective term that has come to describe intervention, to benefit human wellbeing and simultaneously support urban biodiversity. It encompasses a range of established approaches like ecosystem based adaptation, ecosystem based management , green infrastructure solutions, blue green infrastructure as well as ecosystem based disaster

management . Nature based solutions are essentially interventions like forest, wetland, green belts and parks in and around cities, green infra like natural wastewater plants, green roof, green walls, etc. They are often low tech and low-cost solutions that create jobs for local communities besides providing a range of direct and indirect benefits in terms of the ecosystem services, climate adaptation and mitigation. Fig 2 shows the opportunities offered by Nature Based Solutions in Cities.

Urban green spaces, such as parks, gardens, and trees, provide a variety of ecosystem services to humans and the environment. When we look into the urban forest as a whole, we find that there is no definite way to call “The urban green’ ’they change with time and the different conditions that each setting presents. Given a wide variety of purposes for which the urban forest landscape may be created, they offer great flexibility and opportunities for innovative solutions (Gordon A.Bradley, 1995, Urban Forest landscape)

**Green roofs:** Green roofs are roofs that are partially or completely covered with vegetation. They can help to reduce stormwater runoff, improve air quality, and insulate buildings, which can save energy.

**Rainwater harvesting:** Rainwater harvesting is the collection and storage of rainwater for later use. It can help to reduce the demand for drinking water and can also be used for irrigation and other purposes.



Figure 8: Nature based solutions opportunities.  
(Source: IUCN’s Guidance for using the global IUCN NBS standards)

**Trees:** Trees provide shade, which can help to reduce the urban heat island effect. They also absorb pollutants and carbon dioxide, and they can help to improve air quality.

**Parks and green spaces:** Parks and green spaces provide places for people to relax and enjoy nature. They can also help to improve air quality and reduce noise pollution.

**Biodiversity corridors:** Nashik city is surrounded by the hills and forest area-such as Anjaneri hills, Borgad, Ramshej which are a biodiversity hub. Biodiversity corridors are networks of natural areas that connect different ecosystems. They can help to facilitate the movement of wildlife and can also help to improve air quality and reduce noise pollution.

**Blue-green infrastructure:** Blue-green infrastructure is a term used to describe the use of water bodies and vegetation to provide ecosystem services. It can include things like wetlands, floodplains, and urban forests.

**Sustainable agriculture:** Sustainable agriculture is a way of farming that minimizes the negative impacts on the environment. It can include things like cover cropping, crop rotation, and integrated pest management.

**Water-sensitive urban design:** Water-sensitive urban design is a way of planning and designing cities that takes water into account. It can include things like green roofs, rainwater harvesting, and permeable pavement.

## 6. Conclusion:

Nature based solutions bring mitigation and adaptation on the same page. Has more benefits than standalone engineering based solutions. The study of SCM clearly points to adoption of green blue solutions which will result in an increase of the urban greens. The ecosystem services benefits of urban forest such as increase in the employment by creation of jobs in the sector of plantation maintenance nursery etc can be a means of livelihood. Organic farming techniques such as permaculture, aquaponics, vertical gardening has started gaining popularity and has come up with a possible alternative to food production.

SCM can provide certain standard sections incorporating greens which can be adopted within the built and unbuilt framework to accommodate in neighbourhood or buildings to foster the vertical farming and water retention for absorption at various places in the parks, jogging tracks planned across the city. The paper points out the complex view of urban forest with the ecosystem services which involve the other parameters of smartness such as green building adoption cleaner action plan. When urban forest is placed at the highest priority in design and management of urban areas , the green infrastructure developed will provide a range of ecosystem services and protect biodiversity in urban settings.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Response to Context in Architecture of Resorts: A Study of Selected Resorts in Maharashtra

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## **Abstract:**

*Places having a unique context have potential to be developed and promoted as a resort for attracting tourists. These places range from natural landscape settings such as beaches, hills, forests or cultural landscape settings like pilgrimage places, historical cities and so on. Resorts typically offer a range of amenities, including accommodations, food and beverage services, recreational facilities. In the 20th century, the idea of the experience of travel expanded to different contexts, where architecture and landscape play a fundamental role in building the tourist's imagery and localized experience of stay. Context of the site setting such as the climate, nature, local architecture, culture, are part of tourist experience and its reflection in architecture can enhance the tourist experience. The literature provides an overview of the theories that deal with the ideas of context, Contextualism, whereas integration of architecture into the context as evaluation criteria is claimed to be subjective and hardly validated. Thus the paper aims at identifying the responses to context in the design of resort by selecting published resort projects in India. The study is designed on a multiple case study research by selecting cases of holiday resorts situated in diverse geographical contexts. The paper limits itself to secondary data mined from publications, websites, blogs etc. The paper presents a framework of analysis for relationship between 'context' & 'architectural response' in resort buildings. Further it identifies dominant ways of expression of context.*

**Keywords:** *tourist experience; site; contextualism*

## **1. Introduction:**

In architecture, the term "response to context" refers to the process of creating structures and interior environments that are sensitive to and responsive to their surroundings while considering various contextual elements (Capon, 1999). The context is the collection of circumstances and/or facts that surround a situation or state. Additionally, it refers to the circumstances in which something occurs. Topography, vegetation, the urban localness, the type and arrangement of local materials, the geography of the area, people living there, and other factors can all be included (Sara Amirshkari, 2014). There are many distinct ways in which architecture and context interact (Çizgen, 2012). Context of the built form is defined by (Ahmed, 2013) in her work as the integration of unique social and environmental values and processes into the built form within the current global paradigm. In the definition of Contextualism, (Beaver, 2006) relates the idea to the local environment's physical attributes as well as its cultural and temporal characteristics. He further states that design should be handled within the framework of local thought in a modern and contemporary manner. This framework is particularly significant in the context of resorts, which are frequently located in unique and attractive settings and aim to provide tourists experiences they won't soon forget. As the idea of the experience of travel in 20th century expanded to different contexts, it is the need for Architecture and landscape to play a fundamental role in building the tourist's imagery and localized experience of travel (Susana Lobo, 2016). The

'modern resorts' are considered to be destinations where visitors should be able to have "unique experiences that are lacking and missed in normal life" (Franklin, 2004). Thus this paper aims to derive a framework for investigating response to context in resort architecture in Maharashtra.

**Aim & Objectives:** The study aims to identify the design approaches that respond to the context in which the resorts are built. There are three main objectives for this study:

The first objective is to thoroughly grasp the architectural principles of resort with focus on response to context. Examining how architectural projects could fit naturally within their environment involves taking into account elements including the physical and cultural factors of the context. Secondly, the research intends to critically assess how well each resort has responded to its context. Thirdly, the study wants to determine which aspects of context are dominantly responded to while creating the unique tourist experience.

## 2. Literature Review:

The literature reviewed falls in two categories & a concise summary has been added here. The first group of literature is about the definitions of Resort Architecture, Contextual design, and their Relationship with each other.

**Resorts:** are a type of tourism service that offers at least five different kinds of amenities, including lodging, food and beverage services, entertainment, retail establishments, and recreational facilities. Couples, families, honeymooners, and individuals make up the market for resort businesses (O'Shannessy, 2001). The credibility of resorts is determined by the attributes or characteristics a destination has to offer to enhance the way the tourists think, believe and act (Harhoff, 2018).

**Contextual design:** is an approach to architecture that considers both the tangible and intangible characteristics of the site. Every site, location, or place is unique in terms of the features that make it unique. These features can be determined, analysed and considered in the design to integrate them within context. The derived Architectural design will not only be compatible with the surrounding, but will also take into account the changes that need to be made for betterment of any new development (Liauw, 2019)

**Theoretical Underpinnings:** The literature provides an overview of the theories that deal with the local distinctiveness of urban space and urban built form. The theory of place making (Knox, 2011) (G.B Watson, 2007) (Lynch, 1972) and place identity (Relph, 1976) are helpful in resolving the disagreements between the global and the vernacular, as well as in understanding the idea of local. The theory of critical regionalism acknowledges the importance of context while also questioning the idea that architecture should be bound by a specific regional or cultural identity. Critical regionalist architects may use local materials or techniques, but they also seek to create buildings that are innovative and push boundaries (Frampton, 2002). (Sanyam Bahga, 2018) in his article says that in contemporary India, resort hotels located in diverse remote locations are becoming more critical regionalism oriented. The study of situated regionalism refers to a design strategy that aims to address a location from the perspective of its local residents' concerns and values as well as the important dynamics of place. It considers the built environment as a component of human and environmental systems, rather than just as a collection of discrete form-types, plan-types, or design elements (Heath, 2009). (Ackerman, 1980) in his article stresses upon the experience of the culture, personal experience with the locale and experience of the environment, concerning the level of experience involved in designing with the Dynamics of the place. The theories on neo-vernacular architecture (Yamini Rajpu, 2020) refer to an application of existing architectural elements, both physical (form, construction) and non-physical (concept, philosophy, spatial) with the aim of preserving traditional elements and settings which may have undergone a little change to a more modern or advanced work without overriding the values of local culture. (Beaver, 2006) argues that designing in reference to the context has existed for a long time.

**Gap identified from the literature study:** In practice, Architects tend to respond to context and recreate or create a new manufactured and marketed sense of place. It is necessary to further investigate the already designed architectural solutions to identify the gap between image creation and social environmental

significance. An examination of the Architectural projects (Resorts) could help to evaluate the responsiveness of design to the regional context (Czalczyńska-Podolska, 2021).

### 3. Methodology:

**Criteria for selecting the resort case studies:** The study is designed as a multiple case study research by selecting cases of holiday resorts situated in diverse geographical contexts in India in the state of Maharashtra, based on popularity index from a social platform of 'trip adviser' (Tripadvisor). The most popular resorts with varied contextual backgrounds & locations have been selected for the study. The ratings given by the tourist are not necessarily for architecture of the resorts but locational aspects are of importance in these ratings. Thus it is interesting to find out the architectural responses to the locational aspects.

**Data collection method:** The paper limits itself to the visual content analysis of architecture, from the secondary data such as photographs, tourist reviews mined from publications, resort websites, blogs etc. These documents can provide insights into the overall understanding of the case study. Site plan, locational characteristics are studied using google map images (Google maps).

**Method of analysis and interpretation of the collected data:** The resort sample is analysed to understand how each resort design addresses its unique context. Study of its physical environment, surroundings and interaction with the context, observing the architectural elements, design features, materials used, spatial layout, and how they relate to the natural, cultural, and social context is done. The method also includes assessment of the factors such as landscape integration, climate responsiveness, views, and historical & cultural references. Researchers have tried to use a framework, essential for the analysis of case studies to enhance the quality and depth of analysis & promote continuous learning and improvement. (Ahmed, 2013) in her paper suggests one such framework for architectural case study analysis for understanding the dimension of context addressed by various design components.

**Comparative analysis:** The selected resorts are then grouped based on their response to context. The similarities and differences in architectural strategies, design elements, and contextual integration are documented by creating a structured framework or matrix to present the findings systematically.

### 4. Case Study:

Table 1: List of Resorts (Source: Author)

	Name	Location: Landscape Context	Area & No of occupancy rooms, Facilities
1	Resort 1	Chimur Town, near Nagpur, 1.5 km from the Kolara Gate of Tadoba, Forest	The resort features 26 tastefully designed individual cottages, 3 F & B outlets (a multi-cuisine restaurant, outdoor dining, and Bar), swimming pool, landscaped gardens, kids play area, spa and 2600 sq. ft. conference/banquet hall.
2	Resort 2	Igatpuri, Rural, Hill	Sprawled across 8.5 acres of land with 63 luxurious guest rooms, inclusion of adventure activities such as Burma Bridge, Commando Bridge, Zippy Zip & Multiple Strings
3	Resort 3	Karjat, Hill	49 rooms with the vast meandering pool, the infinity pool, extensive amenities like banquet, spa, restaurants and indoor games
4	Resort 4	Jambulane, Forest	Set on 25 acres with Treehouses, cottages and villas with aprx. 4km walkway









5	Resort 5	Matheran, Forest, Hill	It's a chain of hotels with Matheran branch having 42 lavish rooms with other facilities like a multipurpose hall, restaurant, a swimming pool, wellness spa and adventure activities
6	Resort 6	Alibaug Coastal	It sprawls over a 12 acre of land with 3 types of accomodation. Deluxe rooms with attached bathroom, Club pool suite, an exclusive facility with a private pool, & private parking facility. And luxury villas with 4 bedrooms, each with a maid/driver's room, and a private parking facility.
7	Resort 7	Lonavala, Hill, Forest	It offers varied types of accomodation like rooms, suits etc with amenities like a bar, fine dining restaurant, 24/7 cafe, temperature control indoor swimming pool, Vayu spa, wild water – water park, banquets & open lawn
8	Resort 8	Mahabaleshwar Hill, Forest	Spread across 4 acres of landscape in 3 blocks,consisting of a wide variety of rooms to choose from.
9	Resort 9	Nashik Agrotourism	It offers Luxurious accommodation with an infinity pool having an outrageous view along with restaurant and bar, courtyards of indoor games like Fuss Ball, Air hockey, Table Tennis etc
10	Resort 10	Tamhini Ghat road, Hill, Forest, watershed area	40 km away from Pune, the resort offers rooms with an ecstatic view of the Mulshi Lake with various facilities such as indoor games center, kids play area, the swimming and splashing pool deck, barbeque area, jogging track etc



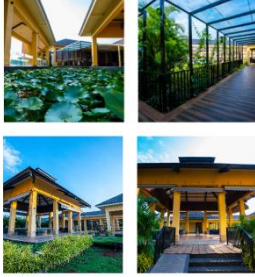





Maharashtra has a lot of potential for natural tourism in the form of mountains, sea, and beaches. This is also an attraction for tourists to make well-established tourism circuits of Maharashtra as the preferred tourist destination when on vacation (INDIA, March 2003) The resorts selected fall into different types such as: Lake resort, mountain resort, coastal resort, hill resort, forest resorts, agro tourism resorts etc.





