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79th Independence DAY

15th AUGUST

Jai hind

THE INDIAN INSTITUTE OF ARCHITECTS

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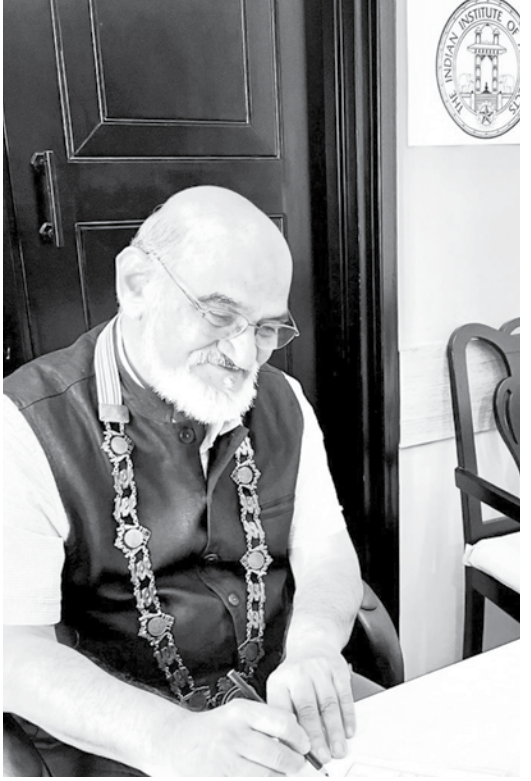
PRESIDENT'S MESSAGE



President's Message JIIA Aug. 2025
Is Architecture Still a Dream Career in India?

Namaskaar

From an Indian perspective, a recurring question is whether architecture remains a sought-after profession. While the past is remembered and the present experienced, the future is uncertain. What we can do now is set the direction to make architecture more relevant and in demand, especially considering India's vast potential.

The IIA Head Office is housed in *Prospect Chambers*, a name that reflects optimism for the profession's future. Looking at the numbers, India has about 400 architecture colleges, offering nearly 20,000 seats annually. With a population of 1.4 billion- roughly 310 million households- and only about 1,25,000 registered architects in 2025, the ratio stands at one architect for every 2,500 households. This clearly signals India's pressing need for architects.

Encouragingly, architectural education is evolving. Many colleges are introducing subjects such as sustainability, digital tools like BIM and GIS, and design thinking, preparing students for contemporary challenges. The new generation, born in the 21st century, is tech-savvy, environmentally conscious, and globally connected, placing them in a strong position to shape the profession's future.

Yet, continuous improvement is vital. Professional institutions and practitioners must lead reforms, strengthen standards, and foster industry–academia partnerships to ensure architecture thrives as an essential pillar of India's development.

Having said that, there is always scope for improvement by us. Our institutional bodies and practitioners need to take the lead. For this, I propose the six fronts to begin with:

1. ***Change the Story:*** **Architecture is more than buildings; it shapes society, addresses climate change, housing shortages, and ensures sustainable resource use with sensitivity and resilience.**

2. ***Reach Out to Schools:*** Engage high school students through workshops, open studios, and summer camps, letting them experience creativity, impact, and possibilities.

3. ***Make it Affordable:*** Provide scholarships and tie-ups with labs and field setups so students gain well-equipped, hands-on learning during their five-year education.

4. ***Stronger Internships and Mentorships:*** Students can get real exposure through well-structured internships. Firms and institutions should create mentorship programs that help students feel supported and connected to the profession.

5. ***Update the Curriculum:*** Integrate business, project management, and digital tools to prepare students to design, lead, manage, and innovate.

6. ***Show Career Options:*** Highlight diverse paths in policy, housing, urban design, technology, film, and gaming.

Architecture in India remains a respected profession, but to attract today's practical and career-focused students, we must meet them halfway. By making architecture inspiring, accessible, and rewarding, we can help them see it not just as a job, but as a meaningful way to impact society. Through collaboration between schools, professionals, and bodies like IIA and ARCASIA, we can reaffirm architecture's true purpose: to benefit people and the profession, beyond personal gain.

Thank you for your commitment to building not just buildings, but futures.

And looking at India, the prospects are plenty.

Dhanyawaad

Ar. Vilas Avachat
President, IIA

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EDITOR'S NOTE

Greetings to all IIA members from the JIIA Team.

We celebrated our 79th Independence Day on 15th August 2025. This is a reminder of our responsibility towards our nation to make sure that we stay united for our national interest, especially when the world is volatile and prevent destabilising the world's largest democracy and fastest-growing economy. As architects, we need to participate, apart from building physical infrastructure, in an intellectual framework for building a strong nation. It's time- as trained critical thinkers- to participate in the diverse interests of the nation.

We are extremely proud of the various social responsibilities taken by various Chapters like the IIA Himachal Pradesh Chapter to donate to people affected by natural calamity. All IIA Centres are doing phenomenal work in various aspects like outreach, social responsibility, students' activities through competitions and other events. It shows IIA's commitment towards creating a sensitive built environment and habitat.

We want to tender our best wishes to the delegation who will be attending the 21st Asian Congress of Architects in the coming month at Incheon, South Korea led by our dynamic president Ar. Vilas Avachat. This is a great forerunner for IIA to host ARCASIA Forum 2026 in India. Hosting this prestigious international forum is not only a great honour but also a profound responsibility, placing IIA firmly on the global architectural stage. To rise to this occasion, we will need meticulous preparation, innovative thinking and the wholehearted involvement of every member, so that together we can showcase India's architectural voice with clarity, confidence and pride. The journey ahead promises both challenges and opportunities. If we walk together, holding on to the values that define our profession and embracing every chance to learn and grow, we can shape a vibrant and inspiring future for architecture in India.

We are deeply grateful to our fellow IIA members whose dedication and hard work continue to create lively spaces for dialogue and the exchange of ideas. It is your passion that drives Indian architecture forward and ensures our voice resonates on the global stage. A heartfelt thanks also goes to the authors for their thoughtful contributions which adds immense value and makes this collective journey truly meaningful.

We encourage all IIA members to actively engage in these initiatives and contribute to demonstrating our collective leadership on the global architectural stage.

Stay united and stay ahead.

Jai Hind.

Prof. Vinit Mirkar
Editor, JIIA

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COVER THEME

हमर छत्तीसगढ़

By Devam Ghatak

The cover design for this edition presents the story of Chhattisgarh, a land of history, culture, nature, and tradition. Each part of the illustration highlights something important about the state.

On the left, the ancient Mahadev temple of Pali shows the historical and spiritual legacy of Chhattisgarh. In the past, the region was known as Dakshin Kosala and is mentioned in the Ramayana and Mahabharata. It is believed to be the birthplace of Mata Kaushalya, mother of Lord Rama. Over time, dynasties like the Kalachuris, Nagas, and Chhindaka-Nagas built beautiful temples, forts, and sculptures that still stand today to keep alive this rich heritage.

At the bottom, the mountain represents the natural minerals that have made Chhattisgarh an important centre for industries like steel, power, and cement. Along with this, the illustration also shows the state's forests and wildlife. Nearly 40% of Chhattisgarh is covered with forests, home to tigers, leopards, sloth bears, wild buffalo, and many rare species. These forests and wildlife make Chhattisgarh one of India's most biodiverse states. Above the mountain, tribal life is shown. Tribals make up over a third of the state's population and have always lived in close connection with forests and natural resources. Their art, dance, music, and crafts bring out the beauty of their everyday life and culture.

In the centre, the Mahanadi River flows. It is one of the most important rivers of Chhattisgarh and a symbol of life and continuity. On both sides of the river, two islands made of rice grains remind us why Chhattisgarh is called the Rice Bowl of India. Rice farming is not only the main livelihood but also deeply connected with festivals, food, and traditions. On the far right, the vertical design of a Kosa silk saree. Kosa silk, made in places like Janjgir-Champa, is world-famous for its fine texture and craftsmanship, and it reflects the skill of Chhattisgarh's artisans.

Together, these elements present the true identity of Chhattisgarh, a land of forts and temples, forests and rivers, rice and silk, industries and traditions. The cover is not only an artistic depiction but also a reminder of Chhattisgarh's layered narrative: a state of forts, forests and faith, standing at the confluence of heritage and progress.

Devam Ghatak has been a student of Rachana Sansad's Academy of Architecture, Mumbai (IIA affiliated). During his academic journey, he served as the General Secretary of the Academy of Architecture, actively contributing to student leadership and institutional initiatives. He has also won national-level competitions and had the opportunity to represent India internationally in architectural competitions, reflecting his commitment to innovation and design excellence.
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JIIA Call
for Papers, Articles, Projects

The Journal of the Indian Institute of Architects invites original and unpublished contributions from members **ONLY** (academicians, practitioners and students) under the following FIVE categories. Submission in each category is strictly only through the respective google forms.

In order to be accepted for publication, all material sent in these categories should have the following components:

1. MS Word document file with text only. Please do not format it in anyway. The numbered captions for all the images will also be in this document.
2. Folder with all images (minimum 300 dpi), numbered according to the captions given in your text file
3. Photograph of the author/s (minimum 300 dpi).
4. Author biodata – Maximum 50 words.
5. PDF (optional)– showing the intended layout. This pdf should include text and all images, with numbered captions.

Category 1 : Articles

google form link: https://forms.gle/7pDFva1HDH4hfUyj8

Essays, interviews, articles (1500- 2500 words), book reviews (600 and 750 words), travelogues, sketches and photo-essays in the areas of architecture, planning, urbanism, pedagogy, heritage, technology, ecology, theory and criticism, visual design, practice or any other relevant subject pertaining to the built environment. (Details of the format will be available on the JIIA website).

- For a design project, please include the 'Fact File' with the following details : Project Name, Location, Plot area, Total built up, Structural consultants, Project completion. Also please give the photo captions and credits. Please ensure that the image is referred to within the text. For eg, "As seen in Figure 1…". This is essential for the layout.
- For design projects, plans and sections of the project are desirable along with the photographs.
- Book reviews should be only of books by Indian authors. please include the "Fact File" with the following details: book title, author name, publisher, year of publication, ISBN, language the book is written in, genre (technical/ fiction/ etc.), no of pages, dimensions (in cm), type (Kindle/ paperback/ hardback), available at (amazon.in/ flipkart.com/ others).
- Please send a write-up of about 200-300 words along with sketches and photo-essays.

Category 2 : Student Work

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Summaries of dissertations (2000-3000 words) at the level of B.Arch. & M.Arch., and theses at the Ph.D. level. The Guide for that work will be mentioned as the Co-author. (Format will be available on the JIIA website).

Category 3 : Contributions from Chapter Correspondents

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(a) *Chapter News:* This includes various interesting activities from the Centres of your Chapters (maxm. 500 words for the news from the *entire* Chapter).

(b) News of conferences by the academic institutes in your respective Chapters.

(c) *Obituaries :* Obituaries of IIA members should consist of the photograph of the departed soul, the dates of birth and death and a short 50-word note.

Category 4 : Research Papers

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Research papers (2000-5000 words) in the prescribed format. The research may be based on their ongoing or completed research. (Format is available on the JIIA website). All contributions in this category will be double blind peer-reviewed before being accepted for publication by academic experts of repute.

Category 5 : Cover Design

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Students from affiliated colleges are invited to design the cover page theme. This should be a graphic based on some aspect of Indian Knowledge Systems. The submission will include the graphic file (jpeg or corel draw); a theme note (with a title) of about 500 words explaining the concept of the graphic.

Please note that the image you send will be adjusted as per the layout requirements of the JIIA Cover.

Please note:

1. All submissions will be accepted only through google forms.
2. Submissions will **NOT** be accepted through email.
3. Any queries to be addressed to : jiiaeditorial@gmail.com.
4. When you correspond with us, please give your email id (that you regularly use) and your cell no. (preferably with WhatsApp).
5. It is compulsory to mention your IIA regn. No. Submissions will **NOT** be accepted from non-members.
6. The review process takes anywhere between 4-6 weeks. Since it may not be possible to respond to all authors who send in their work, we will definitely revert if and when your work is accepted.
7. JIIA does not charge any fees for publication of any professional or academic work.
8. It is understood that submission from an author is an original work, unpublished anywhere else, and that IIA and JIIA are in no way responsible for any matter or dispute arising out of the publication of the same.
9. All authors are requested to refer to further detailed information available on the JIIA website.

RESEARCH PAPER

This research paper was presented at the IIA ANVESHAN Research Conference held at MCAP, Thiruvananthapuram, Kerala, 29-31 August 2024, under Stream: The Significant Present

Guidebook to Kerala Re-Inventing Kerala Tourism Infrastructure

By Frank Jose

Abstract

Tourism never existed alone. Architecture and tourism are very well related. A fair contribution to tourism development is through infrastructure development. However, none of these would be possible without integrating resources, ideas and facilities in the tourist destination. A clear path of travel of itinerary and its execution would become the best experience for a tourist. This would require factors like 'what do I get to see?', 'how do I get there?', 'where do I stay?'. These are the exhibit, path and infrastructure that need to be integrated to serve the visitor. The potential of Kerala, as showcased by the exhibit, is huge; however, seamless integration and connection are the missing factors. Sustainable development of physical infrastructure involving or resulting in community development should be the key. Kerala, a state in India, is often cited as 'God's own Country' to project its unique advantages on the tourism front, beautiful natural environment, vast beaches and backwaters, moderate climate throughout the year and so on. The fact remains, however, that Kerala's tourism potential is not properly utilised and that the unscientific use of the State's natural resources has led to the fast degradation of the natural environment, thus adversely affecting sustainability in the long run. This research seeks to critically analyse the situation of Kerala tourism and policies of the Government of Kerala from the perspective of the natural environment and its sustainability and address the current ecological aspects of the tropical region that tourists immensely love and develop an integrated tourist circuit map that can develop the local infrastructure, boost the local economy and thereby re-invent facilities for local, domestic and international tourists.