## 5. Observation and Analysis:











(Fletcher, 1896) emphasises the interdependence of design, form, and construction to reflect the basic principles of architectural development. It provides a thorough analysis of how the built environment has evolved through time as a result of human creativity, cultural contexts, and technical developments. Thus the resorts are analysed on the basis of the concepts of planning, form, and construction as a framework for analysis, especially in the context of resort architectural and built environments. Planning involves analysis of design intent, functional layout and organization of spaces. Form refers to the physical appearance, shape, and arrangement of the built elements, visual appeal of the buildings etc. Construction encompasses the construction techniques & material pallet used.




Table 2: List of Resorts (Source: Author)

Name	Planning	Form	Construction	Response to context
<b>Resort 1</b>	Scattered Planning with clusters of different types of accommodation facilities. Informal & non structured landscape areas.	The structures are grouped as per their functions. The cottages are small scale, simple & rustic with sloping roofs, located & oriented away from each other for better in-out interaction spaces & privacy. Restricted vehicular movement inside the campus. Tents are located in one corner with noticeable change in architectural vocabulary.	RCC construction. Use of local materials, rustic colours and sloping roof technology. Semi open structures are built in steel and covered with shingled roofs. Interiors are modern.	Visually connected to the context. Partial use of local materials.
	  		 	
<b>Resort 2</b>	Context of the mountainous surrounds. The buildings are linearly arranged with the sit outs and balconies on first floors overlooking the pool. Inward looking plan.	A balanced interaction of built-un built spaces. The semi-open structures are used for various outdoor activities. Passages are colonnaded with a blurred boundary between internal space and external vegetation area. Large windows of the Jacuzzis and rooms allow unobstructed views of the mountains.	Contemporarily designed G+2 structures. The roofs are sloping (varied types) with large overhangs as a climatic response. Use of steel structures and transparent roofing allows lighter look and unhindered views from the rooms.	Visually connected to the context. No use of local materials.

				
<p><b>Resort 3</b></p>	<p>Carved out of the woodlands like Italian villas. Water and natural views play an important role for organizing the structures linearly. The site has a good visual continuation</p>	<p>The structures are all white, making it a neutral color scheme. The doors of the Executive pool access Room open to a huge meandering pool, while the premium and deluxe rooms have garden views.</p>	<p>The structures are modernist. Individually developed.</p>	<p>Visual &amp; climatic response to the context.</p>
				
<p><b>Resort 4</b></p>	<p>Situated in the context of forest. The units are randomly located so as to provide best views. Strategic planning with the use of existing flora &amp; fauna. The planning is sustainable with the use of renewable resources</p>	<p>The 30-40 feet tall tree houses, set on iron stilts so as to have the least possible impact on the surroundings. Integrated design approach, to create a seamless and harmonious design.</p>	<p>The construction material is mainly wood &amp; steel including glass walls with forest views. The open to sky bath. The decks made from 100% recycled hardwood &amp; the glass railings to offer continuous unobstructed views of the surrounding greenery. Roofs are sloping.</p>	<p>The planning is context sensitive: designed in harmony with nature.</p>
				

	 <p>photo by Hemant Mahajan</p>			
<p><b>Resort 5</b></p>	<p>The planning is introvert with all the patios and terraces of the rooms facing the central swimming pool.</p>	<p>The building is modern. There is a descent interaction of open and built spaces. The elements like zulas and sitouts are planned as interactive spaces around existing trees.</p>	<p>The construction is mostly RCC with a few stone cladded walls. The local Jambha stone has been used for compound walls.</p>	<p>Ergonomic planning best suited for tourist's comforts and needs more than the context.</p>
				
<p><b>Resort 6</b></p>	<p>The resort has no direct connection with the beach &amp; the sea visually / physically. There are separate sections of types of accommodations with a large chunk of green space in between with sparsely spaced facilities. The villas are linearly placed. The villas have a deep plan, with all in house facilities. Its an inward planning for rooms.</p>	<p>It offers a classic and contemporary ambience. There are elements like sitouts on ground floor &amp; balconies overlooking the central swimming pool. Villas have a private gazebo, features like an open to sky bath. The driveways are planned to accommodate horse rides, bullock cart ride etc</p>	<p>RCC construction in combination with sloping roofs for the accommodation facilities. Thatched roof is used for a wooden finished bar.</p>	<p>The arrangement and layout of spaces within the resort, are considering flow and functionality of the design and not the context.</p>
<p><b>Resort 7</b></p>	<p>It is a 5-star luxury resort having a water theme park near Mumbai/Pune. It's a single building but expanded to accommodate the various amenities like indoor swimming pool. The landscape plays a very important role in accommodation of water park.</p>	<p>The building is modernist with linearly arranged passage on one side &amp; windows on other for getting views of the surrounding hilly landscapes. The sloping roof profiles, arched windows and yellow coloured façade are the prominent characters.</p>	<p>It's a 4 storied RCC structure with sloping roofs with huge spans to accommodate amenities like swimming pool. The spans are managed to have a column less space.</p>	<p>The resort is visually well oriented to respond to the natural context. Planning allows easy access to the waterpark.</p>

			 	
<p><b>Resort 8</b></p>	<p>Located in the context of dense vegetation. The site is sloping &amp; planning is on stepped terraces. The highrise building houses rooms with private balconies overlooking the lower green levels and the mountains in front.</p>	<p>The Blend of traditional and contemporary expression. It's a green campus with existing trees helping in a microclimatic change. Carefully crafted, multilevel seating areas in the green surrounding.</p>	<p>Use of locally available material - red stone (Jambha) in combination with RCC structure. Use of levels to accommodate various activities on site. Huge glass windows to allow maximum view &amp; natural light</p>	<p>The site is graded to have different levels to respond to the setting. Visually well oriented.</p>
				
<p><b>Resort 9</b></p>	<p>Planning is such that the 180 degree of water view and the view of Sahyadri Ranges is well captured. The form dominant building houses rooms with varied visual angles. It's a very compact plan with a single built form.</p>	<p>The resort is visually aesthetical with modern architecture &amp; interiors. The rooms are arranged with private balconies overlooking gardens and the valley beyond. Resort uses huge glass facades to visually connect with the surroundings. The huge overhangs of the blocks are self shading.</p>	<p>The magnificent looking structure is a combination of RCC &amp; random rubble masonry. Metal jalis help in the play of light &amp; shadow. The plant material is edgy, with mostly lawns and ground covers on the palette. The decks &amp; pathways are laid in seasoned wood.</p>	<p>The building responds to the views around.</p>
		 		

<p><b>Resort 10</b></p>	<p>Located in the hills &amp; valleys of the Mulshi region and being a lake-front property, every single room offers a lake view. The rooms are strategically placed on different levels for best views on sloping site.</p>	<p>The cottages are homely with sloping roof and simple planning. They merge into the surroundings with their rustic colours. The connecting pathway is well paved and accommodates vegetation of different textures.</p>	<p>Materials used are RCC, stone and thatched roofs. The material palette for landscape is rustic, natural and blending with the surrounding keeping the existing trees intact.</p>	<p>The hutlike appearance of the cottages merges them well with the surroundings. Response to the site with planning on levels for good views.</p>
				

After examining the resorts in the suggested framework, the responses to the context were analysed and inductive analysis led to generation of certain pattern themes. These themes are listed below.

- 1. Response by exploring views:** It is the ‘view’ that is governing the planning of most of the resorts. In almost all the resorts studied, either it is a borrowed view from the surroundings or it’s an introvert view of the amenities that are provided at the centre. ‘Resort 10’ at Mulshi and ‘Resort 3’ at Karjat have explored the surrounding views to a great extent by maintaining important sightlines and scenic vistas.. Thus view becomes an important context for the planning of resorts. In all the inward looking plans, factors such as landscaping, outdoor spaces, and recreational facilities have been instrumental in enhancing the views.
- 2. Response by Planning & approach:** Out of the 10 resorts, 4 resorts are observed to be directly responding to the site topography, surroundings and context. ‘Resort 8’ at Mahabaleshwar subtly makes use of the existing levels to accommodate various activities, landscape areas & accommodation facilities on site. The decks and carefully crafted seating areas at different levels make it interesting for tourists to get engaged with the natural surroundings. This also allows required privacy. In the resort ‘Resort 4’ at Jambulane, the 30-40 feet tall tree houses, set on iron stilts ensure the least possible impact on the surroundings, also making the design environmentally sustainable. Moreover, the design elements like open to sky bath, the wooden decks & the glass railings offering continuous unobstructed views of the surrounding make it more closer to the nature. Whereas ‘Resort 5’, located at Matheran, is an introvert plan with all the patios and terraces of the rooms facing the central swimming pool. Being a lake-front property, ‘Resort 10’ at Mulshi offers a 360 degree lake view from every single room.
- 3. Response by architectural vocabulary:** Out of the 10 resorts architecturally only a couple of resorts like ‘Resort 4’, ‘Resort 8’ are responding to the local architectural context but otherwise most of the resorts use modern vocabulary and contemporary architecture. ‘Resort 10’ is a non-imposing architectural vocabulary with hut-like structures merging into the surrounding areas, very well respecting the context. Resorts like ‘Resort 5’ & ‘Resort 2’ have an independent modern vocabulary of architectural language.
- 4. Response by exploring material palette:** Only 3 of the selected resorts reflect the use of local traditions, local materials etc. in building design. ‘Resort 4’ tries to attempt a sustainable planning approach by selecting materials like wood, stone, glass, or local materials that align with the resort's design concept. ‘Resort 8’ at Mahabaleshwar uses red stone (Jambha), a locally available material as a response to climate as well as to get merged in the rustic surroundings. In ‘Resort 1’, local materials are partially used for roofs of the structures. The local stone is used for laying pathways. But the use of tensile structures contradicts the overall vocabulary and looks like an imposed modern look.
- 5. Response by site integration:** 4 resorts out of 10 have harmoniously responded to the site and its natural surroundings, utilizing the existing landscape and topography by planning on terraces and levels. There is

also a thoughtful consideration of existing flora for strategic placement of the cottages in resorts like 'Resort 4'.

6. **Response using thematic elements:** Out of the studied 10 resorts only one tries to attract tourists by incorporating a theme in design. The 'Resort 7' resort has a waterpark theme as main attraction, which reflects in the planning & design.
7. **Response for the expression of localness:** Overall, the resorts provide almost similar facilities which are mostly tourist activity oriented except for a few resorts like 'Resort 2' where the unique 'grape stomping' activity is conducted as its nearby Nashik, giving tourists a unique experience of the place and bring in that extra local flavour. 'Resort 4' offers Activities like bird watching, hikes and trail trek. The food is mainly local and cooked by the villagers. The resort also practices various ways in which it can be environmentally sensitive. Some of these practices involve, strategically using & planning for native flora & fauna of western ghats.
8. **Pattern Finding:** The research conducted suggests recurring ideas, strategies, or approaches that resorts take in response to specific contextual factors. These patterns are due to connections and relationships between the responses and contextual factors.
  - There are some common strategies that resorts have adopted in similar topographic contexts.
  - Some resorts excel in specific types of responses leading to sustainability.
  - Some have considered tourists comfort & preferences as their primary response while designing.

## 6. Conclusion:

After analysing the selected sample, it can be concluded that the choice of destination of the resorts is mainly because of the siting & view. Borrowed view concept is predominantly seen. But, popularity for tourists is not necessarily because of resort's architectural design. The focus is more on incorporation of amenities, than on how the architectural layout and design contribute to the overall comfort and enjoyment of guests. The other factors like food, facilities etc play an important role. The locational contexts where site is a governing factor, the planning is site sensitive and has respected the site's natural topography and landscape. Except for a couple of resorts where there is a combination of use of modern technology & traditional materials, the vocabulary used is predominantly modernist in their architectural language, in order to create distinctive and compelling environments.