Keywords: Kerala Tourism, Sustainability, Park System, Urban Design, Regional Development

1. Introduction to Context

Kerala, a state situated on the tropical Malabar Coast of southwestern India, is one of the most popular tourist destinations in the country. Named as one of the ten paradises of the world by National Geographic Traveler, Kerala is famous especially for ecotourism initiatives and beautiful backwaters. But the fact remains that there are growing apprehensions regarding the sustainability of the nature-dependent sectors like tourism, since Kerala's natural environment is facing serious threats because of the unscientific use of natural resources. This, in turn, has resulted in the fast degradation of the State's natural resources and endowments. Accordingly, tourism activities that do not harm the natural environment alone could be sustainable in Kerala in the long run. Moreover, it may be noted that many of the environmental crises faced by Kerala are rather 'irreversible' too (Oommen, 1999) and such resources have been 'lost forever'.

1.1 Aim and Objectives – Tourist Map

Tourism is one of the key industries in Kerala and it has been growing rapidly over the years. However, the growth of tourism has also brought in its wake a range of environmental, social and cultural problems. To overcome these challenges and develop Kerala as a developed and model state, sustainable tourism can play a crucial role. This requires the need for a 'Tourist Map'. Tourist Map is a metaphor. It is not a map that just has places to visit. The proposed Tourist Map is an architectural guideline that portrays the need for physical infrastructure based

on requirements to develop a transit of seamless tourism experience.

1.2 Re-Invention: Why, What & How?

Since becoming a state in 1951, Kerala has made remarkable progress in areas such as education, healthcare and social welfare. The state has a unique social fabric and has been successful in achieving relatively high standards of living for its citizens. However, challenges such as income inequality, population density and environmental degradation remain areas of concern that require continued efforts for sustainable development.

Human development indices seemed to show a standard of living that was comparable to life in developed nations, despite low-income rates. Despite having high standards of human development and a 100% literacy rate, the Kerala model ranks low in terms of industrial and economic development.

Tourism contributes to nearly 10% of the state's GDP. Total GDP: US$130 billion (2021-22) (United Nations Development Programme, 2006). Comparing the GDP of Kerala to other countries, it is observed that equivalent to Morocco, with a rank of 62 in 2018, the Czech Republic, with a rank of 47 in 2017 and the GDP of Sri Lanka is 84 billion USD.

The question of how this re-invention should be is demonstrated in Figure 1. Singapore developed into a metropolis from 1980 to 2022, whereas the Netherlands developed to bring more nature. Both of them are developments that have boosted the local economy and contributed to the community. So, how should Kerala develop? Should it be developed as a metropolis or utilise its nature to be a modern hub of sustainable tourism? The aim should be to bring a perfect balance of both.

1.2.1 Why, What & How? – Develop City for Citizens!

The development of Kerala as a whole, which is geared towards its citizens and tourists alike, can bring about numerous benefits through sustainable tourism. Firstly, it can help improve the quality of life for citizens of Kerala by providing them with better infrastructure, healthcare facilities and employment opportunities. This, in turn, can help to reduce poverty and promote economic growth in the state. It can help preserve the natural beauty and cultural heritage of Kerala, a major tourist attraction. By adopting sustainable tourism practices, the state can ensure that the environment is not degraded and that the cultural heritage is protected for future generations.

Figure 1: The illustration demonstrates the need for a re-invention for Kerala by comparing it to the Netherlands and Singapore
Source: Author

In order to achieve the development of Kerala as a city that is developed for its citizens, along with tourists, with sustainable tourism, there are a number of steps that need to be taken. Firstly, there is a need for proper planning and management of tourism activities. This includes developing a comprehensive tourism policy that takes into account the needs of both tourists and local communities. The policy should also ensure that tourism activities are carried out sustainably, with a focus on minimising the impact on the environment and local communities. This reinvention of Kerala in the architecture front should focus on the preservation of cultural heritage, climate-responsive design, economic development and social and community development. By reinventing its architecture, Kerala can create more livable and sustainable communities that promote social cohesion and well-being.

1.3 Ecological Overkill & Need for Protection

Over the years, a variety of challenges have affected the backwaters and threatened the ecosystem, such as contamination from pesticides that farmers use in paddy fields, dumping of chemical emissions from factories and sewage from cities, unregulated sand dredging for construction and, in recent decades, the tourism boom that has worsened water pollution. Further, the issues are environmental degradation, climate change, lack of infrastructure, unemployment, marginalisation and social issues.

1.3.1 Environmental Management & the Competitiveness of Nature-Based Tourism Destinations

The costs incurred by tourism businesses due to environmental management reduce the competitiveness of the destination's tourism industry compared with other common destinations. Tourists are drawn to the region (demand) because of its superior environmental attractions and protected status. (Bennett, 2002) Nature-based tourism is otherwise a "green and clean" tourism industry. Figure 2 illustrates how regulations can improve tourism.

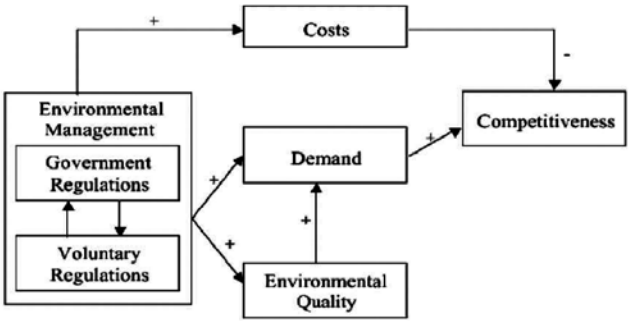

Figure 2: The chart illustrates how regulations can improve tourism
Source: Dwyer & Edwards, 2003

2. Literature Review

2.1 Tourist Gaze, John Urry

Global tourism is a complex and dynamic industry that involves the movement of people across borders for leisure, business, or other purposes. John Urry's "Tourist Gaze" theory emphasizes the role of tourism in shaping and constructing social identities, cultural practices and economic relationships. It argues that tourists are not passive consumers of attractions, but active participants in the creation and transformation of tourist experiences.

If the particular place does not convey appropriate cultural meanings, the quality of the specific service may well be tarnished. There is, therefore a crucial 'spatial fixity' about tourist services.

2.2 Responsible Tourism, Cape Town

Responsible tourism is an approach to tourism that seeks to minimise the negative impacts of tourism on the environment, local communities and cultural heritage, while maximising the positive benefits for all stakeholders. The Cape Town responsible tourism initiative is a prime example of this approach, with its focus on promoting sustainable tourism practices that respect the environment, support local businesses and empower communities (Responsible Tourism Partnership, n.d.).

Cape Town is one of the world's premier tourism destinations, with approximately 2,172,836 International and domestic visitors in 2016 and Rs 14.1 billion was spent by tourists in 2016. However, tourism is not just a means to economic growth; it's also a field through which operators and tourism businesses can help create positive social, economic, cultural and environmental interactions in our country. Responsible tourism aims to meet the needs of tourists and the needs of our city.

Many tourists nowadays also look for a more unique travel experience and an intimate relationship with the countries they visit. They also want to leave knowing that their trip or travel did not have any negative impact or effects on the people or the environment they were in.

2.2.1 Is Responsible Tourism different from Sustainable Tourism?

Responsible tourism and sustainable tourism have the same goal: sustainable development. The pillars of responsible tourism are therefore the same as those of sustainable tourism – environmental integrity, social justice and maximising local economic benefits. The major difference between the two is that, in responsible tourism, individuals, organisations and businesses are asked to take responsibility for their actions and the impacts of their actions.

2.3 National Tourist Routes Project, Norway

In 1994, the Norwegian Roads Administration started a project to increase the attractiveness of eighteen scenic routes from Jæren in the south to Varanger in the far north (Figure 3 (a)). The eighteen routes are not connected. The idea behind the project was not to send tourists on a predefined round trip, but to invite them to make detours and discover spots they would otherwise have ignored and make small design interventions for tourists to interact (Statens vegvesen, n.d.).

Figure 3: (a)Small interventions across all the selected locations make the whole project connected and help the visitors to stop and interact with nature; (b) Norwegian Scenic Routes
Source: (a) Ellefsen, 2014; (b) Panoramio, 2013

The Norway tourist routes project (Figure 3 (b)) is an example of how tourism can be used to promote sustainable development and cultural heritage. This project aims to create a network of scenic routes that showcase Norway's natural beauty and cultural heritage, while also promoting sustainable tourism practices that minimise the impact on the environment and support local communities.

3. Methodology

The clarity in identifying various tourism sectors and seeing the current situation and identifying development requirements. Focus on the time aspect: The Tourist Map must be designed in different ways to accommodate the days the tourist might be spending time in Kerala. This should include the point of arrival, halt stations, travel route and point of departure, along with the visiting places.

Identifying the potential places of visit can be done via research and their current situation and need for development, if required, needs to be studied and charted. Priority and importance can be designated and places can be categorised. A circuit of roadways, waterways and airways connecting all these places is identified or suggested. Tourist Map would be guidelines for design development. Small interventions across all the identified locations (Figure 4).

4. Data Analysis and Findings

The major types of tourism in Kerala are Backwater Tourism, Culture Tourism, History, Art & Architecture Tourism, Beach Tourism, Medical Tourism and Hill Station Tourism. The aim is not to find more tourist types or places but to improve the current Tourist Places with more Infrastructure attractions and basic needs for sustainable development.

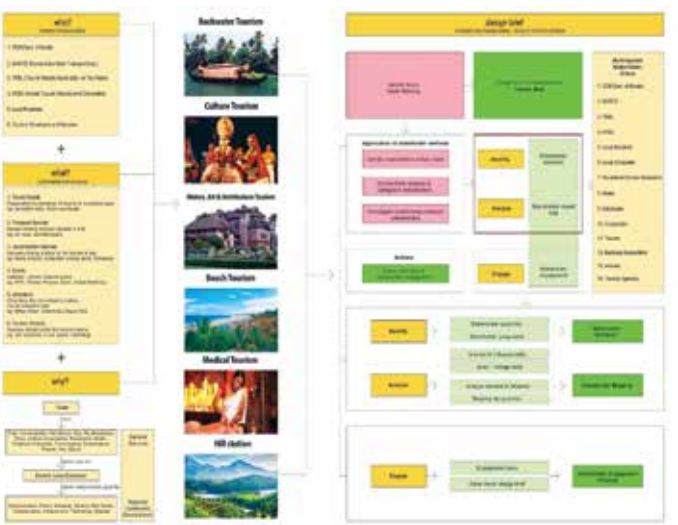

Figure 4: Study Methodology
Source: Author

4.1 Backwater Tourism

The Kerala backwaters are a network of brackish lagoons and lakes lying parallel to the Arabian Sea coast of Kerala state in southern India, as well as interconnected canals, rivers and inlets, a labyrinthine system formed by more than 900 kilometers (560 mi) of waterways and sometimes compared to American bayous.

The life of backwater-based communities has undergone significant changes from the 17th century to the 21st century. In the 17th century, backwater-based communities were primarily involved in agriculture and fishing (Figure 5). The economy was largely subsistence-based and people depended on natural resources for their livelihoods. The waterways were used mainly for the transportation of goods and people. The local communities had developed a system of canal-based navigation that was efficient and sustainable. The waterways were also used for irrigation and flood control. The backwaters were an essential source of freshwater and communities depended on them for drinking and household purposes.

Figure 5: 1760s vs 2020s, Illustration shows Backwater-based Daily Life: Backwater network and allied activities and means of livelihood.
Source: Author

During the colonial period, the British established trade links with Kerala, which led to the development of the port of Cochin. The port became an important hub for trade and the backwaters played a vital role in the transportation of goods. The British also introduced modern methods of agriculture, which led to the cultivation of cash crops such as rubber and tea. The introduction of cash crops and modern agricultural practices led to a shift from subsistence-based agriculture to a more commercialised form of farming. This shift led to a transformation of the local economy and people became more dependent on cash-based transactions.

In the 20th century, the backwaters became a significant tourist destination. The state government recognised the potential of the backwaters as a tourist attraction and started developing the infrastructure required to support tourism. The government initiated several projects, including

the construction of resorts, houseboats and tourist centers, to attract visitors to the backwaters. The development of tourism led to the creation of new job opportunities and helped to boost the local economy.

4.2 Kerala Cultural Tourism

Kerala is known for its diverse cultural heritage and natural beauty, which attracts a large number of tourists every year. While cultural tourism in Kerala has immense potential to contribute to the state's economy and socio-cultural development, it also faces several challenges and issues that need to be addressed. Some of the issues and challenges are commercialisation of culture, lack of infrastructure, lack of marketing and promotion, conflict with conservation efforts, preservation of cultural heritage.

4.3 History, Art & Architecture Tourism

Kerala's history can be traced back to the Neolithic period and the state has a rich tradition of art and architecture that reflects its history and cultural heritage. The state is home to numerous ancient temples, palaces and other historical landmarks that are popular tourist attractions. The art and architecture of Kerala are unique and have a distinct style that reflects the state's rich cultural heritage. History, art and architecture tourism in Kerala attracts around 1.2 million visitors annually. Kerala has a fascinating history that spans thousands of years. It was a major center for trade and commerce, attracting travelers and merchants from across the world since ancient times. The region was ruled by various dynasties, including the Cheras, Cholas and Zamorins. Kerala also had strong cultural and trade connections with ancient civilizations such as the Greeks, Romans, Arabs and Chinese, which influenced its history. Kerala's history, art and architecture offer a unique and captivating experience for tourists interested in exploring the rich cultural heritage of the region. With its ancient temples, traditional art forms and unique architectural styles, Kerala is a treasure trove for history, art and architecture enthusiasts, making it a must-visit destination for cultural tourism.

4.4 Kerala Beach Tourism

Kerala is blessed with a long coastline of about 580 km, which is dotted with some of the most beautiful beaches in India. The beaches in Kerala offer a perfect blend of sun, sand and surf, making them popular tourist destinations. Some of the most popular beaches in Kerala include Kovalam, Varkala and Cherai. Beach tourism in Kerala attracts around 1 million visitors annually. Beach tourism in Kerala offers a unique experience with its golden sands, swaying palm trees and azure waters of the Arabian Sea. The state is known for its diverse range of beaches, each with its charm and appeal, making it a must-visit destination for beach lovers and travelers seeking relaxation, adventure and natural beauty. The beaches of Kerala are not just about sun, sand and sea; they are also home to a diverse ecosystem that includes numerous species of flora and fauna. Beaches like Varkala and Kovalam are known for their unique rock formations, while Bekal is famous for its turtle nesting sites. The beaches of Kerala are also important nesting grounds for several species of migratory birds, making them a paradise for birdwatching enthusiasts. In addition to natural beauty, beach tourism in Kerala also offers opportunities to explore the local culture and cuisine. The state is known for its rich cultural heritage and tourists can witness traditional dance forms, music performances and art and craft demonstrations. The local cuisine, which includes seafood, coconut-based dishes and traditional vegetarian fare, is a gastronomic delight for food enthusiasts. Beach tourism in Kerala offers a unique and memorable experience with its pristine beaches, adventure sports, Ayurvedic treatments, diverse flora and fauna and rich cultural heritage. Whether it's relaxation, adventure, or exploration, Kerala's beaches have something to offer to every type of traveler. With its natural beauty, cultural richness and warm hospitality, Kerala is truly a paradise for beach lovers and a must-visit destination for those seeking a rejuvenating beach holiday.

4.5 Kerala Medical Tourism

Kerala is fast emerging as a popular destination for medical tourism, with an increasing number of tourists coming to the state to avail of high-quality healthcare services at affordable prices. Kerala is known for its traditional Ayurvedic treatments, which are becoming increasingly popular among tourists seeking alternative treatments for various ailments. The state also has several modern hospitals and healthcare facilities that offer world-class medical care. Medical tourism in Kerala attracts around 500,000 visitors annually. Medical tourism in Kerala, India, has emerged as a popular destination for international patients seeking high-quality healthcare services at affordable prices. With its state-of-the-art hospitals, highly trained medical professionals and picturesque natural beauty, Kerala has become a hub for medical tourists from around the world. Medical tourism in Kerala has gained significant momentum in recent years, owing to

its cost-effective healthcare, world-class medical facilities, experienced medical professionals, traditional healing practices, natural beauty and supportive government policies. With its unique blend of modern medicine and traditional healing practices, Kerala offers a holistic approach to healthcare that attracts international patients seeking high-quality medical treatments at affordable prices in a serene and rejuvenating environment.

Major issues in Kerala's medical tourism include consistency in quality of healthcare, language barriers, safety concerns, infrastructure and regulatory issues. The challenges facing medical tourism in

Kerala is complex and requires a collaborative effort by healthcare providers, policymakers and other stakeholders to ensure sustainable growth and success of the industry.

4.6 Kerala Hill Station Tourism

Kerala is home to several hill stations, which offer breathtaking views of the Western Ghats and provide a perfect escape from the scorching heat of the plains. Some of the popular hill stations in Kerala include Munnar, Wayanad and Thekkady. These hill stations are famous for their tea and spice plantations, wildlife sanctuaries and trekking trails. Hill tourism in Kerala attracts around 400,000 visitors annually. Hill tourism in Kerala also offers a chance to experience the local culture and traditions of the indigenous people who inhabit these regions. Tourists can interact with local communities, learn about their customs, taste local cuisine and witness traditional art forms such as Kathakali and Theyyam. Additionally, hill tourism in Kerala also promotes eco-tourism, with several initiatives focused on preserving the fragile ecosystem of the Western Ghats and promoting sustainable tourism practices. Hill tourism in Kerala offers a unique and tranquil experience for travelers seeking a getaway in the lap of nature. With its picturesque hill stations, lush green landscapes, abundant wildlife and opportunities for adventure and cultural experiences, Kerala is a perfect destination for hill tourism. Whether it's the misty tea gardens of Munnar, the dense forests of Wayanad, or the picturesque valleys of Vagamon, hill tourism in Kerala promises an unforgettable journey into the lap of nature.

5. Results and Discussion

Each of the identified tourism types is evaluated and sites are selected for design interpretations and solutions.

5.1 Backwater Tourism

The need for Terminals across all the selected points as Hubs in the Integrated Water Network calls for identifying more locations across the State. The site of Alappuzha and its suggested design guidelines can be used as a prototype for the development of other Tourism Hubs, also through the participation of local architects, engineers, historians, artists and people.

The need for a new Houseboat Terminal is an excellent opportunity to develop the site not just as a Terminal but also as a Tourism Hub with resorts, Hands-on experience centres, Exhibition Centres, Education Theatres, Performing Arts Spaces and a Houseboat Terminal. This Hub should be a model for a series of Hubs that should be developed as median centres in the Tourist Map.

The current scenario of the Finishing Point Houseboat Terminal (Figure 6) is in a dilapidated state. The tourism factor of the design is not considered in most of the infrastructural developments in the current scenario. This needs to change. The need to include expert architects from the local context and artists and the inclusion of historians in the design phase to develop a true-to-context design that genuinely reflects the architecture of the space, is of utmost need.

Figure 6: The Design illustrates the need for a Bilbao effect to transform the finishing point and annex
Source: Compiled by Author

The need to include local context into consideration, such as the ecology, to develop design interventions that accommodate the traditional architecture to solve modern needs, would be the ideal solution. This would require the participation of the architects, designers and thinkers from the region to respond to the needs.

5.2 Kerala Cultural Tourism

Developing cultural tourism in Kerala can be a great way to showcase its unique identity to the world and generate economic benefits for the local community. Kerala is known for its vibrant festivals and events, such as Onam, Vishu, Thrissur Pooram and the Nehru

Trophy Boat Race. By promoting and marketing these events to tourists, Kerala can attract visitors who are interested in experiencing its cultural traditions. Develop cultural trails and heritage walks. Kerala has a rich history and cultural heritage that can be explored through walking tours and cultural trails. By creating well-marked routes and providing visitors with information about local history and traditions, cultural tourism can be promoted. Encourage homestays and community tourism. Homestays are a great way for tourists to experience local culture and traditions while supporting the local community. By encouraging more homestays and community tourism initiatives, Kerala can provide tourists with an authentic cultural experience while also generating economic benefits for the local community. Develop cultural centers and museums. Kerala has a rich history and cultural heritage that can be showcased through cultural centers and museums. By creating cultural centers and museums that showcase the state's unique identity, Kerala can attract visitors who are interested in learning more about its history and traditions. Offer traditional arts and crafts experiences. Kerala is known for its traditional arts and crafts, such as Kathakali, Mohiniyattam, Kalaripayattu and handloom weaving. By offering experiences that allow visitors to learn about and participate in these traditional arts and crafts, Kerala can provide a unique and memorable cultural tourism experience (Figure 7). Developing cultural tourism in Kerala requires a concerted effort from the government, local communities and tourism industry stakeholders. By working together to promote Kerala's cultural heritage, the state can attract visitors who are interested in experiencing its unique identity and traditions.

Figure 7: An illustration of Kadhakali being performed as a similar Broadway show
Source: Compiled by Author

5.3 History, Art & Architecture Tourism

Developing History, art, and architecture tourism in Kerala would require a comprehensive plan and a coordinated effort among various stakeholders, including the government, private businesses, and local communities (Figures 8 (a) and (b)). Preservation of Heritage Sites, promotion and marketing, packages and guides, cultural festivals, skill development, and infrastructure development are some steps to promote this type of tourism (Shinde, 2014).

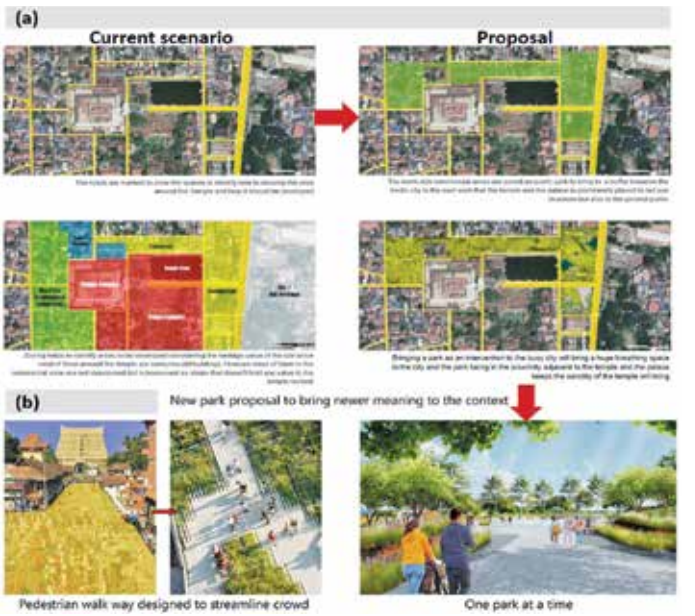

Figure 8 (a): Need for park system- The location is one of many that can be developed as a connected park system; (b) An illustration of how the area should develop, not just in infrastructure, but also be pedestrian-friendly
Source: Compiled by Author

5.4 Kerala Beach Tourism

The site selected for the development of Beach Tourism is Varkala Beach. The idea is to develop the cliff and beach by bringing programs to connect these two together via infrastructure such as restaurants, beachfront seating and a hybrid stepped landscape (Figure 9).

Figure 9: Infrastructure developments, promoting eco-tourism, offering water sports, developing beach resorts, marketing and promotion, providing safety measures and developing community involvement should be some initiatives to boost beach tourism.
Source: Compiled by Author

5.5 Kerala Medical Tourism

Medical tourism in Kerala can be developed by promoting healthcare facilities. Kerala should promote its healthcare facilities that are on par with international standards. The government should invest in upgrading the medical infrastructure and technology to offer world-class services. Tie-ups with travel agencies. Kerala should tie up with travel agencies to promote medical tourism packages. These packages should include accommodation, travel and healthcare services. The state government should make the process of obtaining a medical visa hassle-free for patients from foreign countries. This can be achieved by establishing a dedicated medical visa cell to facilitate the process. The hospitals and clinics in Kerala should obtain quality accreditations such as Joint Commission International (JCI) and National Accreditation Board for Hospitals & Healthcare Providers (NABH) to build trust with foreign patients. The healthcare facilities should have multilingual support staff to cater to patients from different countries. This would help in removing the language barrier and provide a better experience for the patients. Kerala should leverage the power of digital marketing to promote its healthcare services to a global audience. Social media, search engine optimisation and email marketing can be effective tools for promoting medical tourism. Specialized medical services. Kerala should focus on providing specialised medical services like Ayurveda, yoga and alternative medicine to attract a specific segment of medical tourists who are interested in these services.

5.6 Kerala Hill Tourism

Kerala is known for its pristine natural beauty and the Hill Stations and High Ranges in the state are no exception. Developing tourism in these regions can attract visitors and create job opportunities for locals. The government should focus on building infrastructure like roads, bridges and connectivity to Hill Stations and High Range areas. This will make it easier for tourists to access these places. Promote the Hill Stations and High Range areas in Kerala in domestic and international markets through various media like newspapers, magazines, TV channels and social media platforms. Promote eco-tourism in the Hill Stations and High Range areas of Kerala. Develop trekking routes, bird watching spots and nature trails to attract nature lovers. Promote adventure tourism in Hill Stations and High Range areas by developing adventure sports like paragliding, rock climbing and rappelling. Encourage homestays and resorts in the Hill Stations and High Range areas to provide comfortable accommodation for tourists. Promote sustainable tourism practices in these establishments. Encourage the promotion and sale of local handicrafts and products in Hill Stations and High Range areas to generate income for local artisans and entrepreneurs. Promote cultural events and festivals in the Hill Stations and High Range areas to showcase the rich cultural heritage of the state. A sustainable and responsible approach to tourism development is crucial to ensure the preservation of the natural beauty of the Hill Stations and High Range areas in Kerala while promoting tourism.

6. Conclusions and Recommendations

Tourist Map as a guidebook, Kerala gives utmost focus to developing an integrated connection and infrastructure development that includes the built environment and a coastline park system, which is pedestrian-friendly.

Tourist map (Figure 10 (a)) as a guidebook is intended for the development of Kerala, focused on Tourism for economic revival, employment and business opportunities for the people of Kerala and for the tourism experience for the tourists. The guidebook is a guide to development, as it is a guide for tourists and citizens to learn about forgotten history when looking forward to development.

Tourist Map for Development: Kerala 2040

The need for an integrated network that connects the major cities, which is not part of the daily commute highways, is essential to develop a seamless tourist experience, not just for the visitors but also for the locals (Figure 10 (b)). Having such a network will zone the city traffic away from the relaxed tourist network. The Integrated Tourist Map is a connected network of various waterways from North to South of the state of Kerala that should be connected to form a continuous water path with designated hubs that develop as tourism hubs. This continuous Tourist Map should be connected with the tourism areas via roads and metro that connect each district, thus forming a necklace of connected networks. Further, a system of parks and bike lanes is proposed adjacent to the Water Path from North to South of the state of Kerala that completes the Tourist Map.