The importance of integrating architectural design with the variety of contexts in which resorts are located is shown by the study of response to context in the architecture of resorts in Maharashtra. It focuses upon the possibility for responsible, environmentally sound practices and culturally enriching tourist experiences. These results can serve as valuable guidelines for architects & developers looking to design resorts that not only provide unique experiences but also respect and enrich their environments as the hospitality sector continues to flourish.

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## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Solar Energy Use in Residential Building in Pune

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## **Abstract:**

*Solar energy plays a crucial role in our daily lives due to its numerous advantages, such as cost savings, environmental sustainability, and reduced reliance on traditional energy sources. This research focuses on the utilization of solar energy in residential buildings in Pune, India. The study aims to examine solar energy, highlight its significance in our daily lives, explore the components used in solar panel installations, conduct a case study on the electrical usage of an apartment in Pune, and determine the solar panel requirements for residential buildings in the area. To gather practical insights, a case study was conducted on the electrical usage of a residential flat in Pune throughout 2022. The study revealed that the highest electricity usage recorded for the flat during that year was 112 kWh, providing valuable data on energy consumption patterns. Based on this analysis, it was concluded that around five panels of 300-watt polycrystalline solar panels would be needed to meet the energy demands of a similar flat in Pune. The findings of this research hold significant implications for residential buildings in Pune. The study offers a comprehensive understanding of the components involved in solar panel installations and presents a practical case study on electricity usage. Based on these conclusions, it is recommended that residential buildings in Pune consider incorporate solar panels to take advantage of the area's abundant solar energy. This research contributes to the existing knowledge on the utilization of solar energy in residential apartments, specifically in Pune. It serves as a valuable resource for homeowners and customers, providing insights into the benefits, components, and solar panel requirements for efficient and sustainable energy generation. The findings aim to promote the adoption of solar energy and contribute to a greener and more sustainable future.*

**Keywords:** solar energy; residential building; Pune.

## **1. Introduction:**

### **1.1 Background**

In recent years, the use of solar energy in residential buildings has attracted widespread attention due to its ability to solve complex problems such as increasing energy costs, environmental sustainability and energy security. Solar energy, derived from the sun's radiation, offers a clean and renewable source of power that can be harnessed through the installation of solar panels. As a thriving city in India, Pune has witnessed rapid urbanization and an increasing demand for energy. In this context, exploring the use of solar energy in residential buildings in Pune holds great importance and offers immense potential for sustainable development. Pune, located in the state of Maharashtra, is known for its vibrant economy, educational institutions, and cultural heritage. The city has witnessed remarkable growth in population and infrastructure, resulting in a surge in energy consumption. As traditional energy sources continue to contribute to environmental degradation and climate change, there is a pressing need to transition towards cleaner and more sustainable

alternatives. Solar energy emerges as a viable solution, offering numerous advantages for residential buildings in Pune.

## 2. Literature review:

Vikas Khare, Savita Nema, Prashant Baredar (2013) discusses that “The aim of this paper is to present in a coherent and integrated way the major constraints hampering the development of renewable energy in India.” Neeti Garg, Ashwani Kumar, Satish Pipralia and Praveen Garg (2018) “explains that The paper provides an overview of various barriers and challenges in implementing energy efficiency programmes in housing along with suggestions to strengthen the institutional framework and create awareness to accelerate energy efficiency programmes for reducing CO2 emissions.” Y Kotak<sup>1</sup>, EJ Gago<sup>2</sup>, P Mohanty and T Muneer (2014) In their article highlights “the reasons behind the phenomenal rise in the installation of air-conditioners in India are reviewed.” Abhik Milan Pal, Subhra Das, N.B. Raju (2015) outline in detail “the procedure for specifying each component of the standalone photovoltaic power system and as a case study, a residence in Gurgaon, India with typical energy consumption is selected.” Anupama KhareSaxenaa, Seema Saxenaa and K. Sudhakar (2015) “explores the Indian government policies, current approaches, significant achievements and scenario of solar power in India.”

## 3. Methodology:

Descriptive Empirical methodology is adopted for conducting the research which begins with the reconnaissance study of the subject with deeper understanding of need of solar energy in residential units. The secondary data consist information about solar panel components, types of solar panels and the importance of solar energy. The study proceeds with the major primary data collection part of residential unit electricity consumption and basic information from local vendors. Comparative analysis of secondary and primary data resulted in actual implementable strategy of solar panel installation in residential units.

## 4. Results and Discussions:

### Secondary data

#### 4.1 Solar energy:

- Sun based energy is the energy that's created by the sun within the shape of electromagnetic radiation.
- It may be a renewable and feasible source of energy, meaning that it does not drain common assets or cause hurt to the environment.
- Solar vitality is saddled through the utilize of photovoltaic (PV) cells, which change over daylight into electricity.
- The utilize of sun-based energy can offer assistance decrease dependence on fossil powers and nursery gas emanations, which contribute to climate alter and destitute discuss quality.
- Solar energy can be utilized in an assortment of applications, counting private and commercial power era, warming and cooling frameworks, water warming, and transportation.
- Over time, the solar energy industry has experienced rapid growth, creating untapped job and financial opportunities.
- Solar energy can provide access to energy in hard-to-reach or underserved areas, improving quality of life and promoting financial development.

- Solar energy can help achieve energy freedom and security by reducing dependence on imported fossil fuels and unstable energy markets.
- Overall, solar energy can be a promising and important energy source in the long term and can provide a variety of benefits to the environment, economy, and society.



Figure 1: solar panel working diagram (<https://blog.livguard.com/2023/04/maximize-savings-and-sustainability-with-home-solar-power-systems-in-india/>)

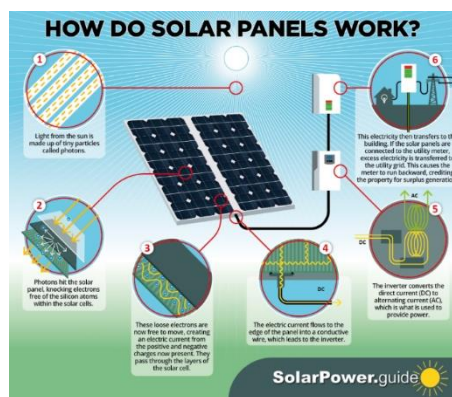


Figure 2: brief working of solar panels (source: <https://solarpower.guide/solar-energy-insights/how-do-solar-panels-work>)

## 4.2 Importance of use of solar energy in our day-to-day life:

### 4.2.1 Renewable and sustainable:

Solar energy is a renewable and sustainable energy. Unlike fossil fuels, which are unique resources that will eventually run out, solar energy starts from the sun and is expected to continue producing electricity for thousands of years

### 4.2.2 Reduce carbon footprint:

Using solar energy reduces our dependence on fossil fuels, which are the cause of climate change. By using solar energy, we can reduce our carbon emissions and help reduce the effects of global warming.

### 4.2.3 Saves money:

While the upfront cost of installing solar panels may be high, over the long term, solar energy can save you a significant amount of money on your electricity bills. This is because once the panels are installed, solar energy is free and any excess energy can be sold back to the grid.

#### 4.2.4 Increase energy independence:

By producing your own solar energy, you reduce your dependence on the power grid and the energy companies that supply it. This increases energy independence and reduces vulnerability to power outages.

#### 4.3 Components required in solar panel installation:

1. **Solar panel:** A solar panel is a device that converts sunlight into electricity.
2. **Inverter:** An inverter is an electronic device that converts direct current (DC) electricity to alternating current (AC) electricity.
3. **Battery:** A solar battery, also known as a solar energy storage system, is a device that stores electricity generated by a solar panel for later use.
4. **Electrical wiring:** Electrical wiring connects the solar panels, inverter, battery, and monitoring system to the home's electrical system. A qualified electrician is typically required to install and connect the electrical components of a solar energy system.
5. **Grid connection:** In some cases, solar energy systems are connected to the electric grid. This allows excess solar energy to be exported back to the grid, and the homeowner can receive credits on their utility bill for the energy they generate. Grid-connected systems also provide a backup source of power during periods of low sunlight or when the battery is depleted.



Figure 3: battery (Source: <https://www.freepik.com>)

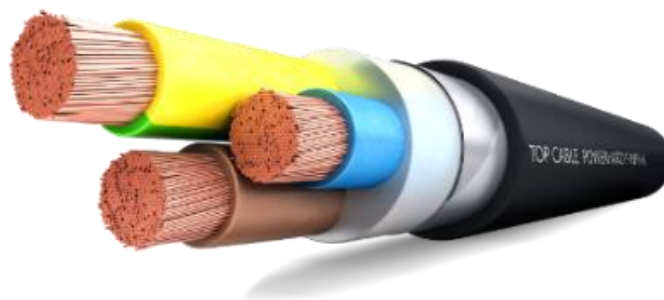


Figure 4: electrical wiring (Source: <https://www.freepik.com>)



Figure 5: inverter (Source: <https://www.freepik.com>)



Figure 6: solar panel (Source: <https://www.freepik.com>)

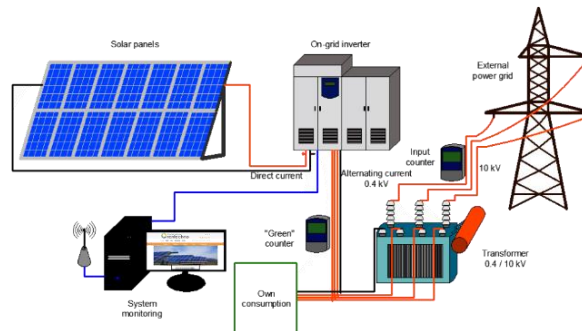


Figure 7: grid connection (Source: [kenbrooksolar.com](http://kenbrooksolar.com))

Table 1: annual electricity consumption of residential unit (source: compiled by authors)

MONTH	UNIT (kWh)	AMOUNT (₹)
January	75	550
February	56	440
March	61	470
April	97	680
May	103	720
June	112	780
July	90	690
August	94	720
September	98	750
October	91	700
November	86	670
December	106	830

#### 4.4 Types of solar panel:

1. **Monocrystalline solar panels:** These are the most efficient and expensive type of solar panels. They are made from a single silicon crystal and have a uniform black color. Space-efficient and work well in areas with limited space.
2. **Polycrystalline solar panels:** Less expensive than monocrystalline panels and have a blue color due to their manufacturing process. They are made from multiple silicon crystals and are less efficient than monocrystalline panels, but are still a good option for residential buildings.
3. **Thin-film solar panels:** These panels are made of thin layers of photovoltaic material coated on a substrate such as glass or plastic. Membrane panels are less efficient than crystal panels, but they are lightweight and flexible, making them easier to install in uneven areas.
4. **Bifacial solar panels:** These panels generate energy from both sides of the panel, which makes them more efficient than traditional solar panels. They are often used in residential buildings where there is limited roof space.
5. **Building-integrated photovoltaics (BIPV):** These are solar panels that are integrated into the building's architecture, such as the roof or walls. BIPV panels are becoming more popular in residential buildings as they offer a visually appealing and energy-efficient solution.



Figure 8: Types of solar panels (Source: climbingvan.co)

## 5. Primary data:

### Monthly electrical usage of a 500 sq. ft residential flat in Pune.

**Location:** Mane Complex, Nanded gaon, Pune – 41.

Total annual light bill (12 = 8000/-)

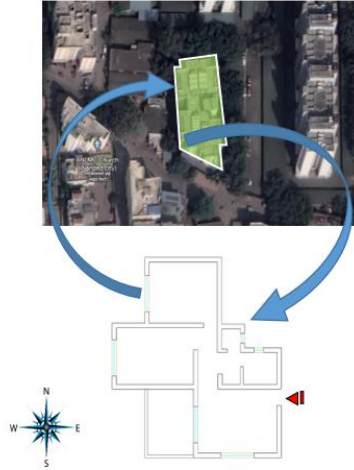


Figure 9: residential unit located at Pune (Source: compiled by authors)

- It is observed that the highest usage of electricity is **112 kwh**.
- With additional usage, it can be rounded up to 150 units.

### 5.1 Solar panel requirements for a residential apartment in Pune:

1. Because of cost effectiveness, polycrystalline solar panels are most preferred solar panels in residential building.
2. In our case, **300-watt polycrystalline solar** panel is preferable.
3. The dimension of 300-watt solar panel is 1968 X 987 X 40 mm (Approx).
4. To generate 150-300 kWh of energy per month in a smaller size, a polycrystalline solar panel can be a suitable option for a residential building.

Assuming an average solar radiation of 5 kWh/m<sup>2</sup>/day in Pune, a 300-watt polycrystalline solar panel can generate around 1.5 kWh of energy per day, or 45 kWh per month. To achieve 200-300 kWh per month, you would need around **4-6 panels** of 300-watt capacity.



**300 Watts**

Figure 10: 300 watt polycrystalline solar panel (Source: [www.indiamart.com](http://www.indiamart.com))

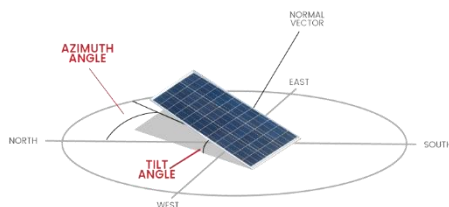


Figure 11: orientation of solar panel (Source: [www.prostarsolar.net](http://www.prostarsolar.net))

To get the maximum advantage of sunlight in Pune, the orientation and tilt angle of the solar panel should be carefully considered:

#### a) Orientation:

In Pune, the solar panel should ideally be oriented towards the south direction to receive maximum sunlight throughout the day. The panel can be oriented towards the southeast or southwest direction as well, but the energy production may be slightly lower compared to the south direction.

#### b) Tilt Angle:

The tilt angle of the solar panel should also be optimized based on the latitude of Pune, which is approximately 18.5 degrees north. For fixed solar panels, the ideal tilt angle should be around 18.5 degrees. However, if you have a solar panel mount that can be adjusted, the tilt angle can be adjusted twice a year - once in March and once in September - to optimize the energy production based on the changing sun angles during different seasons.

- You will get a subsidy of Rs 14,588 for 1KW solar system.
- 1kw solar panel price in Pune without subsidy ranges from Rs 70,000 to Rs 1,10,000. Therefore, after the subsidy, the cost of solar panel for a 1 kW power plant in Pune will be between Rs 55,412 and Rs 95,412.

Table 2: Costing details for 5 no's of 300 watt solar panels (Source: Authors)

Cost Item	Cost Estimate (INR)
Solar Panels (5 x 300W)	70,000 – 1,00,000
Inverter	20,000 - 30,000
Mounting Structures	10,000 - 15,000
Wiring and Cables	5,000 - 10,000
Installation Labor	15,000 - 25,000
Miscellaneous Expenses	5,000 - 10,000
Total Estimated Cost	125,000 - 190,000

Approximate estimation of total installation cost of a 300-watt polycrystalline solar panel system consisting of 5 panels in Pune.



**Note:** Cost estimates are based on average market rates (January to April 2023) and may vary depending on several factors, such as the market conditions, brand and quality of the components, the size and complexity of the installation, and the location and accessibility of the site.

## 6. Analysis:

- **Climate Analysis:** Pune has a tropical wet and dry climate, which is suitable for solar energy generation. The amount of solar radiation received by Pune is relatively high,
- **Energy Consumption Analysis:** It is observed that the consumption of energy for single unit in residential building is about 150 units per month.
- In general, a 300-watt polycrystalline solar panel can generate around 1.5 to 2 kWh of electricity per day, depending on the weather conditions and the angle and orientation of the solar panel. This can help to offset a significant portion of the electricity consumption of a typical household in Pune, which is around 8-10 kWh per day.
- It is observed that to cover all the expenses regarding to solar panels and other components related to it compared to general electricity bills (considering average bill of Rs. 666 per month), one could require about 84 months to nil all the expenses. Once the investment is nil, that day onwards the energy is totally free of cost.

## 7. Conclusion:

**Key impact of solar energy:** Highlight its important role in modern life as it provides cost savings, environmental sustainability and reduces dependence on energy sources.

**Case Study in Pune:** The use of solar energy in residential buildings in Pune is reviewed, its importance and applications are explored.

**Data-based information:** In practice, the maximum electricity is 112 kWh, solar panel for similar buildings.

**Proposal:** Proponents combine five 300-watt polycrystalline solar panels to meet the energy needs of Pune's residential areas.

**Key Takeaways:** The findings have positive implications for the Pune region, encouraging the use of solar panels.

**Helpful Resources:** Helpful resources for homeowners that provide insight into the benefits of solar energy, materials and sustainable energy needs. .

**Environmental Contribution:** The use of solar panels is recommended to achieve a greener and more efficient future and contribute to Pune's environmental protection.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Environment Management Techniques – Case of Matheran Hill Station

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## **Abstract:**

*Man's intervention in nature causes its ecology and biodiversity to deplete from its inherent natural conditions and forms. It is difficult to define, evaluate and quantify the significance of biodiversity in any tourist and religious places where development is inevitable. The gap between supply and demand due to growth in these regions is fulfilled using the natural environments, in turn intensifying the pressures to conserve its status. One such environmentally compromised site is Matheran in Maharashtra. Matheran plateau emerged during British rule as a scenic hill station located at an altitude of about 700 meters. Due to its proximity to the two big cities in Maharashtra, i.e. Pune, and Mumbai, it is a hotspot for the retreat (respite) and attracts a large number of tourists for its pleasant climate and the unique toy train ride to reach the plateau. Matheran showcases the rich flora & fauna along with diverse cultural and built heritage. Due to these conditions, Matheran has been declared an Eco Sensitive Zone. Steep increase in tourist activity resulting in environmental threats due to pollution and land use patterns is seen at Matheran. Currently, due to haphazard development and the escalating tourist population, it has led to the increasing demand for water supply, solid waste management, and an effective drainage system at Matheran. The increase in tourist activity every year, horses plying on mud roads, and development has caused serious environmental threats like erosion, deforestation, land degradation, etc. The increasing activities are putting tremendous pressure on existing landscapes, ecology, and other natural resources. A balance between the utilization of resources and conservation is required and calls for holistic planning. The sustainable development of the hill station is essential by using Environmental Management techniques. The paper highlights the case of Matheran Hill station, a declared Eco sensitive zone and the strategies adopted to conserve landscape and ecology for a long-term benefit.*

**Keywords:** *ecology; soil erosion; degradation; eco sensitive; techniques*

## **1. Introduction:**

With the advent of urbanization, the development scenario with respect to build and unbuilt ratio is rapidly changing. Development is prone to alter the conditions to cater to the human needs, be it accommodation, recreation, enjoyment etc. But this rapid change is inevitable and is the need of the hour too for economic progress. The limited resources are in turn at threat due to man intervening into nature. This intervention is in varied forms of development like habitable spaces, tourism, infrastructure development etc. Any intervention into the natural environment causes a threat to its very existence causing a domino effect affecting the flora, fauna, climate, humans etc. This intervention has led to a lot of environmental issues like soil erosion, exposed loose soil, deforestation, which eventually leads to water pollution, land pollution, air pollution etc.

### **1.1 Purpose:**

The purpose of this paper is to help identify all the environmental issues pertaining to the natural environment, by understanding the root cause for the same and then to curb or mitigate them with the use of environmental management techniques which can target the source point of degradation of the natural environment.

### **1.2 Scope:**

The scope of this paper is limited to the commonly found issues pertaining to the environment like soil degradation, open loose soil, soil erosion etc. Also, solutions and recommendations are done at a tangible and a primary case-based level and not in terms of policy changes. Matheran Hill station, which is one such hill station facing these environmental issues due to the influx of tourists, is taken as a case study. Few techniques implemented there are studied and put forth which can set an example for the other similar issue-based areas.

### **1.3 Limitations:**

Access to Matheran Municipal Council, or other similar kind of government offices was not feasible hence numerical or statistical data was not always available. Policies abiding the Eco-sensitive zone are in place and this puts a lot of restriction on the recommendation strategies which are to be adopted.

### **1.4 Organization of the paper/ Methodology:**

The methodology followed for the paper is based on the following-

1. Understanding that development is inevitable with the growth of urbanization and this leads to man intervening into nature.
2. Once man has intervened into nature it does affect the natural systems existing in nature w.r.t. topography, hydrology, vegetation, flora, fauna, avi-fauna, geology, slope gradients etc due to construction activities.
3. These alterations in nature due to construction activities lead to environmental issues like soil erosion, degradation, afforestation, alteration in natural channels etc harming the natural settings.
4. Environment Management Techniques are the need of the hour like pitching, Gabion walls, slope stabilization, geotextile fibers etc which are in vogue nowadays.
5. Understanding of how nature works is important or else blindly few known techniques are followed without taking consensus of the actual site conditions.
6. Matheran is one such example of an Eco-sensitive Zone, where issues detrimental to the natural environment have occurred and few Environment Management techniques have been adopted. Though certain measures are seen, more such site-based measures need to be adopted for reviving and rejuvenation of the lost natural heritage.

7. One such specific degraded area on the Matheran plateau is the Charlotte lake. Charlotte lake and its catchments have faced adverse effects of degradation due to soil erosion. The surrounding catchments have an elevation of about 700 meters. This drop of 700 meters has a steep gradient, making it more vulnerable for soil erosion. Denuded slopes are of prime concern here.
8. Recommendations and mitigation measures to curb these environmental issues, which are site based are recommended.

## 2. Understanding Nature:

### 1.1 Landscape ecology:

It is crucial to understand nature & its intrinsic qualities through observing its various patterns & processes. The ecological character of the landscape through understanding of its multiple interacting ecosystems should be the approach towards development. Ian Mcharg & his ecological approach towards landscape planning shall help derive some solutions to deal with the ecologically sensitive areas through conserving the landscape.

Landscape is a Heterogeneous area with multiple ecosystems interacting with each other in the form of patches and corridors. Also, there are the natural ecosystems of terrestrial & aquatic life interacting with man-made ecosystems of urban & agricultural settings.

The intrinsic patterns existing in Landscape are called Patches & Corridors. The Patches are units of land which are homogeneous in nature but it becomes heterogeneous when compared to the whole of the environment. They mainly occur due to habitat fragmentation. The size, shape & location of patches are determined by interaction of land with climate & other ecosystem interactions. Corridors - are linear connections between the patches which connect habitats together. They serve as highways for organisms to move from one patch to another. They help to distribute material & energy between the patches. Both patches & corridors are surrounded by matrix, which together form a whole structure of landscape.

### 1.2 Strategies in Use today:

Today there are many techniques and strategies which are in vogue for the conservation and rejuvenation of the environment with little understanding of Landscape & its composition in the virtues of patches, corridors, matrix & mosaics etc. Few commonly used and also the most effective ones are stated below -

A few of them can be adopted for the Charlotte lake and its catchment areas too.

**Contour bunding and Trenching** - A ditch along the hillside is called as trenching which helps in water percolation and reduces water velocity. Soil excavated from the trench is placed alongside which acts as a bund. This also helps in reducing water velocity. On the steep slopes of the catchment, apt contour bunding and trenching techniques can be adopted after further research to reduce the velocity of water gushing down the slopes into the lake.

**Pitching** - Laying of stone on the slopes to avoid erosion and soil stabilization. Immediate edges of the Charlotte lake can be made more permeable for water to transpire between edges.

**Gully plugs** - A check dam on a temporary or a permanent drainage channel to curb the gushing water flow. Several streams provide water to the Charlotte lake, gully plugs used on these could be helpful.

**Gully bunds** - A temporary or permanent bund created in a water body to cut down the velocity of water. This technique too can be used on the feeder streams that supply water to the lake.

**Gabion walls** - Stone boulders stacked in net or wire mesh to create a wall with no mortar in the joints. This allows a soft edge between land and water

**Wetland vegetation** - Wetlands are highly productive and biologically diverse systems that enhance water quality, control erosion, and maintain stream flows.

Environment Management Techniques....

**Afforestation** - Plantation of trees of desired species which help the overall ecosystem and curb erosion. The denuded slopes have to be afforested to curb soil erosion.

**Slope protection by using coir logs** - Natural coir logs used bunds along the slopes to stop soil erosion and reduce velocity of water. the immediate edges of the Charlotte lake

**Slope protection by using Geo-textile material** - Geo-textile material has seeds in it which grow into vegetation after 2-3 monsoons which in turn help in slope stabilization. Certain sections which are affected the most can be identified and slope protection using Geo-textile material can be laid on those to stabilize them.

**Mulching** - In mulching a material placed on the soil surface to maintain moisture, reduce weed growth, reduce soil erosion and improve soil conditions. Also Mulching can help to improve crop yield and optimize water use reduce soil and water erosion.

**Conservation Tillage** - Conservation tillage is a method of soil cultivation that leaves of the previous year's crop residue (such as corn stalks or wheat stubble) on fields before and after planting the next crop to reduce soil erosion and runoff, as well as other benefits such as carbon store in soil.

**Cover crops** - Avoids splash erosion and helps percolation of water in ground

**Ground Covers** - Avoids splash erosion and helps percolation of water in ground

**Terraces along the slopes** - A steep gradient slope can be turned into flat terraces at different levels into steps which help in plantation as well as absorbing water in turn curbing soil erosion.

**Continuous Contour Trenching/ Canal (CCT/ CCC)** - These trenches which are parallel and along the contours help control the water from flooding downstream farm areas, which helps in saving water and channeling it in the right direction.