The Guidebook to Kerala can fuel the state's sustainable development. The strategies developed after extensive research and case studies are presented in this book in front of you. Implementing 'The Guidebook to Kerala' and developing the Tourist Map will give a sustainable Kerala 2040. The future of tourism development can be a fine line between development and destruction and we must be certain that we shouldn't let it slide to the latter!

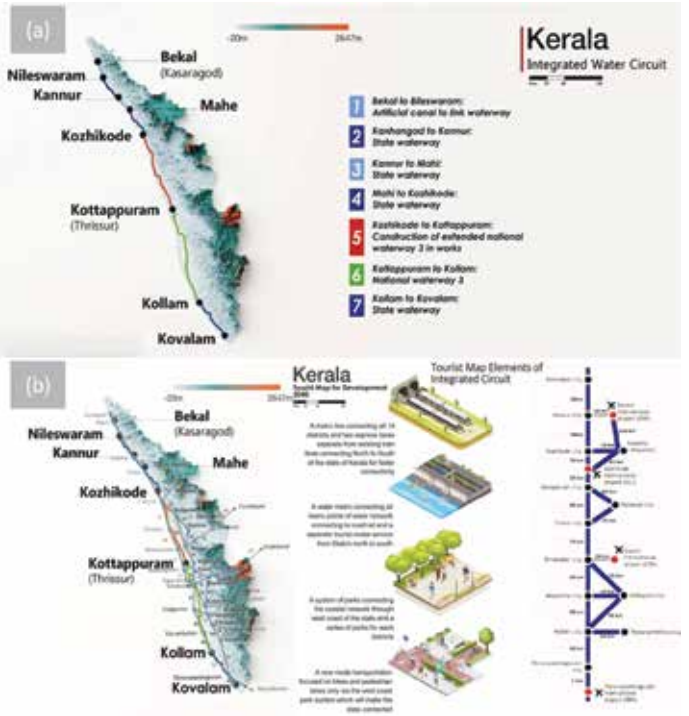

Figure 10: (a) The map demonstrates the need for a connected waterway from North to South of the state of Kerala to develop as an Integrated Water Network for not just tourism but also general transportation; (b) Tourist Map as a guidebook. Kerala gives utmost focus to developing an integrated connection and infrastructure development
Source: Author

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RESEARCH PAPER

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Design Strategies for Floating Buildings on Inland Water Bodies

By Fasna C and Karthik Mohan

Abstract

Floating architecture is a globally innovative solution to address challenges posed by rising sea levels, urbanisation and climate change. However, there is a need to advance further the design strategies for floating architecture to enhance its functionality. This research aimed to investigate and propose new design strategies for floating architecture, with a focus on inland water bodies in Kerala. Objectives included reviewing existing literature, identifying current challenges and limitations through case studies and proposing design strategies. The methodology involved comparing selected case studies, reviewing literature and analysing live examples to identify key design parameters. The study examined six case studies to assess the effectiveness of parameters like buoyancy, mooring systems, materials, superstructure weight and height, buffer height, water life, portability, wind and wave direction and water depth. Key findings suggest that adaptability and stability rely on strategies tailored to each identified parameter. Notable strategies include using strong mooring systems, curved designs with EPS bases for better buoyancy and building lightweight structures off-site for easy relocation. Materials should be lightweight and resistant to salt, such as steel or concrete. It is crucial to design based on the site, placing structures in shallow waters, regularly checking buffer heights and considering wave dynamics and aquatic environments. The study provides clear insights and strategies for creating flexible and sustainable floating architecture.

Keywords: Floating structures, Inland waterbodies, Buoyancy, Material selection

1. Introduction

The convergence of rising sea levels, floods, land scarcity and climate change present significant challenges for human society and the environment. Sea levels are rising due to the rapid melting of polar ice caps and glaciers, as a result of global warming. This threatens low-lying coastal areas, leading to the loss of valuable land and endangering coastal towns. Climate change also increases the frequency and severity of extreme weather events. These events devastate communities, destroy vital infrastructure and disrupt industries. Urbanisation and population growth have also resulted in land scarcity.

Floating architecture offers a creative solution to these issues. This architectural style provides adaptive protection against flooding and sea level rise while addressing land shortage problems. Floating architecture uses buoyant structures to build on water surfaces. These structures can reduce the burden on limited land resources and provide an innovative response to rising sea levels. Additionally, floating buildings can adapt to changing water levels during floods, reducing the risk of infrastructure damage (El-Shihy & Ezquiaga, 2019).

However, little is known about the specific design principles and effectiveness of floating architecture. The improvement in sustainability and usability of these structures required further research and innovation. Future efforts should focus on enhancing the engineering, materials and building techniques used in floating architecture to ensure their long-term survival and resilience. This research aims to explore and propose new design approaches that will improve floating architecture by critically examining the fundamental requirements for these structures.

1.1 Aim and Objectives

This research aims to formulate design strategies that can contribute to the enhancement of floating architecture on Inland Water Bodies.

Objectives:

- To review existing literature on floating architecture and its design strategies.
- To identify the current challenges and limitations through case studies.
- To propose design strategies for floating architecture on Inland Water Bodies.

The research process follows a logical progression; it starts with reviewing existing literature to build a foundation. Then, real-world case studies are analysed to identify challenges and limitations. Finally, the information is synthesised to propose viable design strategies. This approach ensures that the design strategies are well-informed, relevant and capable of addressing the unique challenges of floating architecture on inland water bodies. The research design allows for effective and innovative solutions.

1.2 Scope of the study

- The study will primarily focus on the design aspects of floating buildings.
- It will address unique environmental challenges, considering inland water bodies.
- Architectural and engineering considerations will be emphasised.

1.3 Limitations of the study

The study will be limited by the availability of data and information on existing floating architecture projects. It will not address the regulatory and legal aspects of floating architecture in detail. Additionally, varying environmental and climate conditions may impact the generalisability of the proposed design strategies.

2. Literature Review

2.1 Defining floating structure and Inland waterbodies

"Floating architecture" refers to the planning and construction of buoyant structures that rest on the water's surface. This approach offers a resilient living solution in response to rising water levels associated with global warming.

Floating architecture includes the creation of various structures, such as islands, homes, businesses and cities, on bodies of water for diverse purposes. These structures are characterised by their ability to float while maintaining a functional floor height above the water's surface, adapting to conditions like high tide and flooding. Initially focused on floating houses, the concept has expanded to encompass floating villages and even floating cities (Ambica & Venkat Raman, 2015; Lin et al., 2019).

Inland water bodies, located on land and not part of the open sea or coast, include lakes, rivers, ponds, wetlands and reservoirs. Lakes are large, land-surrounded bodies of water that host diverse aquatic habitats. Rivers are dynamic, shaping landscapes and supporting rich ecosystems. Ponds are shallow, natural or artificial, smaller than lakes and contribute significantly to biodiversity. Collectively, these inland water bodies support diverse ecosystems, serve as essential freshwater reserves and are important for recreation and cultural activities (Convention on Biological Diversity [CBD], n.d.).

2.2 History of floating structures

King Xerxes of Persia demonstrated early technical prowess in 480 BC by using two rows of floating bridges, each with about 300 boats, to guide his army across the Hellespont (now the Dardanelles). In 1874, a 124-meter floating wooden railroad bridge was constructed across the Mississippi River. The 98-meter Brookfield Floating Bridge, originally built in 1936, is still in use today. In Yanshan County, Jiangxi Province, China, a 187-meter floating bridge built in 1908 during the Qing Dynasty, with 42 boats connected by chains, remains operational. Around 3,000 BC, houseboats in southwestern India carried goods and passengers. Over time, buoyant structures developed. Today, floating architecture is proposed as a solution to environmental degradation and land scarcity, continuing a historical trajectory where floating structures have been crucial for sustainability, connectivity and mobility (Garkhel, 2020; Mor Temor, n.d.).

2.3 Significance of floating structures

Kerala faced significant challenges due to high-intensity rains and strong monsoon winds, which caused a precarious flood situation, particularly in central regions. Swollen rivers inundated low-lying areas, prompting the state administration to evacuate residents to relief camps, haunted by the bitter experience of the 2018 flood (The Hindu, 2022).

Limited land availability was a major issue, as highlighted by Shaffi Mather (2012), economic advisor to the Chief Minister, during a panel discussion on 'Emerging Kerala.' Additionally, large areas of central

Kerala, including Kuttanad, Vypin, Vaikom, Kochi Island and parts of Thrissur, were identified as high-risk zones for sea level rise. Implementing floating structures would be an effective solution to these problems (Nambudiri, 2019).

2.4 Components of mooring systems (Figures 1 and 2)

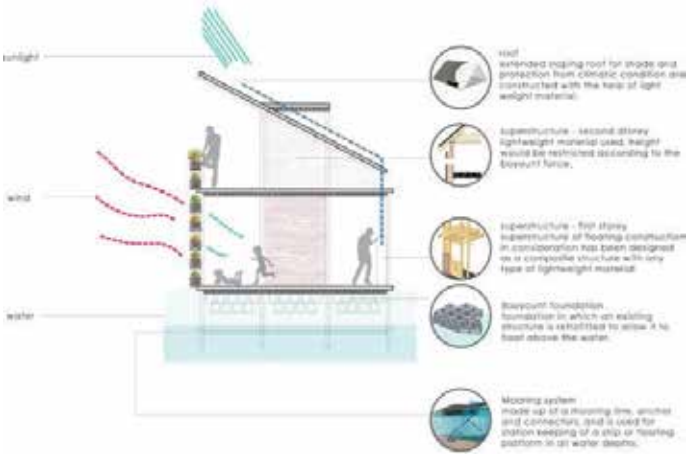


Figure 1: The basic components of a floating structure
Source: (FloodList, 2017)

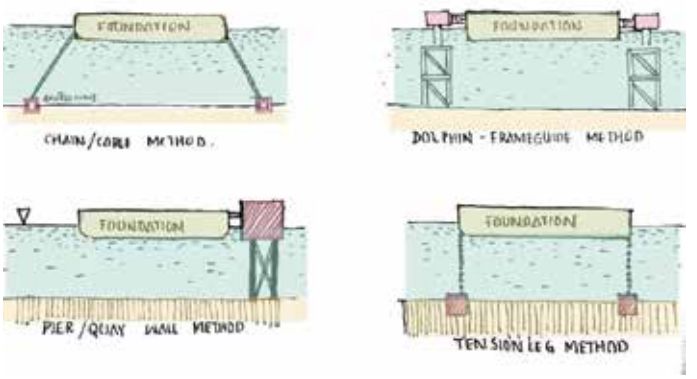


Figure 2: Different types of mooring systems
Source: (Garkhel, 2020)

2.5 Theories and principles

Archimedes' principle and Stevin's law

Archimedes' principle states that an item immersed in a fluid receives an upward buoyant force proportional to the weight of the displaced fluid. It is a foundational law of physics and fluid mechanics. This fundamental idea of hydrostatics provides both qualitative and quantitative insights into a wide range of natural events (Mohazzabi, 2017).

According to Archimedes' principle, buoyancy—an upward force experienced by a body submerged in a fluid—is equal to the weight of the displaced fluid. This concept determines the initial requirement for equilibrium. The center of buoyancy, which is the middle of the submerged hull, is where the force of buoyancy acts (Biran, 2003).

The second requirement is that the floating body's center of buoyancy and center of gravity must line up vertically, as stated by Stevin's law. When there is a small slope, the centroid of the waterplane is crossed by a line that connects the initial and inclined waterplanes. The center of buoyancy follows a curve when the inclination changes; this curve's center of curvature is known as the metacenter. If the metacenter is positioned above the body's center of gravity, stability in equilibrium is guaranteed for a floating body at the surface. The stability properties of floating bodies in fluid settings are determined by the interaction of forces and geometric factors (Biran & López-Pulido, 2014).

2.6 Identifying parameter (Figure 3)

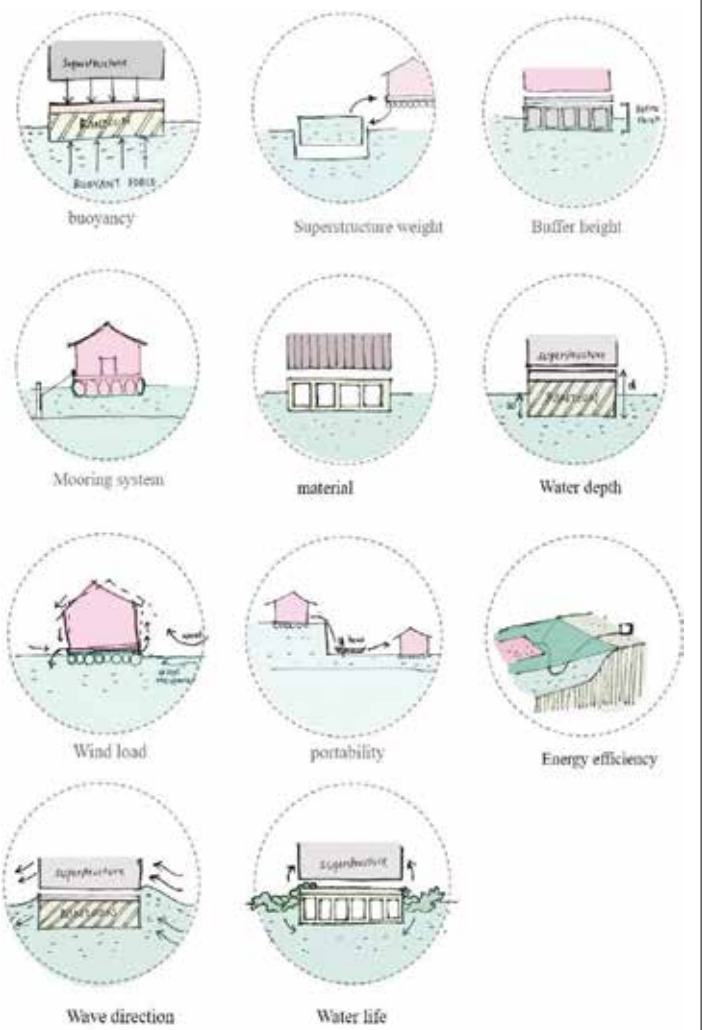


Figure 3: Identified parameters
Source: Authors

2.6.1 Buoyancy

The natural propensity of an object to float in a fluid due to pressure differences between the two sides of the object submerged in the stationary fluid is known as buoyancy (Ambica & Venkat Raman, 2015; JCB, 2019; Rehman, 2020).