**Check dams** - These are erected along the stream or a canal with temporary or permanent materials especially post monsoon to keep a check on the water velocity and also storing of the water.

**Shore stabilization** - Geotextile fibers, contour trenching and bunding, Coir logs are all techniques used for Shore stabilization

### **1.3 Inclusive Design Approach:**

In the above heading we looked at the various strategies which are in vogue and commonly initiated by the experts to mitigate issues related to the environment. These techniques are very effective in curbing issues of soil erosion, soil runoff, slope stabilization etc. But these environment management techniques cannot be replicated or copied from one site to another. A detailed site analysis of that particular area is required with the technical know-how to arise at a solution or to recommend any one technique. The ecosystem varies from place to place and thus the natural intrinsic patterns vary. With the ecosystem and landscape varying the topography, the hydrology, the geology, the flora, fauna etc is bound to vary. Thus an Inclusive design or a Case specific/Area specific design is of utmost importance. This also calls for an environment assessment report or a detailed site analysis to first understand its problems or issues, which can be inferred only out of a detailed site study in various layers. The findings and the analysis obtained from these layers will help one to recommend a solution which will be area specific or site specific. This is called an Inclusive Design Approach.

### **1.4 Case study : Oikos Ecological Services:**

Oikos for ecological services is one such organization which works on the delicate balance of human expectations as well as conserving nature through its nature restoration & biodiversity conservation strategies. The approach of the organization aligns to site specific strategies such as detailed assessment of site to understand the existing natural components (such as soil type, water resources, flora & fauna) & their processes, followed by creation of eco-plan by including the best suited ecological solutions for the land along with inclusion of client expectations. The final stage involves the actual execution of the eco-plan on site, keeping the naturalness of the site intact. The unique study of reference ecosystems of the surrounding landscape provides a thorough understanding of the prevailing ecological conditions, helps to decide the strategy for future developments on site. It is seen through the projects of Oikos for ecological services that

the ecological processes such as recycling within soil & vegetation, pollination, regeneration of soil along with identification of macro & micro habitats & their linkages play a vital role in improving overall ecological health of the area.

The eco-farmhouse project (0.5 acres) in Khanapur, Pune is an excellent example of implementing the eco-friendly approach in its execution. The use of Bamboo as a renewable construction material for its buildings, use of native flora in its landscape areas, use of natural materials & total avoidance of lawn & foreign materials highlights the importance of nature conservation going hand in hand with inclusion of client expectation development.

The Ranwa, the forest restoration project (24 acres) at Koyna catchment area highlights the low-cost techniques used for eco-restoration. The project with its soil moisture conservation, habitat & vegetation development, planting of native species along with local people participation highlights the willingness of the stakeholders into restoring the ecological character of the land with integrated planning.

### **3. Case study : Matheran Hill station:**

Matheran hill station emerged as a hill station during the British period due to its soothing climatic conditions. Then later due to its close proximity to the two metropolises that is Pune and Mumbai, it has become a hotspot for the tourist. It almost serves as a weekend getaway for the people staying close by. Being easily accessible by road or by the Local train and then taking a taxi or a toy train, it is a popular demand for all. the taxi ride in the mountains or the toy train ride reveals very appealing scenic views. Day by Day the tourist influx is increasing and is thus changing its nature from a quaint hill station to a highly commercial spot. The Matheran - Malang Gad region was declared as an “Eco-Sensitive Zone”, under the Environment Protection Act (EPA) 1986. This suggests that the region has naturally occurring unique forest & is a home to a number of rare flora, fauna & avifauna diversity. The Matheran-Malang Gad ridge receives rainfall up to 2500-3000 mm every year & is the catchment area of many perennial rivers such as Gadhe, Dhavari & Ulhas rivers to name a few. The streams network of the plateau, forms many small to large basins, Simpson tank and Charlotte Lake are some of its large lakes. The geological character of the plateau is of Basalt Trap with varying thickness & character along the slopes. The trap varying in chemical composition disintegrates & forms soil on the sloping sides, thereby becoming home to many bushes & forest trees. However, the Basalt trap (Deccan trap) found in Matheran is a bad aquifer, leading to less potential of groundwater. The soil type found in Matheran is red soil with low Ph value of 4.5 along with high percentage of silica & alumina, which when decomposed with vegetable mould could support large vegetation.

The climate at the plateau is cool & pleasant throughout the year. However, from the past 70-80 years, the average temperature has increased up to 2 degrees Celsius. Since there is no agricultural or horticultural land on the plateau, the resources such as basic food grains & other materials are sourced from the outside. The economy of the plateau is solely based on tourism, which is completely dependent on the healthy natural environment around. Despite this, the potential of recycling solid wastes created due to human interventions, is still yet to be explored to its full capacity.

The forest typologies of semi-evergreen to evergreen with both evergreen & deciduous trees are found on the plateau. At the mature forest patches, the clear hierarchy of forest is seen with tall trees, medium sized trees & lower storey consisting of plants such as ferns & other flowering plants. However, the M.G road & Bazaar areas show many degraded patches. Tree species such as Jambhul, Ain, Hirdi, Ashta, Umbar, Asauna, Anjani, Ghela, Pesha, Ursool etc are found here. Plant species such as Karvi, Pangli, Shikekai, Hirda, Ragatrod are also abundantly found here. The wildlife on the plateau has many animals such as hyena, wild cats, antelopes, giant lizards, squirrels, monkeys etc along with birds such as cuckoo, bulbul, robin, barbet, spotted dove etc. Besides birds & animals, thousands of insects, moths & butterflies’ dwell in its natural wilderness.

**a. Issues at Matheran Hill station:**

Almost 50% of the area of Matheran plateau is prone to moderate to severe soil erosion. Tree felling, change in land use, high rainfall, are few of the reasons to be blamed. Above this the material holding quality of laterite soils makes it vulnerable to erosion. The higher elevations of the plateau face soil erosion due to exposure to winds, resulting in bald patches of exposed rocks. Moreover, the laterite soils are less susceptible to heavy rains, as the soil cannot withstand high moisture retention. Due to the above-mentioned qualities of the laterite soil, problems such as slope instability, settlement of soil, acidic leaching & less retention capacity of soil occurs commonly. Solid waste, horses trotting on the roads and grazing into the forest are also reasons for the undergrowth to be disturbed.

In addition to the soil behaviour, the erratic human induced activities such as overcrowding due to tourism & tourism related infrastructure projects facilitates the surface run-off of water, causing havoc during heavy downpours during monsoon. Of late the cases of plastic dumping at Charlotte lake, due to irresponsible behaviour of tourists has raised the question of surface water quality & use of water for domestic purposes on the plateau for the inhabitants.

**b. Strategies adopted in Matheran:**

As discussed earlier the major concern affecting the natural heritage is the soil erosion and chunks of soil being washed away. The roads cave in and felling of trees occur leaving the place degraded. This needs to be preserved on an urgent basis and thus few site-specific strategies are adopted at the crucial areas. Amongst the few commonly used environment management techniques the technique adopted here is the slope stabilization around the Charlotte lake. Charlotte lake is situated about 700 meters below the highest altitude on the plateau, it has very steep slopes in the catchment area. Heavy soil erosion is leading to the lake siltation thus reducing the holding capacity of the lake too. Thus, few environment management techniques are adopted within the catchment areas.

Few issues which required immediate attention and were of concern are -



*Figure 1: Headward erosion of the streams - occurs due to process of erosion which lengthens the streams, valley or gully at its head & thereby enlarges its drainage basin.*





*Figure 2: Burrow pits along the road and in the forest area - occurs due to natural settlement of soil in particular area*



*Figure 3: Siltation of the lake - occurs due to increased concentration of sediments at the bed of lakes & followed by overflow of lakes*



*Figure 4: Heavy pedestrian and horse movement - occurs due to increased human activity & horse plying on the land surface*



*Figure 5: Pony Parking - causes stamping & movement of particulate matter of the soil.*



*Figure 6 : Temple related activities - causes increase movement of people*

Remedies to protect eroded slope surfaces

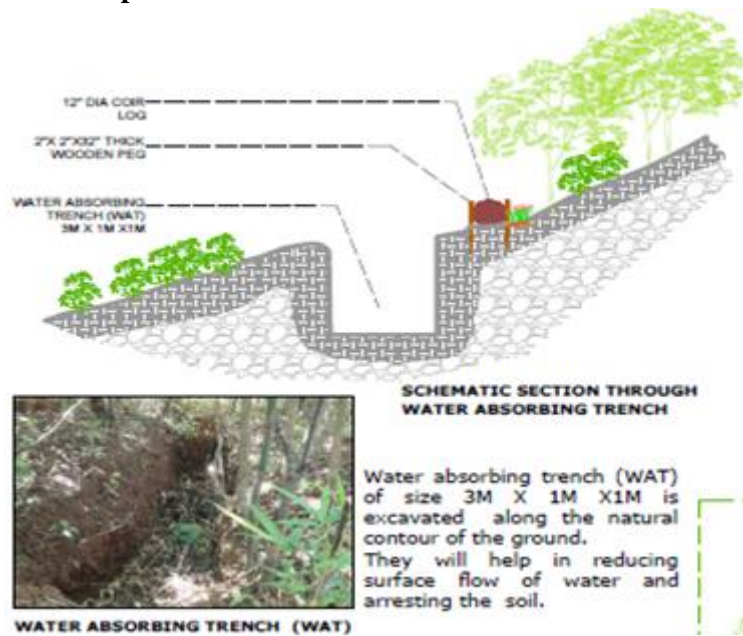


Figure 7: Water Absorbing trench in denuded areas :

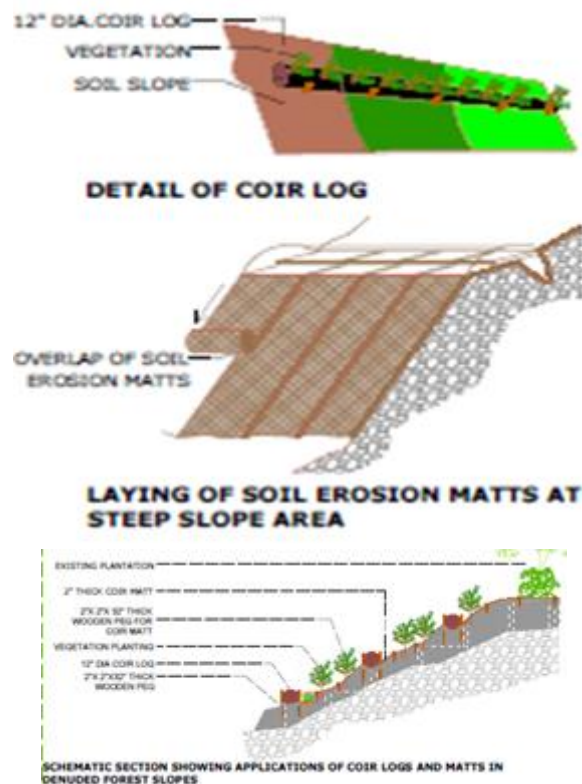
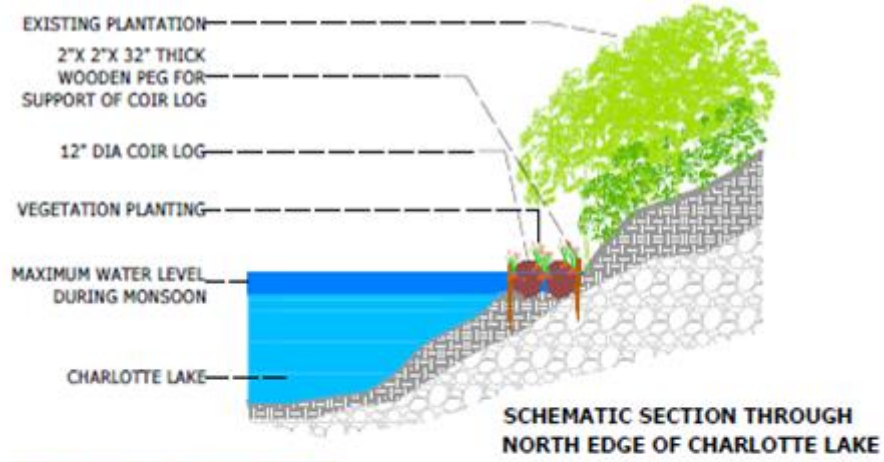


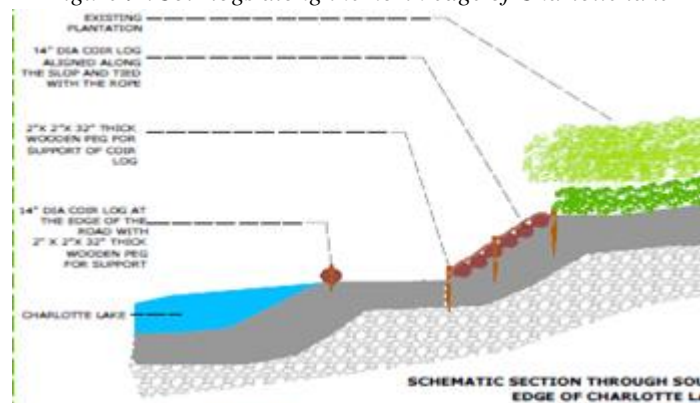
Figure 8: Coir mats & coir logs along the denuded slopes



**COIR LOG LAID ALONG THE WATER EDGE**

Coir logs placed along the north edge of the Charlotte lake above the maximum water level. This will help in stabilizing the lake edges and also prevent the eroded soil from entering the lake.