Table 1: Functional, spatial and structural aspects of each parameter
Source: Authors

S.No	PARAMETERS	ASPECTS		
		FUNCTIONAL	**STRUCTURAL**	**SPATIAL**
I.	Buoyancy	Cater for incoming load, yet float. Buoyancy for floating houses makes them resilient to natural disasters. Earthquake Resistance	The centre of buoyancy should not shift much. The foundation should be of a geometric shape. structural stability	Symmetry. Material (The mass of the superstructure should be equal around the vertical axis.)
II.	Weight of superstructure. Weight stability		The lower the center of gravity, the more stable the floating structure. The design is carried out using lightweight construction materials and the entire structure has a stable arrangement.	Should be equally distributed to the foundation
III.	Structure height /high-rise buildings		Structural height is restricted by the depth of the foundation.	
IV.	Buffer Height		The floating house model is to be able to have at least 150 mm above the water surface when it is fully loaded.	Buoyant structures are curved on the bottom for better float.
V.	Energy-efficient	Ocean thermal energy conversion.		Usually kept exterior to the floating structure.
VI.	Water Depth			
	Local bathymetry		Sufficient water depth to prevent grounding.	
	Tides and currents		The mooring system dimensioning will be based on an average depth of 20 meters.	
	Waves		The height difference considers a mean tide of 1 m and a maximum wave height of 2 m, totaling approximately 2 m.	
VII.	Wave direction		Wave motion affects the structural stress of various platform sizes. The optimum platform size for stability and safety ranges between 45 and 75 meters. Translation forces on a floating object (6 degrees)	Symmetry.
VIII.	water life	Might affect the durability and maintenance of the structure		Designing the exterior of floating structures such that it keeps away any debris.
IX.	Wind load		Wind loading shall be applied to the completed floating home, including dead load and live load, but not off-centre loading.	The location of floating structures should be away from any wave disturbance
X.	Portability	Mobility Adaptation Rapid Installation and Ease of Assembly	This is also done for the maintenance of existing structural elements during water level rise.	
XI.	Mooring systems	Prevent jerking of the superstructure.	To prevent lateral displacement. Mooring prevents horizontal movements	Structurally looks unpleasant; thus, there is a need to enhance the aesthetic, especially the exterior.
XII.	Materials Selection			
	Titanium and its alloys	Lifespan more Maintenance	Durability more. Elements satisfy structural requirements, address the operating conditions, structural strength, serviceability, durability and safety standards	Built using light material, the thickness of the components is reduced for the reduction of structural load to the buoyant base.
	Local materials	Lifespan less	Durability is less	
	Vulcanised rubber.	lighter, easier to move and could be easily repaired and replaced.		
	Steel, concrete, steel concrete composite, advanced concrete and plastic.	watertight concrete or offshore concrete High-performance Concrete containing fly ash and silica fume is most suitable in corrosive salt water		

2.6.2 Superstructure weight

For a floating construction to be stable on moving water, weight stability is essential. For the structure to stay afloat, the weight of the structure must accurately balance the buoyant force (JCB, 2019; Ambica & Venkat Raman, 2015).

2.6.3 Water depth

In floating architecture, "water depth" is the distance from the water's surface to a structure's submerged base. It is crucial for stability, buoyancy and functionality. Engineers must consider water depth to ensure the safety and performance of floating structures (El-Shihy & Ezquiaga, 2019).

2.6.4 Buffer height

The size of the load is closely related to a foundation's depth. A heavier load requires a deeper foundation for support and stability, ensuring the structure's safety and integrity. Thus, foundation depth is a crucial engineering factor for structural longevity (Ambica & Venkat Raman, 2015).

2.6.5 Portability

In floating architecture, "portability" refers to the ease of moving structures on water. It is significant for regulatory compliance, emergency response, maintenance, transport, deployment and adaptability (Rehman, 2020; Habibi, 2015).

2.6.6 Material

In floating architecture, "material" refers to substances used for constructing water-floating structures. Their selection is crucial for performance, durability, weight management, environmental impact, modularity, aesthetics, functionality and cost (Garkhel, 2020).

2.6.7 Wave direction

In floating architecture, "wave direction" describes the direction in which waves come toward a building on the water. This metric is crucial for the planning and building of floating structures (Zhao et al., 2020; El-Shihy & Ezquiaga, 2019).

2.6.8 Mooring system

A mooring system, comprising a line, anchor and connectors, is essential for maintaining station-keeping in floating architecture. It ensures stability, flexibility, safety, minimal environmental impact and effective navigation in various water depths (Rehman, 2020; Zhao et al., 2020; El-Shihy & Ezquiaga, 2019).

2.6.9 Wind load

In floating architecture, wind load refers to the force that wind exerts on exposed surfaces, which is crucial for stability and safety. When designing and building floating structures, it is essential to account for wind load to ensure resilience and security against varying wind conditions (JCB, 2019).

2.6.10 Water life

In floating architecture, recognising aquatic life is crucial for environmentally sustainable practices. A comprehensive approach ensures floating structures respect conservation and environmental stewardship principles while fulfilling practical and aesthetic purposes.

2.6.11 Energy Efficiency

In floating architecture, "energy efficiency" involves designing, constructing and maintaining buildings to maximise energy use and minimise waste. This approach supports resilience, cost-effectiveness and environmental stewardship throughout the structure's lifecycle (Bradecki & Konsek, 2020).

3. Methodology (Figure 4)

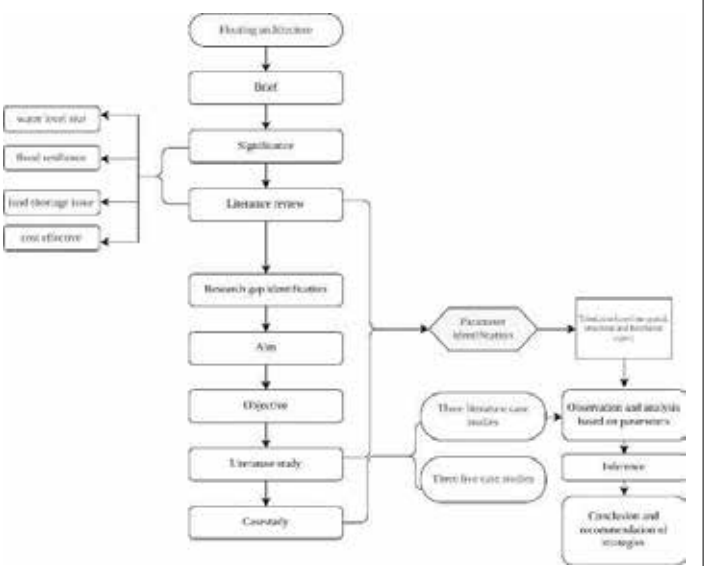


Figure 4: Methodology
Source: Authors

4. Data Analysis and Findings

4.1 Identified parameter for functional, structural and spatial aspects of floating structures (Table 1)

4.2 Literature case study

4.2.1 A case of 'Makoko floating school' in Nigeria by Ar.Kunle Adyami (Figure 5 and Table 2)

4.2.2 A case of 'Floating pavilion' in Rotterdam (Figure 6a and Table 3)

4.2.3 A case of 'Oregon Yacht Club flotels' in the USA (Figure 6b and Table 4)

Table 2: Observation tabulated by the parameters
Source: Liu, 2013

S. No	Parameters	Observations
1.	Buoyancy	The whole structure sits on a base of plastic barrels
2.	Weight of superstructure	14.5 tons - one ton of metal and 13.5 tons of wood
3.	Height of superstructure	950 cm excluding base
4.	Materials used	glued laminated wood sections for swirling and curved design. Makes versatile forms
5.	Portability	Disassembled after collapse.
6.	Buffer height	120cm
7.	Water depth	Shallow water depth -2.5m
8.	Wave direction	Jerks when boats pass nearby.
9.	Water life	Water with aquatic life. Murky, dark, sludgy water
10.	Wind load	Strong winds from the ocean nearby
11.	Mooring system	The mooring system has 4 anchors at the corners and a combination of temporary metal and wooden posts to keep it in place.
12.	Energy efficiency	Barrels at the periphery can be used to store excess rainwater from the catchment system.

Table 3: Observation tabulated by the parameters
Source: Garkhel, 2020; Deltasync, 2010; Fidgor & Bekker, 2010

S.no	Parameters	Observations
1.	Buoyancy	A pontoon is made of EPS combined with a grid of concrete beams
2.	Weight of superstructure	Low weight of the construction
3.	Height of superstructure	1190 cm; Excluding the base
4.	Materials used	Lightweight ethylene tetrafluoroethylene (ETFE) foils
5.	Portability	Replicability
6.	Buffer height	Above 60cm
7.	Water depth	Shallow river depth
8.	Wave direction	No jerking
9.	Water life	Can be used in flowing water
10.	Wind load	Does not affect much
11.	Mooring system	Rope-tied mooring system
12.	Energy efficiency	Solar thermal collectors & absorption material on the roof and PCM in the wall liquefy/solidify when the auditorium warms up/cools down.

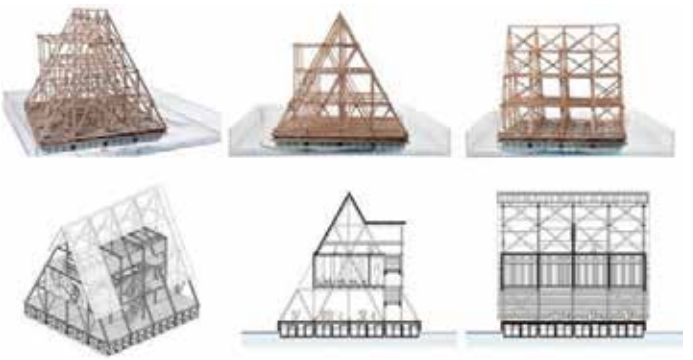


Figure 5: Prototype model of Makoko School; Isometric View; Section 1; Section 2
Source: Liu, 2013

4.3 Primary case study

4.3.1 A case of 'Poovar Island Resort' in Trivandrum, Kerala (Figures 7a and 7b and Table 5)

4.3.2 A case of 'Flotilla restaurant' in Veli, Kerala (Figure 8 and Table 6)

4.3.3 A case of 'Floating bridge in Veli, Kerala (Table 7)

4.3.4 Analysis

All the above case studies were thoroughly observed and compared based on the identified parameters. This process involved formulating a comprehensive comparative analysis and noting inferences for each parameter.

Comparative analysis has been presented in Table 8

5. Results and Discussion

A number of elements must be carefully taken into account during the design and construction of floating structures in order to guarantee their adaptability,

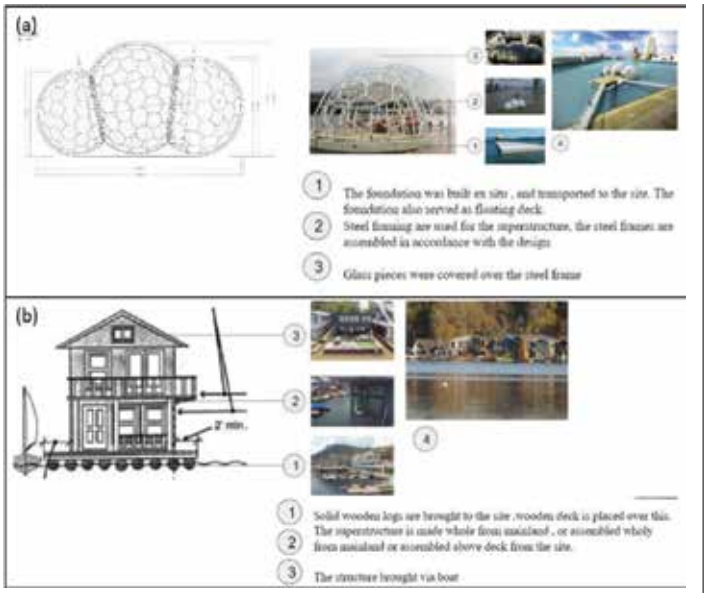


Figure 6: (a) Plan and construction stages of Rotterdam Flotels; (b) Construction stages of Rotterdam Flotels
Source: (a) Deltasync, 2010; (b) Oregon Yacht Club, 2013; Portland Yacht Club, 2023; Portland floating home, 2013

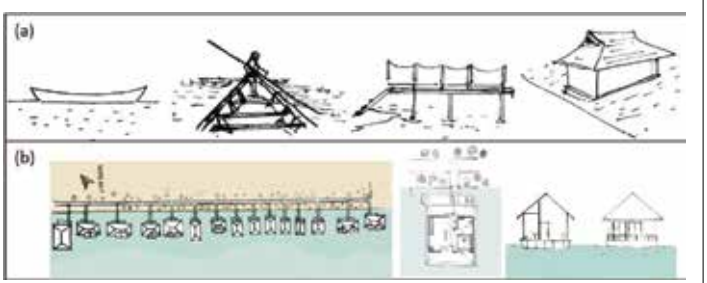


Figure 7: (a) The Island is accessed via boat from the mainland. Boat Service within 1 hour daily. Guests reach the island via a bridge. Floating cottages located to the west of Poovar island; (b) Plan, elevation and section of medium-sized Floating cottages located to the west of Poovar island.
Source: Authors

Table 4: Observation tabulated following the parameters
Source: Authors

S. No	Parameters	Observations
1.	Buoyancy	EPS is used for bases; an unsinkable, closed-cell structure, which consists of 98% air.
2.	Weight of superstructure	very light due to the material used
3.	Height of superstructure	900 cm
4.	Materials used	glued laminated wood sections for swirling and curved design. Makes versatile forms
5.	Portability	Easily portable by both dismantling and carrying via boat
6.	Buffer height	Depth of structure less than half of a concrete shell- 185 cm
7.	Water depth	Shallow river depth (400cm - 660cm)
8.	Wave direction	No jerking, can even be used in a river
9.	Water life	Can be used in flowing water (like a river)
10.	Wind load	Does not affect much when moored.
11.	Mooring system	anchored on 2 sides.
12.	Energy efficiency	(details not available)

Table 5: Observation tabulated by the parameters
Source: Authors; photography: Alice Maria Chungath)

S.no	Parameters	Observations	Images
A.	Buoyancy	Cement hollow foundation with a curved under base.	
B.	Weight of super-structure	10 ton - depends upon timber wall, ferrocement foundation, tiles and interior furniture.	
C.	Height of super-structure	595 cm including base.	
D.	Materials used	Concrete base, Glass doors, Malaysian teak wood wall, steel concrete composite	
E.	Portability	Easily portable via boat This made ex-situ construction easy	
F.	Buffer height	30 cm- 70cm	
G.	Water depth	Water rises seasonally	
H.	Wave direction	Structure Jerks when boats pass nearby, due to the undulating wave direction	
I.	Water life	Algal bloom causes issues. Leaks in the foundation. And regular maintenance is required.	
J.	Wind load	Since the roof is sloped, it does not affect much.	
K.	Mooring system	Cable mooring system. Anchored to the mainland and interconnected with adjacent units	
	Energy efficiency	Solar (50 KW)	

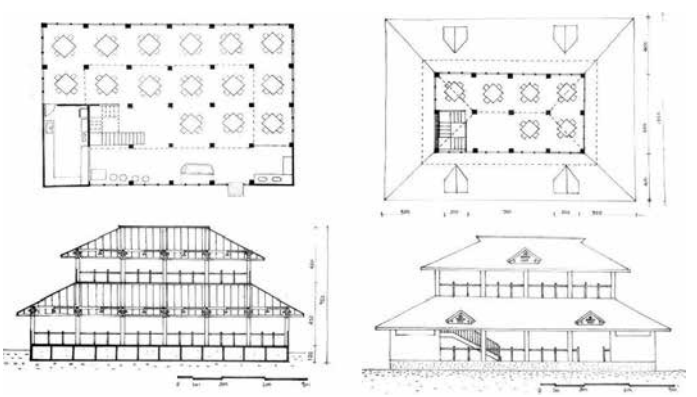


Figure 8: Plan, elevation and section of Flotilla restaurant in Veli, Trivandrum, Kerala
Source: Authors

stability and functionality in changing aquatic settings. Water depth, buffer height, wave direction, buoyancy, mooring systems, portability, material selection and superstructure features are among the important factors to take into account. Every one of these components is essential to the overall viability and sustainability of floating architecture.

Buoyancy *(Figure 9a and b)*
Buoyancy is a key concept in floating architecture, guiding the construction of foundations. A hollow foundation increases the upward buoyant force, enabling the structure to float effectively, especially with a curved design. Expanded Polystyrene (EPS)

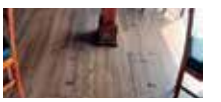
is often used to enhance buoyancy further. This is better than a solid base, which might get hard to maintain later.

Mooring system*(Figure 9b)*
For stability and control, an efficient mooring system is essential. Lateral force prevention is ensured when more than two floats are connected, ideally with a cable mooring system anchored with resilient materials like Dyneema or Nylon. The anchoring system affects the structure's aesthetic qualities in addition to its utilitarian uses.

Portability *(Figure 9d and e)*
When designing floating structures, the ease of mobility is a major factor. The key to improving portability is to build the structure entirely ex-situ, use lightweight materials and make sure it weighs little enough to be pulled by a boat.

Material selection *(Figure 9f)*
One of the most important factors affecting the floating structure's longevity and overall performance is the selection of materials. Durability and ease of maintenance are enhanced by the use of

Table 6: Observation tabulated by the parameters.
Source: Authors (photography: Alice Maria Chungath)

S.no	Parameters	Observations	Images
A.	Buoyancy	Cement hollow foundation with a rectilinear under base.	
B.	Weight of superstructure	About 16.2 tons. The load is mainly contributed by the timber used.	
C.	Height of superstructure	950 cm excluding base	
D.	Materials used	The superstructure is made of wild jack wood, teakwood and coconut trunk, while the base is concrete and steel with a shingled roof.	
E.	Portability	Easily Portable via boat	
F.	Buffer height	About 50 -90cm	
G.	Water depth	Shallow water depth, as it is very close to the mainland	
H.	Wave direction	Jerks in the structure when boats pass nearby.	
I.	Water life	Algal bloom causes issues. Leaks in the foundation and structure are already damaged. And regular maintenance is required.	
J.	Wind load	Does not affect much	
K.	Mooring system	Cable mooring system.	

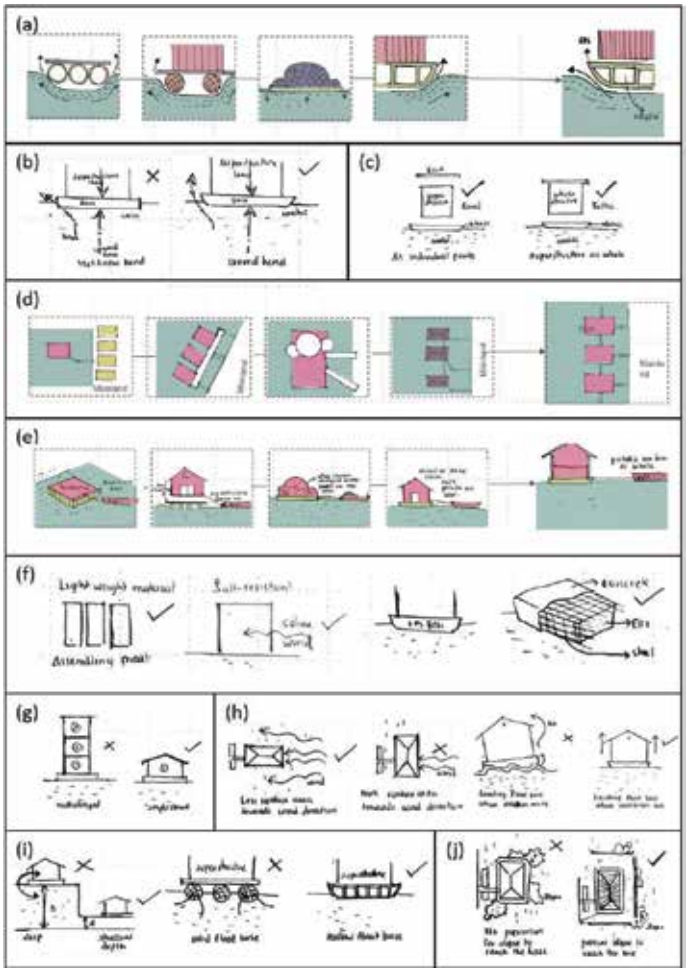


Figure 9: (a) Float base of Makoko school; yatch house; Rotterdam; poovar resort were analysed; (b) dos and don'ts to a floating structure for better buoyancy; (c) Best and better strategies for portability of floating structure; (d) Mooring system of Makoko school; yatch house; Rotterdam; poovar resort were analysed; (e) Relocation and dismantling of Makoko school; yatch house; Rotterdam; poovar resort were analysed; (f) Best and better strategies for materials used for constructing floating structure; (g) Dos and don'ts for constructing floating structure; (h) Dos and don'ts for constructing floating structure (i) Dos and don'ts for constructing floating structure; (j) Dos and don'ts for constructing floating structure
Source: Authors

lightweight materials for superstructures, resistance to salinity and a preference for concrete or steel in the structural system.

Weight and height of the superstructure *(Figure 9g)*
To ensure practicality and adaptability, choose lightweight and easily transportable superstructures, like panel-like aluminum or Polyurethane Foam (PUF) panels. The structure's maximum height is limited by the base's load-bearing capacity, which is usually between two and three stories.

Wind direction and wave direction *(Figure 9h)*
The surface exposed to the direct wind should always be minimised while orienting the flotels. Also, the structure may experience jerks and disruptions due to undulating waves. Finding the float where there is less wave undulation guarantees a more secure and cozy setting.

Water depth and buffer height *(Figure 9i)*
The best places for floating buildings are areas with shallow water depths of 2–7 meters off the coast. To determine sinking depth, check hollow buffer heights daily, considering variables like maximum capacity and potential foundation leaks.

Water life *(Figure 9j)*
When choosing a location, consider the presence of aquatic species and algae blooms. Algae blooms can affect the buoyant foundation's integrity, so preventative measures like water barriers may be needed to reduce maintenance issues.

6. Conclusions and Recommendations

To sum up, the study highlights key factors for constructing adaptable and stable floating structures. Essential elements include buoyancy, robust mooring systems, portability, material choice and superstructure characteristics. Key findings emphasise curved bends and EPS for buoyancy and lightweight, salinity-resistant materials like steel or concrete for portability.

Superstructure weight and height must meet load-bearing and transportability requirements. Context-specific design is crucial, considering site placement in shallow waters, buffer height monitoring and wave direction.

Overall, the study offers strategies for innovative, flexible and sustainable floating architecture solutions.

1. Buoyancy

- Hollow foundations should be used instead of solid ones
- Curved Bent in the foundation is preferable to cuboidal foundations. It increases the upward buoyant force, enabling the structure to float
- EPS material is preferred.
- Massing should be balanced; hence, symmetry is preferred.

2. Mooring system

- Better to construct more than two floats; interconnection of moorings in between prevents lateral displacement.
- Cable mooring system is preferable, since it's easy to move the structure in case of any hazard.

Table 7: Observation tabulated by the parameters.
Source: Authors (photography: Alice Maria Chungath)

S.No	Parameters	Observations	Images
A.	Buoyancy	Pontoons are used to provide buoyancy to the bridge.	
B.	Weight and Height of the Superstructure	The steel railing weighs little and is about 95 cm high. As more people cross the bridge, it jerks, making walking unstable.	
C.	Materials used	Steel railings, timber planks and concrete pontoon as base floats.	
D.	Buffer height	Pontoons have a diameter of 60 cm	
E.	Water depth	Wave depth is Deeper than the flotilla restaurant.	
F.	Wave direction	Undulating waves during strong winds can cause the bridge to sway.	
G.	Water life	Some of the pontoon units have already been damaged by the algal bloom and they are being tossed away to the adjacent mainland.	
H.	Wind load	As the Wave depth is Deeper, the bridge sways in a strong wind	
I.	Mooring system	Pontoons, anchored with coconut trunks and interconnected by nylon ropes, sway when user numbers increase.	

- Anchoring distance between 2 - 4m
- Anchored using Nylon, Dyneema fabric (UHMWPE) (excellent break load)
- The mooring system affects the aesthetic of the structure; hence, exteriors of the structure should be designed to compensate for this.

3. Portability

- It is easier to move as a whole than individual parts of the structure. So, ex-situ construction of the structure as a whole is preferred over in situ.
- Structure should be lightweight, so that it can be drawn by a boat.

4. Material selection

- Lightweight material should be used for superstructures.
- Material should be resistant to salinity, to avoid the necessity for monthly maintenance of the structure.
- Concrete or steel is preferable in constructing of structural system of a float.
- EPS or hollow concrete pontoons are preferred in constructing a floating base
- Material should respond to the microclimatic conditions of the region.

5. Weight and height of superstructure

- Lightweight superstructures should be used. It should be easily dismantled and easily transportable.
- Panel-like metal or PUF panels are preferable.
- Height of the structure is restricted by the load that the base can take.