*Figure 9 : Coir logs along the north edge of Charlotte lake*



**COIR LOG LAID AT SLOPE NEAR WATER EDGE**



*Figure 10 : Coir logs along the south edge of Charlotte lake :*



COIR LOGS LAID ON BOTH ROAD EDGES

The roads leading to Charlotte lake have heavy pedestrians and horse traffic movements. Since they are compacted mud roads, this has led to loosening of the soil which eventually flows into the lake. Coir logs laid along both road edges prevent this loose soil from contaminating the lake.

Figure 11 : Coir logs along the road edges

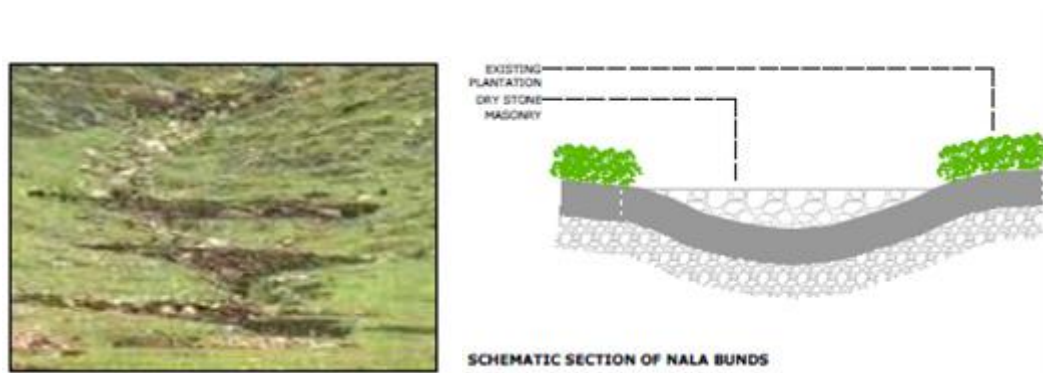


Figure 12 :Nala bunds across the streams

#### 4. Recommendations:

Use of native, endemic & indigenous species for all types of plantations must be adopted & widely spread amongst the local communities residing on the hill station. Avoid monoculture through plantations of similar species.

Protection of forest patches in its existing hierarchical composition is required for the health of the environment, since it supports patches & corridors which help to distribute material & energy within the forests.

- Degraded slopes of the plateau can be protected by planting “*Vetiver Grass*” on the slopes. The *Vetiver* grass is easily available, low on maintenance, and it can be grown on any type of soil. More important to note is that these grasses can penetrate in the soils up to a depth of at least 3.00meters.
- Using local water resources wisely through efficient water conservation & water harvesting techniques, since the plateau has a bad aquifer which reduces its potential to store groundwater. Protection & management of natural streams & springs is crucial to avoid water scarcity in future.
- Promotion of ecotourism through participation of local communities shall be given preference. Conserving the natural setup of the place, along with catering to the needs of tourists shall require active participation from the local communities.
- Awareness programs for the tourists , local residents & owners of the properties shall be required, focusing on the aspects such as health & hygiene of the place, less wastage of resources, ecological aspects, waste management, ecosystem & biodiversity conservation of the place etc.

#### Environment Management Techniques....

- Analyzing the no.of tourists & distributing the flow of tourists evenly over the year with proper tourism management plan. Activities aligned with nature such as nature trails, boat rides, camping, trekking ,hiking, boardwalks, horse rides, sightseeing etc. should be encouraged, instead of separate entertainment developments inside the sensitive areas.
- Discourage the vehicular movement & parking in the hill stations, as it can cause air & noise pollution affecting the other species inhabiting the hill station.
- Use of eco-friendly materials & techniques for man-made interventions should be given priority.

## 5. Conclusion:

It is crucial to understand that destinations such as hill stations shall always be appreciated by the visitors only through its experiential qualities & not purely based on its looks. Hence the climate, natural vegetation, natural streams, views & vistas, ambient temperature of the place with minimal & responsible man-made interventions is the key aspect for its development. However much of the effort is only focused on beautification of places rather than restoring the ecological character with integrated planning.

Retaining the Ecological value (of forest lands & natural resources ), visual value (views & vistas) & recreational value (eco-tourism activities)

The regional forest authorities intervene wherever the natural setting of Matheran is altered or subjected to removal/change. The protection of existing flora, continual maintenance, pruning & replanting of trees & shrubs is needed to maintain the ecological value of the area.

Undertaking intensive scientific character appraisal of the whole of Matheran & its valley slopes to be undertaken. Vigilance of forest areas along the slopes & plateaus, along with forest fires & shifting cultivation needs to be checked regularly.

Forest enhancement programmes involving locals & tourists could be formulated.

Maintenance of retaining walls & laterite pitching along the roads should be on priority.

Since most of the slopes of Matheran are steep (above 30 degrees), made with deccan trap which is bad aquifer (making the area less potential of groundwater) most of the rainwater washes down the slopes in the form of springs leading to soil erosion of precious & rich top soil of laterite. Hence water harvesting techniques (specific to the area) needs to be used. Bunding of streams as check dams should be used.

## Conflict of Interest:

The authors have no conflict of interest to declare.

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# Climate Responsive Dogma: Pedagogic Approach

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## **Abstract:**

*Architecture is a branch that deals with the human habitual needs and takes care of the infrastructural needs. The architects involved in the process are expected to go through a lot of research work for the reason that a designer has to cope with each and every stakeholder involved in the project. At the same time an architect is expected to extend a line of thought towards the environmental aspect of design. Every design Intervention disturbs the ecological balance in some or other way because of the physical activities involved. A skillful and impactful thinking philosophy needs to be ingrained to achieve the desired positive outcomes aligned with environment conscious intent. The matured efforts and responsible approach need to be imbibed by designers to curtail the environmental imbalance. The research paper aims to identify the pedagogic experiments which help in aligning the thinking process of students of architecture with the environment-conscious design approach at an early stage of design. It attempts to surface several pre-design parameters and checklists which can be discussed with the students so that they can get a notion of environment conscious design strategies. The methodology or the approach shall be to review few case studies and retrospect how efficiently can the impulse of climate responsive solution be imbibed in students as a part of pre-design, design process and can be inculcated in which part of architectural syllabus. The findings of the paper shall focus on few guidelines derived through case studies which explain the thinking process involved in the design of some of the structures designed in India. For better understanding of the site and site context this paper shall only review Indian case studies, so as a part of Research limitation the guidelines or inferences will be restricted to Indian context only. It's high time that we need to take initiative as educators in grooming matured designers who can responsibly carry the climate responsive design approach in academics as well as in their practice as a part of practical implementation. They can create a benchmark for generations to come in the field of architecture with a broader perspective of Environment sensitive architectural practice with considerable social impact on the society.*

**Keywords:** *climate response; pedagogy; design; environment*

## 1. Introduction:

An Architecture fraternity is known for the solution-based thinking capabilities as it is a technical and creative branch which is directly connected with lifestyle of people. An architect is responsible for making day to day lifestyle better and provide a suitable atmosphere for users so that they can do their jobs, household duties or perform their tasks in the most appropriate way. One can't anticipate giving his or her best output without having convenient infrastructure around. In short, the thinking process of an architect and the actualization of the ideas can create a strong base for others to perform their best. It becomes utmost important to have such strong base in order to achieve the desired results.

Over the years, architects have done remarkable work of providing such suitable conditions which either come as a part of the requirements from the client or comes as a research outcome of the architect himself which he has to do before starting any of his or her design concepts. During the process of ideating, an architect is expected to think various aspects of the design as a solution because such solutions impact lot of other branches.

Design impact on various factors: Social impact turns out to be important aspect because the design outcomes have strong effects on daily routine and the neighborhood activities. The design solution also affects the urban pattern as the proposal shows heavy reflections on the micro level circulations like pedestrian as well as vehicular movement configuration. The proposed infrastructure has an immense impact on the success rate of the stakeholders which in turn defines the accomplishment of an original idea.

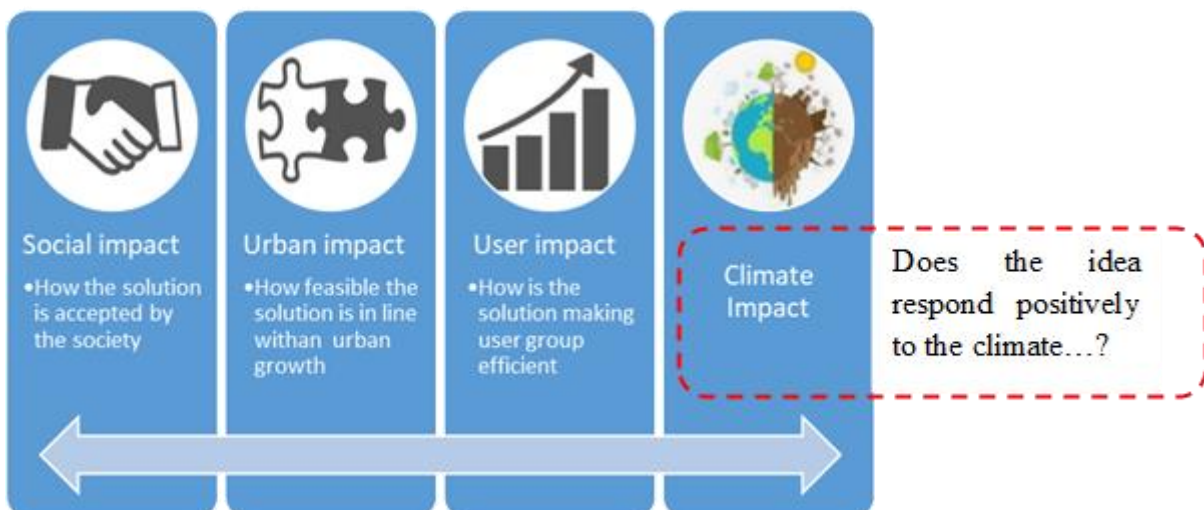
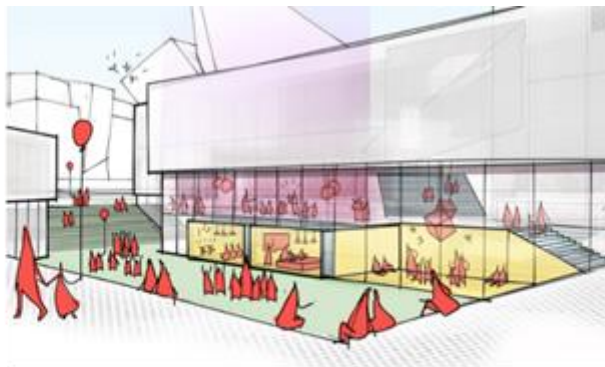


Figure 1: Showing various impacts which a new proposal cast  
(Source: Author)

Need of retrospection comes into the picture at this stage which prominently makes the designers think about how does the proposal respond to the climatic conditions? Is the sufficient thought given to the environment conscious design?



## Need for Climate responsive design:

Architect's scope is not limited to resolve mere client's requirement. In addition to his or her forte to address user segregation and circulation, site development, technical solutions, services and municipal norms, a design architect must think about Climate response that the design is expected to deal with, during and post construction. Any structure built on earth is going to disturb the balance of nature but at the same time keeping the necessity of the infrastructure, it becomes inevitable to consider our role as a responsible designer who can utilize the natural resources in a favourable manner. Lot of research has been done till date and all that necessary information is available at our fingertips to go for Sustainable design solutions. Designers need to contribute with their logic and Caliber to produce contemporary design solutions with environment conscious touch to their designs.

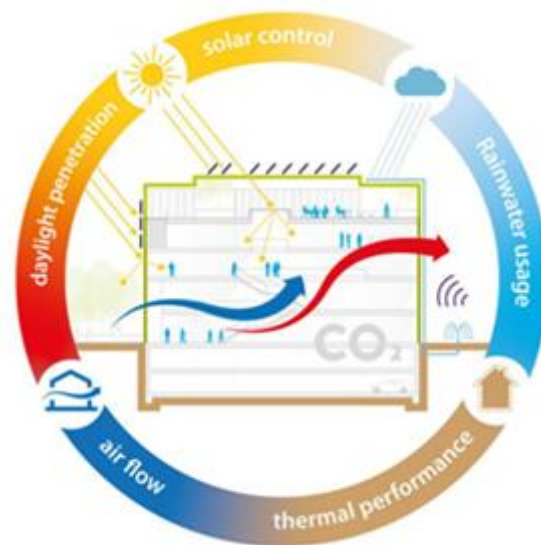


Figure 2: Showing elements of climate responsive design (Source: <https://www.burohappold.com/articles/climate-responsive-envelope-design>)

## 7.2 Pedagogic dogma:

The observations above have a very powerful role to play as far as an architectural proposal is concerned. One has to be very precise and extremely cautious while conceptualizing something architecturally and more cautious while building it because, the realization of these proposals has a long-established effect on the environment. A clear-cut and accurate methodology is required before ideating the concepts which are going to make an influence on the ecosystem. This is where the pedagogy plays an important role. The brain of an architect can create wonders and the results could be recognized in positive and negative both ways depending upon how the brain is trained. An effective and efficient result can be expected when the creative idea is balancing the demands of the nature.

It is therefore essential to sensitize the future architects to get aligned with the future demands of the environment conscious designs and this can be achieved through the accurate pedagogic approach in order to give a correct direction to the students at predesign stage making them well-equipped to study and follow the correct sequence and flow of design instead of thinking environment consciousness as an afterthought once design is finalized only to enhance the superficial fulfilment of the climate responsive ideas. The best practices can be studied in a correct way to understand the way experts work and get oriented with the process or define one for oneself so that one can be in the best possible position to draw out the best possible solution for the set of issues to be addressed not only in terms of clients' requirements but also in the scope of the environment-sensitive and climate responsive direction.

## 2. Aim:

The Aim of the research paper is to identify the pedagogic experiments which help in aligning the thinking process of students of architecture with the environment conscious design approach at an early stage of design.

## 3. Objective:

The objective of the study is to surface several pre-design parameters and checklists which can be discussed with the students at the advance stage of the curriculum so that they can get a notion of environment conscious design strategies.

## 4. Research question:

How can an improved pedagogic approach prepare graduates industry ready and environment conscious to achieve improved quality of output?

## 5. Methodology:

A checklist of few important pre-design parameters was jotted down. Case study was taken up to check or compare how these parameters which were studied at pre-design stage have assisted achieving environmental efficiency of the building after the construction of the project. A process is defined as a sample for analyzing various environmental needs to be considered before starting the Architectural Design that can be included in the pedagogic approach in the course of Architecture. After thorough examining of the case study few reference points or recommendations shall be made which can be included in the starting point of the design so that the design kicks-off at a sustainable base. The research includes case study restricted to Indian context only.

Approach:

To chalk out a pedagogic application, an approach is extremely important so as to identify which part of the academic structure we can have an introduction of the strategy. An effectivity of outcome is highly dependent on introduction of the program at the correct level. Following criteria is considered to identify implementation of the strategy.

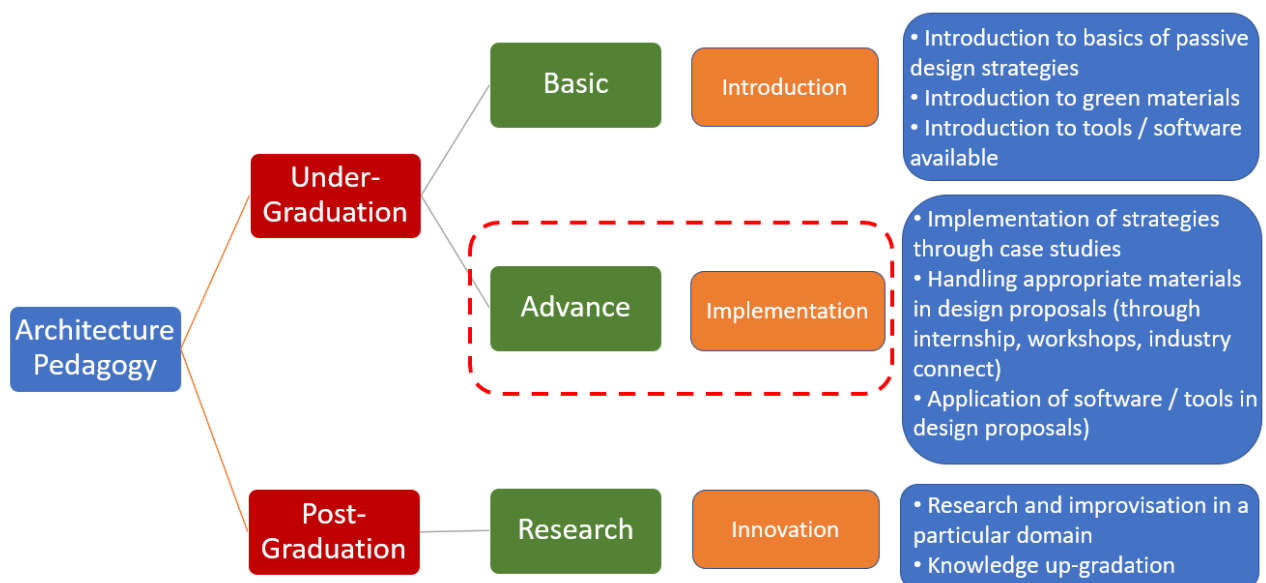


Figure 3: Showing Architectural pedagogy based on curriculum (Source: Author)

The Architecture pedagogy is analyzed which is divided in two main parts majorly as undergrad and postgrad level. Undergrad course of five years is subdivided by universities as basic and advance considering the level of depth in syllabus that it includes. Basic course covers the introductory part of concepts of designing including basic design principles, tools of designing, material identity and basic application in terms of software. Advance level involves an implementation of the basic knowledge. It includes application of strategies, handling of material, experiential learning through internship, workshop, industry connect and so on. Advance level therefore is appropriate for the introduction of climate responsive tactics while students are exposed to industry through curriculum to understand industry needs and expectations from the next generation of architects. Moving further, the post grad level expects research and innovation in the knowledge base a graduate has. The whole idea behind having this approach is to bridge the gap between what the industry expects and what the graduates possess. The success of this strategy could achieve superlative excellence in the field if implemented with precision. Intention is to make students of architecture equipped with climate responsive strategies which prepares them as responsible professional who can lead the environment conscious practices in future.

## **6. Literature Review:**

### **a. Climate responsive design strategies:**

Climate responsive design strategies are sub divisions of Environmental design. It is very important to determine for a project, how best it should be carried out. The approach should be making different design decisions based on the relation of human comfort and climate through the medium of site, building and the immediate environment. The strategies applied to the project and design decisions taken to solve environmental issues are sometime tangible and intangible both. The complexity of the design process lies in selecting, integrating and evaluating passive design strategies which are climate responsive. There are different ways to achieve it like, grouping strategies, prioritizing strategies and using them for different models and select appropriate models for particular climate types.

### **b. Ordering and prioritizing design strategies:**

Climate responsive design strategies should be ordered and prioritized to have greater impact on the built environment. The outcome of different research suggests that building as a climate filter can be related to three sets of factors. 1) Topography, macroclimate, microclimate 2) Building form and fabric 3) Mechanical services. The first-order decisions are more related to alteration of macro, micro climate. The second order decisions are related to the form and manipulation of the building fabric and fenestrations. The third order decision is to select the services and position them accordingly.

### **c. Active and Passive models of climate modification:**

The further way to articulate the ordering approach is to group the climate responsive architectural aspects in to active and passive models. The passive models include use of natural light ventilation energy in the project which includes the first and second order decision. The active models include the third order decisions which includes the use of man-made energy. The intellectual approach for mapping of Passive and Active models includes energy simulation software. The best can be achieved by working out different models through the use of software and implementing them in required climatic conditions.

## 7. Case study:

Pedagogic approach could be introduced with the help of case studies in classrooms. Knowing the fact that case study-based learning always creates interest in students so as to understand the extremes of strategical approach one can have at the initial stage of design to predict what could be the best possible outcome of the given project. A sample case study is analyzed here to understand the outcomes of the design.

Case Study: Office-cum-laboratory for the West Bengal Pollution Control Board, Kolkata.

Since the building was a government office keeping a check on the pollution control, the Architects and the engineers took it as a challenge and focused on the fact that the building should actively engage in uplifting of the environment and should be an exemplary case of “Environment – friendly building”.

### 7.1 Building for Geographic area:

Building for Geographic area is a major deciding factor of the strategies which are to be applied to the building for maximum energy efficiency. The site was located in Kolkata which comes under warm and humid region of our country. As a result, the strategies which were to be taken was minimum heat gain and maximum ventilation.

### 7.2 Performing a site Analysis:

Being clear of the strategies to be adopted the second thing which was done was Performing a site Analysis. The site was a long narrow plot having larger face towards South-east and North-west. Which did not suit parameter of glare from direct sunlight and excessive heat gain. A conventional plan would have given more exposure towards South east and North west (As shown in the plan in Fig- 4) resulting in more heat gain inside the building. Based on the site analysis strategies were adopted to reduce on the exposure of South and West walls.

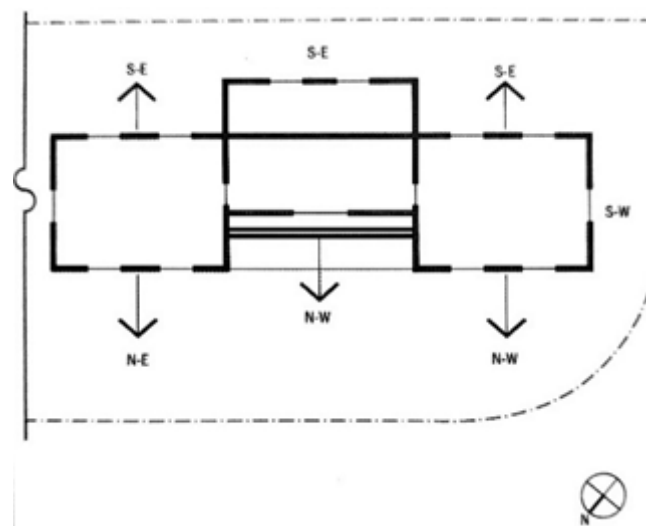


Figure 4: Showing Site Analysis of the Project (Source : Book, Energy efficient building in India)

### 7.3 Building orientation on site:

Based on the site analysis next very important decision which was taken was the building orientation on site. The angle of the walls of the building was designed in such a way that, the maximum exposure of the walls was on the east side and North side (Refer Fig –5) . Maximum ventilation of the building was taken from East side and very small openings were designed on the south side.

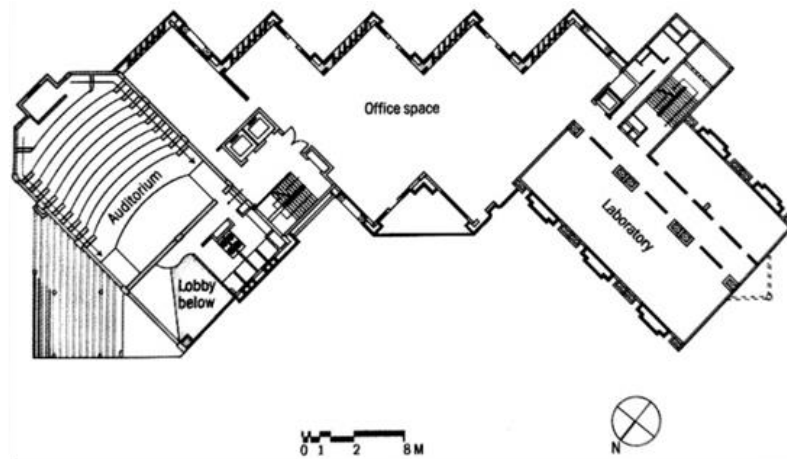


Figure 5: Showing activity zoning of the project (Source: Book Energy efficient buildings in India)

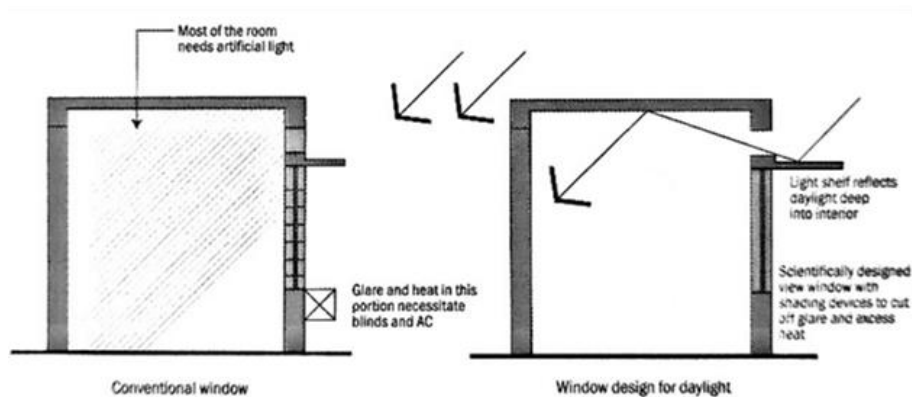


Figure 6: Showing traditional window and window design for integration of daylight (Source: Book Energy efficient buildings in India)

#### 7.4 Zoning:

Zoning of the activities also play a major role in placement of the activities on site. So, the building was divided in to three parts. One fully air-conditioned laboratory wing of about 1115m<sup>2</sup> towards the Northern exposed wall. Second a ventilated non-air-conditioned office wing of about 1300m<sup>2</sup> which was placed in between with East and North ventilated walls. Lastly an ancillary wing housing entrance lobby, training center, cafeteria and mainly Auditorium on North and North east side of the building (Refer Fig – 5). The toilets and the staircase block were placed towards the unavoidable west façade of the building.