Table 8: Comparative analysis of case studies accordance to the parameters.
Source: Authors

S. No	PARAMETERS	CASE STUDIES					INFERENCE
		Makoko School	Oregon Yacht Club	Rotterdam, Pavilion	Poovar Island Resort	Flotilla KTDC	
1	Buoyancy	The whole structure sits on a base of plastic barrels	EPS is used for bases; an unsinkable, closed-cell structure, which consists of 98% air.	Pontoon is made of EPS combined with a grid of concrete beams	Cement hollow foundation . Depth increases as structural load increases. Curved base.	Cement hollow foundation.	EPS can take more load as; buoyant force is high. Curved bent to increase upward force.
2	Weight of superstructure	14.5 tons – one ton of metal and 13.5 tons of wood	Very light due to the material used	Low weight of the construction	Average 10 ton – Depends upon timber wall, ferrocement foundation, tiles, interior furniture.	About 16.2 tons	Lightweight materials should be used
3	Structure height	950 cm excluding base	900 cm Excluding the base	1190 cm Excluding the base	595 cm including base	950 cm excluding base	Height is restricted by the buoyant force
4	Buffer Height	120cm	Depth of structure less than half of a concrete shell- 185 cm		Depends on the superstructure load. Usually 30-70cm		About 50 - 90cm
5	Wave direction	Jerks when boats pass nearby.	No jerking, can even be used in a river	No jerking	Jerks when boats pass nearby.		Jerks when boats pass nearby.
6	water life	Water with aquatic life. murky, dark, sludgy **water**	Can be used in flowing water (like a river)	Can be used in flowing water	Algal bloom causes maintenance issues in the foundation		Algal bloom causes issues with the foundation.
7	Buffer Height	120cm	Depth of structure less than half of a concrete shell- 185 cm		Depends on the superstructure load. Usually 30 cm-70cm		About 50 - 90cm
8	Wave direction	Jerks when boats pass nearby.	No jerking, can even be used in a river	No jerking	Jerks when boats pass nearby.		Jerks when boats pass nearby.
9	water life	Water with aquatic life. murky, dark, sludgy **water**	Can be used in flowing water (like a river)	Can be used in flowing water	Algal bloom causes a maintenance issue in the foundation		Algal bloom causes issues with the foundation.
10	water depth	Shallow water depth of 2.5 meters.	Shallow river depth (400cm - 660cm)	Shallow river depth	Water rises seasonally	Shallow water depth	A region with water of shallow water is preferable
11	Wind load	Lateral wind load causes sway; it collapsed during a storm	Does not affect much when moored	Does not affect much	Does not affect much, since the roof is sloped.	Does not affect much	Consider wind loads while designing the structure. Or else might get destroyed.
12	Materials Selection	Bamboo and wood from the local community	Glued laminate wood sections for swirling and curved design. Makes versatile forms	Lightweight ethylene tetrafluoroethylene (ETFE) foils	Malaysian timber, steel, concrete, steel concrete composite, advanced concrete and plastics.	Wild jack wood, teakwood and coconut trunk for the superstructure.	According to climatic resilience. Consider the alkalinity, salinity of water while choosing material, especially for the foundation.
13	Portability	Disassembled after collapse.	Easily portable by both dismantling and carrying via boat	Replicability	Structure relocated to a region with shallow Depth during the monsoon season, as water levels tend to rise.	Easily Portable via boat	Components should be such that it's easy to reassemble, so that it can be relocatable.
14	Mooring systems	The mooring system has 4 anchors at the corners and a combination of temporary metal and wooden posts to keep it in place.	Anchored on 2 sides.	Rope-tied mooring system	Tied and anchored on 4 sides.	Tied and anchored on 4 sides.	Mooring systems affect the aesthetic of the structure; hence, exteriors of the structure should be designed to compensate for this. Cable system used.

- 2- 3 Storey height preferred

6. Wind and wave direction

- The surface should be such that it diverts the wind. For this, a curved surface is better than a plain surface
- Surface area facing towards the wind direction should be less to reduce the lateral push of the whole unit
- Undulating waves can cause jerks within the structure.
- Locate the float where the undulation is less.

7. Water depth and buffer height

- Floating structures should be located in a region with shallow water depth.
- It should be near the land within a distance of 2- 7m from the mainland
- Floating structures placed far away from the mainland have more chances for lateral displacement and are hard to control the movement of the structure; people within might experience jerks.
- Rise and fall of the water depth should be studied before placing the float
- Depth of 1.5 - 2.5m is ideal for structures.
- Rather than a solid buffer, hollow buffers should be used.
- Buffer heights should be checked daily to understand the sinking depth of the structure. Sinking would be due to two reasons: either the structure has exceeded its maximum capacity, or the buoyant foundation leaks within it.

8. Water life

- Presence of aquatic species and algal blooms should be taken into consideration while locating the floats.
- If there is any such bloom, the chances for buoyant base damage might increase. This might make maintenance of the structure hectic.
- Necessary precautions, like locating a water barrier, must be taken in such a case

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STUDENT WORK

Redeveloping the 'Regional Science Centre'

into a Green 'Science City' at Dehradun

By Anudesh Saini; Guide: Ar. Vivek Sehgal

1. Introduction

Science City, managed by the NCSM (National Council of Science Museums) under India's Ministry of Culture, is a hub for interactive science education. Owned by state governments, it features exhibits, activities and displays promoting science and innovation, inspiring young minds and fostering public engagement in scientific disciplines. A Science City is conceptually similar to a Science Centre. However, it will be larger in scale with a focus in frontier areas of Science and Technology and edutainment. It is also financially self-sustainable. In this article it has been conceptualised as an attractive and useful public place for one and all.

1.1 Aim and objectives

The aim is to design a IGBC (Indian Green Building Certification) rated Science City campus that bring new ideas to the minds of the visitor by creating a space that showcases science and its achievement through interactive spaces. Accordingly, the following objectives have been formulated.

- To promote and enhance public understanding of culture of science and technology.
- To design a building for the public considering circulation patterns, open spaces and appropriate lighting.
- To achieve IGBC gold rated green campus
- To create a landmark for the city

1.2 Requirement of the project

- Space Odyssey or Planetarium: A planetarium is a theatre built primarily for presenting educational and entertaining shows about astronomy and the night sky, or for training in celestial navigation. A dominant feature of most planetariums is the large dome-shaped projection screen onto which scenes of stars, planets and other celestial objects can be made to appear and move realistically to simulate their motion. The projection can be created in various ways, such as a star ball, slide projector, video, full dome projector systems and lasers.
- Convention Centre: A 500-seated auditorium for multipurpose use like science education programs and science film show and for organising educational, cultural, industrial and corporate programmes. Besides, the convention centre an exhibition fair ground is also a part of the Science City along with two conference halls 100 seats and 50 seats each.
- Outdoor Science Park: To bring science outside the boundary of four walls, interactive exhibits are placed aesthetically in the lush greenery of the park. Children are expected to play with these while learning the fundamentals of science. Water body, aviary, herbal and medicinal plant corner, picnic area for visitors etc. are the added attractions.

- Gate complex: A gate complex will be the first building for the visitors to enter the Science City, thus, it consists of a ticket counter, waiting, interpretation center, toilets and commercial areas.
- Science Exploration Halls: It consists of exhibition spaces that of 10,000 sqm for science theme-based exhibitions

2. Site selection

The Regional Science Centre (RSC) in Dehradun is set to undergo a transformative redevelopment, evolving into a vibrant Science City, aligning with the visionary proposal put forth by the Uttarakhand Council of Science and Technology (UCOST). This ambitious project aims not only to enhance the existing scientific infrastructure but also to cultivate a dynamic hub that fosters edutainment zone in the state, ultimately positioning Dehradun as a prominent centre for scientific excellence and exploration.

The 29.27 acre site for the Regional Science Centre redevelopment in Dehradun lies at the foothills of the Jhajra Range mountains. With nearly flat terrain and minimal grade differences, the site offers an ideal canvas for the project. This expansive space, total of 1,18,451.50 sqm, allows for practical development, seamlessly integrating structures into the gently undulating landscape.

The site designated for the redevelopment of the Regional Science Centre in Dehradun holds a unique and strategic location along the picturesque banks of the Asan River, seamlessly connected by the Advani Bridge. Positioned approximately 13.3 kilometres from the heart of Dehradun city, the site is intricately woven into the fabric of diverse rural and urban landscapes.

2.1 Existing site condition

The on-site existing built-up of 5500 sqm comprises the science exploration hall (museum building facing towards west of south-west) and UCOST building (an office building facing towards north) (Figure 1). The structure of the existing regional science centre building is an excellent museum building and has a cut-cylinders shape frustum at the top as a design element. This element has been used widely in the overall campus and imparts an identity to the overall scheme. The proposed design continues to incorporate the element to retain the identity of the place.

3. Conceptual development

The master planning of the Science City is inspired by the inventions of Dr. Chintamani Nagesa Ramachandra Rao, his invention of nano-particles,

Figure 1: Existing site plan

particularly an organic liquid based NPS (polymeric nanoparticles) 'dendrimers'. The structure of dendrimer molecules begins with a central atom or group of atoms labelled as the core. From this central structure, the branches of other atoms called 'dendrons' grow through a variety of chemical reactions. This inspiration was collated with human attraction toward nature to achieve the proposed form of the building.

Biophilic architecture: The word 'biophilia' originates from the Greek, 'philia' meaning 'love of'. It literally means a love of life or living things. Humans have a deeply engrained love of nature which is an intuitive and natural drive imprinted into our DNA (deoxyribonucleic acid). Biophilic design is an approach to architecture that seeks to connect building occupants more closely to nature. Biophilic designed buildings incorporate things like natural lighting and ventilation, natural landscape features and other elements for creating a more productive and healthier built environment for people (Figure 2).

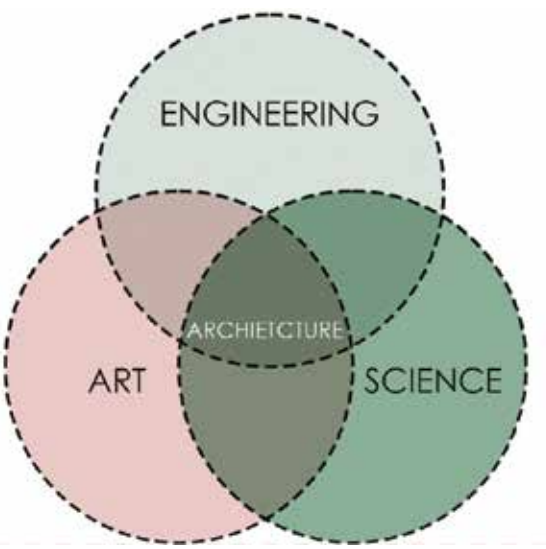

Figure 2: Concepts derived from art, science and engineering

4. Site planning

The vehicular circulation within the site follows a structured route, commencing from the entry point and leading directly to designated parking areas. Upon parking their vehicles, visitors are given the freedom to explore the premises through a network of pathways accessible upon entry through the gate complex. Furthermore, distinct parking facilities have been allocated for different groups, including visitors to the Science City, attendees of the convention centre and staff affiliated with UCOST. Also, provisions have been made for separate entry and exit points catering specifically to very important persons (VIPs), ensuring their convenience and security within the premises.

The site, sprawling over an expansive area of 29.27 acres, boasts of an intricately designed layout wherein approximately 12.93% of the land is enveloped by built structures, while the remaining 87.07% is thoughtfully allocated to open spaces, fostering a harmonious blend of architecture and nature. Among these open areas lies a meticulously crafted science park, dedicated to promoting exploration and discovery amidst the serene backdrop of lush landscapes (Figure 3).

4.1 Science Park

The proposal includes a dedicated Science Park, seamlessly integrated with the built-up area, serving as an edutainment zone for visitors. The park features themed exhibits of plants and flowers, carefully zoned to enhance visitor circulation, alongside picnic spots and commercial kiosks for a relaxed experience. A designed artificial lake with seating arrangements offers an ideal space for lighting and musical water shows, adding to the park's interactive atmosphere.

Additionally, the park houses an Open-Air Theatre (OAT) for group gatherings and functions and a hedge maze with science exhibits placed at the maze junctions for an engaging experience. Among the most captivating attractions is the bio-dome showcasing desert ecosystems and the Dino Park where artificial dinosaurs provide an unforgettable experience. This multifaceted design ensures the Science Park offers both educational and recreational value, enhancing the overall appeal of the Science City (Figure 4).

Figure 3: Proposed site plan

Figure 4; Proposed science park at the centre of the built-up area

4.2 Landscape planning

The rosary garden and cacti garden utilise terracing to create visually striking displays and improve visitor access. This design feature enhances the gardens' aesthetics and allows visitors to enjoy the plants from different perspectives as they explore the pathways.

Artificial lake planning: The central lake offers seating for visitors, doubling as a venue for captivating laser and music shows. This dynamic feature enhances the Science City's allure, providing immersive entertainment against the serene backdrop of the water. Visitors can enjoy these spectacular performances while relaxing in the picturesque surroundings of the lake.

5. Proposed Built-up spaces

Gate complex: The Science City gate complex serves as the welcoming entry point for visitors, thoughtfully designed to provide essential amenities such as ticket counters, an interpretation centre, assistance desks, souvenir shop, cafeteria and restrooms. Drawing inspiration from Dehradun's local pitched-roof architectural style, it reflects the region's cultural heritage while ensuring functionality and aesthetic appeal. The unique design concept is based on a sinusoidal wave form, derived by slicing a cylinder at a 45-degree angle, which shapes the gate complex and creates two engaging plazas, adding a distinctive architectural element to the site (Figure 5 and 6).

Space odyssey: The Space Odyssey at Science City celebrates ISRO's (Indian Space Research Organisation) remarkable space achievements through immersive exhibits and interactive displays. It features a 200-seat planetarium, a 50-seat "Science on Sphere" facility and an exhibition hall. The thoughtfully zoned oval space separates the planetarium and sphere areas, ensuring efficient design and engaging visitor experiences in space exploration (Figure 7 and 8).