#### 7.5 Planning with Sun in mind:

Planning with Sun in mind is a major factor which ensures required thermal comfort inside the building. The above plan shows staggered plan form to ensure maximum day lighting and ventilation and minimum direct solar gain which will help to reduce the electricity bill contributing to the sustainability factor.

#### 7.6 Opening considerations or fenestration design:

Opening considerations or fenestration design were decided according to the orientation of the walls. At the very initial stage the architects decided on the size of fenestration to maximize on the day light penetration in to the rooms of the building. The fenestrations were designed in such a way that the position and size of the windows allowed maximum day light cutting off the harsh sun. The conscious decision of the Architects was

to minimize on the glare from the uncontrolled day lighting which requires curtains and blinds there by increasing in artificial lighting and cooling load.

**7.7 Design for Natural ventilation:**

Designing for Natural ventilation also plays major role in making the building sustainable. Maximum glazing in the building was provided in North-south direction and minimum in East-west direction, which proved to be advantageous for solar heating in winter and minimizing passive heating in summer. This particular orientation is best suitable for ventilation according to the prevailing wind in Kolkata city.

**7.8 Conduction of Modeling and Analysis:**

Consumption and savings on one typical floor

Case	Lighting consumption (kWh)	HVAC consumption (kWh)	Total consumption (kWh)
g Conventional window/shading	5070	11592	16662
Final design	936	10080	11016
g Conventional window/shading	2150	5760	7910
Final design	624	5328	5952
i Conventional window/shading	12960	–	12960
Final design	624	–	5160
Conventional window/shading	20180	17424	37608
Final design	7170	15408	22578

ii. 1996. Design review of West Bengal Pollution Control Board Building at Salt Lake. Tata Energy Research Institute [TERI report 1995RT65].

Table 1: Showing consumption and saving on one typical floor (Source: Book Energy efficient buildings in India)

Conduction of Modeling and Analysis of the project is done to arrive to an optimum solution the entire interior was computer – simulated for testing the light levels and also thermal performance test was done with different window sizes. After doing model analysis window sizes and fenestrations were finalized.

**7.9 Scientific design of shading devices:**

The shading device for all four walls are calculated and designed specifically for that particular orientation. The shading device were designed to reduce thermal load of the building, also they were efficiently designed to control the glare inside the building. Combination of horizontal and verticals louvers are done in such a way that the summer sun gets cut off, allowing the winter sun inside the building. Software simulations were done to compare the energy consumption and finally the shading device were decided.

**8. Discussion and Findings:**

The above-mentioned adaptations in the building resulted in various positive impact in cutting down the load on energy consumption. The cooling load for air-conditioned was reduced to a great extent in the laboratory area. The table on the right (Table 1) shows the percentage of energy saving on all the activity area of the building such as North-facing laboratory (33.9%), South-facing laboratory (24.7%), Office block (24.7%), one

typical floor (39.8%). So totally 39.8% of energy is saved by controlling size and shape of window design and shading device design, also 2.6% energy is saved through solar passive techniques, altering the orientation, depth of plan etc. Hence by adopting Passive design strategies a total of 41.5% has been saved annually over a conventionally designed building of same type.

## 9. Recommendations:

The case study strongly supports a set of pre-design parameters. Every region has its own demands in order to react to and an accurate study of these demands make the job of a designer smooth and allows him to sail through the entire process without any trouble. The additional advantage is that having the base parameters studied and decoded there is an extremely rare possibility of going away from the decided path to achieve the desired results. With the process implemented in pre-design stage, one can have the best possible foot forward to decide a strategy which suits the best in the given conditions.

In the advance stage of academics, it is highly recommended to develop a strategy which becomes a design pattern of the student. Eyeing the end result and back-tracking it with the parameter study could be a precise strategy that students can target for. All round thinking process is what is expected at the pre-design stage and through study of the ground realities can certainly change the outcome of the project. Forecasting the future needs of the structure considering the given climatic conditions is something that comes with a practice and academics is the best possible platform to get trained for it.

In academics it is not very uncommon to have case studies but it is limited to selection of a similar setup of a case study which gives a clear-cut guidelines about how to handle the given set of requirements as far as user group is concerned but at the same time it is extremely important to study what sort of climate response the structure is going to have. The parameters once listed can be explored at micro level to have a design methodology catering both physical and environmental needs.

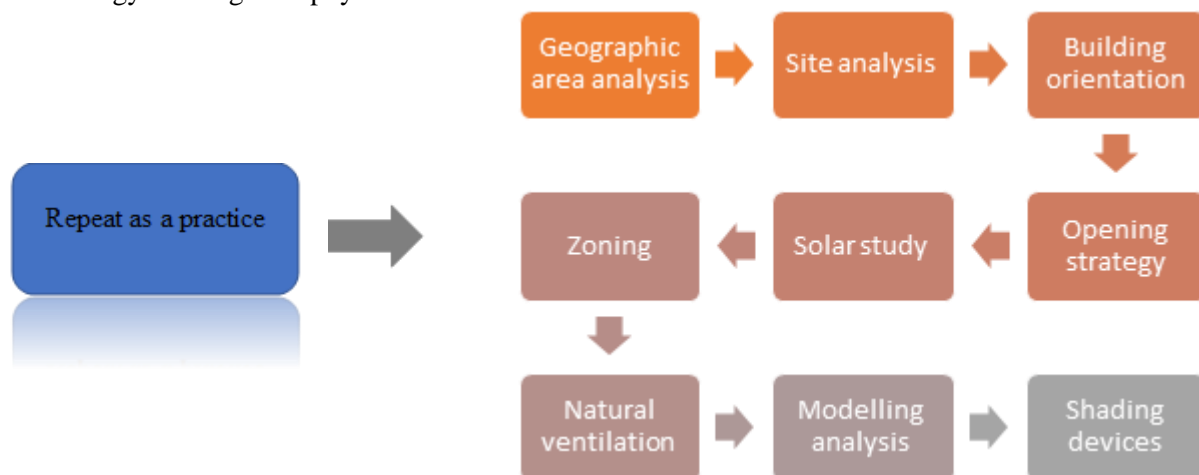


Figure 7: Showing parameters of climate responsive pre-design strategy  
(Source: Author compilation)

### Parameters to track for Climate responsive design solution:

- It's extremely important to consider which geographical area are you designing for in order to respond to the climate.
- Site analysis plays an important role in strategy formation.
- Building orientation, sun path calculations, opening analysis can be addressed with massing and façade strategies.
- Minimizing the building footprint and providing the maximum possible green area could prove extremely beneficial.

- A bunch of available softwares can guide to achieve comfort conditions in internal areas like Climate Consultant, Ecotech, EQuest.

## **10. Practical Implications:**

### **10.1 Design process maturity:**

Shaping up the design process is the key outcome of the design assignments given to the students in the course of architecture. Students are tested on the basis of their problem-solving abilities. As the design process, students are expected to identify the challenges that an architect comes across in order to fulfil the user requirements keeping in mind the other technical inputs including services, structural stability and so on. The proposal is expected to cover up all necessary aesthetical as well as mechanical aspects. Tremendous efforts are required to achieve the best outcomes but the 'best outcomes' can be turned into 'matured outcomes' by touching upon the environmental needs of the proposal. Attaining this maturity in design at an educational base can be a game-changing strategy. The maturity once imbibed at the academic level is easy to maintain in practice.

### **10.2 Logical approach:**

In addition to the maturity, logic in the design process is equally important. Certain strategies look fabulous and attractive on paper but practical implementation of the same may not be easy or executable. The term 'logic' includes an understanding of material selection, adaptive use of architectural elements in the proposal, effective give and take of weather conditions with the structure, current demands of users and future demands of the environment. How the structure responds to the weather conditions of the region and vice versa is what is expected in the environment sensitive approach. Developing the approach at the students' level is the need of the hour to create responsible professionals of tomorrow.

### **10.3 Environment-conscious professionals:**

Professionals are accountable for the achievement of comfort conditions. Especially when it comes to the field of architecture, the outcomes of the profession have a big impact on the environment. That is the reason why the role of the architect is considered to be the pivotal one. Having responsible professionals in this field is extremely important. Being a creative field, there is a plethora to explore for the architects but while exploring the solutions great consciousness is necessary to fulfil the environmental needs. Creating environment conscious professionals is not an easy task. Education system plays an important part to train the future professionals and that is the only way forward in order to achieve the desired results.

## **11. Social Implications:**

### **a. Setting an example:**

Societal needs are extremely important to address. Most of the infrastructural needs are taken care by the government policies and strategic planning with successful execution by the authorities. The physical necessities are satisfied with various schemes but environmental needs have to be taken care parallelly. Architectural interventions when take shape they have a major impact on environment and adverse effects of such trajectories can disturb the livelihood of the citizens. As a social responsibility, architects have to be tremendously well equipped with environment friendly approaches so that the adverse impact on the ecosystem



is minimized. Climate responsive and sustainable practice is the closest solution to achieve this and the necessary training required for this can be targeted by strategic pedagogic approach. Having environment sensitive architects in future could be the best asset a city or country can possess.

### **b. Climate-responsive results:**

Achieving climate responsive results can prove advantageous not only to resolve environmental issues but also living conditions of the users can be improve with the expected results. In order to sensitize the budding architects with environment conscious practices can result in better quality of life. The methodology also directs the students to explore and research various social conditions, varied lifestyles, weather conditions, cultural practices, professional needs of people living in various parts of the country. The expected outcomes could be different depending on the geographical location the project is situated in.

## **12. Conclusion:**

Correct pedagogic approach can guide students with appropriate approach to predict targeted results which can be channelized to overcome certain myths which students may possess in earlier stage of their academics. As it is been evident from the case study that a correct approach at the predesigning stage towards passive design can save up to 41.5% of energy annually, it's a high time that we, as architects need to understand and take environment consciousness seriously and make awareness of the same through our practice and train the budding architects at right time. It is observed that there is a huge gap between what is expected in the industry and the level of knowledge base students possess when they pass out of the institutions. Moreover, as a responsible professional, a graduate must have the attributes with the help of which he or she can serve the society with best of knowledge. It is a responsibility of the education system to equip them with what is the demand of the industry. The knowledge base can include software based environmental solutions, calculative approach towards ecological strategies while designing, social and economic impact of successful designs and so on. Education system can change the direction of graduates and direct them towards the responsible design. It is extremely important that graduates possess climate responsive strategies which have a strong back up of environmental theories, software application and calculative analysis at predesign stage. To target this, architecture pedagogy can experiment few strategies in classrooms to make graduates competent and confident to align themselves with the environmental and industry needs. This could be easily achievable if they are exposed to such strategies at student level and practice the same in curriculum for better future. Architecture is a branch of profession which along with other parallel branches directly affects the environmental balance. It becomes extremely important for us to align our goals and make ourselves stand as the protectors of environment and this is the only way forward (climate responsive pedagogic approach) if we want to get recognized as Environment Conscious Architects.

“If teaching has any purpose, it is to implant true insight and responsibility. Education must lead us from irresponsible opinion to true responsible judgement. It must lead us from chance and arbitrariness to rational clarity and intellectual order.”

## **Conflict of Interest:**

The authors have no conflict of interest to declare.

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# BNCA Research Hub (BRH)

BRH is a hub of activities conducted at BNCA related to Research in Architecture and allied/ specialized disciplines working on individual and collaborative research. BRH aims to become a versatile, inclusive and holistic knowledge building platform not only at local and national level, but also at international level. BRH intends to provide varied scales and types of opportunities for students, researchers, innovators, mentors, experts, professionals and funding agencies across the city, state, nation and world to participate, conduct, collaborate, publish and execute their research potentials and innovative concepts through forming and evolving Research Clusters of various subject domains as a long-term objective. This platform is envisioned to act as a Regional Research Centre, to facilitate and nurture the culture of research in architecture and allied disciplines, encouraging collaborative and participatory research from academia and industry/ practice.

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Professor, Head BRH (BNCA Research Hub)

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