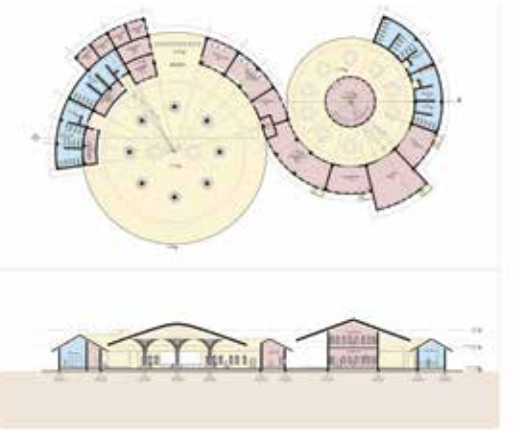

Figure 5: Gate complex - plan and section

Figure 6: Gate complex

Figure 7: Space odyssey

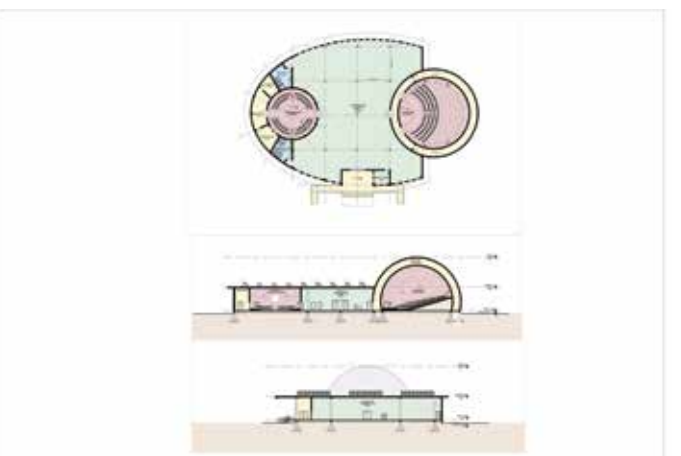

Figure 8: Space odyssey - plan and section

Science exploration hall: The Science Exploration Hall serves as the focal point of Science City, offering an immersive journey through diverse scientific disciplines. It comprises four expansive halls of 600 square meters each, featuring thematic exhibits designed to unravel scientific principles and phenomena. The hall also includes dynamic supplementary attractions like a digital panorama and a capsule simulator, enriching the visitor experience.

Its unique feature is a gently sloping infinity-shaped ramp (1:12 ratio), symbolising the limitless possibilities of science. This innovative vertical circulation system, complemented by modern lifts, ensures effortless movement between levels while inspiring visitors with the boundless potential of scientific exploration.

The circulation within the Science Exploration Hall follows a fixed path, guiding visitors through a structured journey of discovery. Upon entering the building, visitors are directed through themed exhibition halls 1 and 2 on the ground floor. Exiting exhibition hall 2, visitors encounter a ramp leading to the first floor, where they explore exhibition halls 3 and 4.

From there, another ramp leads to the second floor, where special exhibitions and a thematic tour await. The thematic tour commences on the second floor and proceeds to the basement via a 20-passenger lift. After exploring the basement exhibits, visitors have the option to exit either through a staircase or a ramp, completing their immersive journey through the Science Exploration Hall (Figure 9).

Figure 9: Science exploration hall at the right and existing RSC building at the left

Convention centre: The convention centre is vital for the financial sustainability of Science City, generating revenue through events and conferences, ensuring long-term viability. It includes a 500-seat auditorium, two seminar halls (100 and 50 seats), a conference hall and a 1.5 acre fairground for exhibitions. Inspired by two perpendicular ovals, its layout creates distinct zones for the auditorium and seminar halls, optimising space and functionality for diverse gatherings.

6. Conclusion

In conclusion, the proposed Science City project exemplifies a harmonious blend of sustainability, innovation and functionality. Designed in alignment with IGBC Green Campus design strategies, it achieved a gold rating academically. With an impressive 87% green cover, solar energy integration, a rainwater

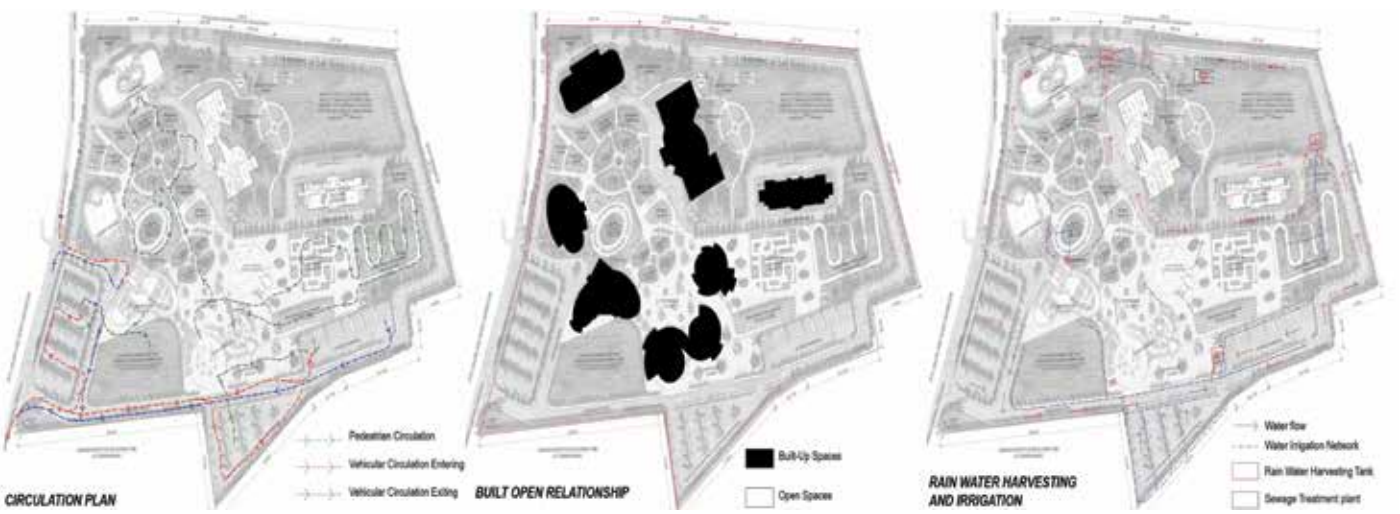

Figure 10: Plans explaining circulation, built and open space relationship and rain water harvesting system in the Science City

harvesting system and modern energy-efficient technologies, the project sets a benchmark for environmentally conscious development (Figure 10).

The extensive use of precast construction and maximised steel application reflects a commitment to reducing resource waste and promoting sustainability. This thoughtfully planned campus not only supports scientific exploration but also fosters an eco-friendly environment, ensuring a lasting positive impact for generations to come.

All images courtesy authors

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STUDENT WORK

REINFORCING THE IDENTITY OF CHHATTISGARH

A MULTI-PURPOSE CULTURAL CAMPUS

By Ar. Devam Ghatak; Guide: Dr. Shilpa Sharma

Abstract

This dissertation explores the overlooked cultural identity of Chhattisgarh, a state often defined by its industrial and resource driven economy since its formation in 2000. While these factors shape its economic profile, they have obscured a deeper historical and cultural legacy rooted in ancient traditions. Historically known as Dakshin Kaushalya during the Tretayug, the region holds strong connections to the Ramayana and Mahabharata, underscoring its significance in India's civilisational history.

Focusing on Bilaspur Chhattisgarh's judicial capital and a city rich in historical relevance this study proposes an architectural vision that repositions the city as a cultural hub. Through spatial design that supports local traditions, art and heritage, the thesis advocates for a renewed identity that prioritises cultural depth over industrial image. The project aims to foster regional pride and contribute to a broader recognition of Chhattisgarh's historical and cultural richness.

Keywords: Regional & Cultural Identity, Chhattisgarh Heritage, Adaptive Cultural Spaces, Philosophical Design Framework, Contextual Architecture and Saptarishi Principles

Introduction

At the time of India's independence in 1947, there were 565 princely states. Through strategic diplomacy, Sardar Vallabhbhai Patel unified most of them into the Indian Union. A major reorganisation in 1956 resulted in the formation of 14 states and 6 union territories, laying the foundation for modern India's political geography (Zubrzycki, 2023). By 2000, India had expanded to 26 states, with the creation of Uttarakhand, Jharkhand and Chhattisgarh from existing regions (Bhattacharya, 2001).

Chhattisgarh was carved out of eastern Madhya Pradesh due to prolonged underdevelopment and a lack of regional representation. The vast size of the parent state made governance inefficient, resulting in neglected infrastructure and diminished regional identity (Kumar, 2000). The creation of Chhattisgarh aimed to address these disparities and empower the region culturally and economically.

Despite its formation, Chhattisgarh remains largely known for its natural resources such as rice, coal and iron while its rich cultural heritage is still under-recognised (MS Parmeswaran, 2014). The state is home to ancient temples, vibrant folk traditions and unique festivals (Incredible India, 2016), yet it continues to lack a strong national cultural identity. This underlines the need to actively promote and preserve Chhattisgarh's heritage on a broader scale.

1.1 Need for formation of the new state of Chhattisgarh:

Chhattisgarh was once part of the larger state of Madhya Pradesh, whose vast size made governance and public service delivery challenging. Residents often had to travel over 800 kilometres to Bhopal for basic administrative needs, leading to widespread inefficiency and disconnection (Vivek & Subdha, 2024). Despite being rich in natural resources and contributing significantly to the state's revenue, the region received minimal investment in return, fuelling feelings of neglect and inequality.

Beyond administrative and economic issues, Chhattisgarh possessed a distinct cultural identity reflected in its traditions, languages and ancient heritage which was often overshadowed within Madhya Pradesh. These combined grievances sparked a movement for statehood, rooted in demands for better governance, fair development and cultural recognition (Bhattacharya, 2001, pp. 81-86).

In 2000, Chhattisgarh was formed as a separate state to address these concerns and empower local identity. However, despite its deep historical and cultural richness, the state continues to be known more for its industrial output than its cultural legacy.

1.2 Need for a political state to establish its identity:

A political state must establish and reinforce its identity to reflect its unique culture, history and values. This identity not only distinguishes the state nationally and globally but also helps preserve its cultural heritage for future generations (Ierek, 2016).

In a culturally diverse country like India, where each state contributes to a rich mosaic of traditions, languages and lifestyles, protecting and promoting state identity becomes especially important. Without active efforts, these elements risk being diluted in the face of globalisation (Ibid., 2016).

Reinforcing cultural identity fosters pride and connection among citizens, especially the youth, who then become active custodians of their heritage (IHS, 2022). A strong identity also brings economic benefits by showcasing its distinct festivals, cuisine and heritage. A state can boost tourism, attract investment and support local industries.

Ultimately, a well-defined state identity offers both cultural continuity and economic growth, making the region more appealing for engagement and collaboration (Ierek, 2016).

1.3 Significance of Chhattisgarh:

The name Chhattisgarh, meaning thirty-six forts, is deeply rooted in history, dating back approximately 1,400–1,500 years. This name initially referred to the territory ruled by the Haihaya dynasty in Ratanpur, established around 750 AD (Government of Chhattisgarh, 2016).

Even before this, the region was known as Dakshin Kosala, a name that appears in India's ancient epics, the Ramayana and Mahabharata, highlighting its cultural and historical importance (Government of Chhattisgarh, 2016). This longstanding identity not only reflects the region's political significance through its forts and kingdoms but also underlines its place in India's mythological and historical narratives, connecting it deeply to the nation's heritage.

1.3.1 Historical Significance of Chhattisgarh

Chhattisgarh, once known as Dakshin Kosala, holds a deep-rooted historical and cultural legacy that stretches back to the Tretayug, the era of Lord Rama. It is believed to be the birthplace of Mata Kaushalya and has been shaped over centuries by powerful dynasties such as the Kalachuris, the Nagas and the Chhindaka-Nagas. These rulers left behind a wealth of temples, forts, inscriptions and sculptures that reflect the state's rich spiritual and architectural traditions.

Several sites across the state highlight this legacy. Tala Gaon in Bilaspur is famous for the Devrani-Jethani temples from the Gupta period and an impressive sculpture of Rudra Shiva. Chaiturgarh, also known as Lafagarh, is a massive hill fort from the 10th century featuring the Mahishasur Mardini Temple and showcasing the Kalachuri dynasty's military strength and religious devotion. Ratanpur, once the capital of the Kalachuris, remains spiritually important due to the Mahamaya Temple, known for its intricate stone carvings and historic significance.

Pali, in the Bilaspur region, houses the Pali Mahadev Temple built in 870 AD, an early example of Kalachuri stone architecture dedicated to Lord Shiva. Madku Dweep, an island on the Shivnath River, is both naturally beautiful and historically important, with remains dating back to the 3rd century BCE. It is also associated with sage Mandukya and features the unique Smarthalinga, representing unity among Hindu sects.

Turturiya is believed to be the site of Maharshi Valmiki's ashram and the birthplace of Luv and Kush. It is archaeologically significant for its ancient statues and remains of Shaivism, Vaishnavism and Buddhism. Similarly, Shivrinarayan is linked to the Ramayana and the story of Shabari. Its temples and inscriptions reflect the fusion of tribal and Aryan traditions and its importance in Kalachuri-era religious life.

Bhoramdeo, often referred to as the "Khajuraho of Chhattisgarh", is known for its exquisite carvings and blend of Shaiva and Vaishnava iconography. Built around the 11th century, it features distinctive temple architecture that reflects the craftsmanship of the period. Ramgarh Mountain in Surguja district is connected to Lord Rama and is also considered to have inspired poet Kalidas. The mountain contains ancient inscriptions, caves and what is believed to be one of the oldest open-air theatres in the world.

Malhar, with roots going back to 200 BCE, was an active centre of trade and religion under the Satavahanas and later the Kalachuris. Excavations here have revealed important Shaiva, Vaishnava and Buddhist structures. Barsur, once the capital of the Chhindaka-Naga dynasty, is known as the "City of Temples" and is home to architectural marvels like the Battisa Temple, Twin Ganesha statues and the Mama-Bhanja Temple.

Together, these sites represent the essence of Chhattisgarh's heritage—a land where mythology, history, religion and art come together. They reflect the region's significance as a spiritual and cultural heartland of India, where ancient traditions continue to shape contemporary identity.

1.3.2 Current Significance of Chhattisgarh:

In present times, Chhattisgarh plays a significant role in India's economic development, primarily due to its abundant natural resources and growing industrial base. The state is one of India's leading producers of coal, iron ore, bauxite and other minerals and contributes substantially to the country's steel, power and cement production. However, this focus on industrial growth and resource extraction has often overshadowed Chhattisgarh's rich cultural and spiritual legacy. The region's deep tribal traditions and cultural heritage remain underrepresented in mainstream narratives.

- ***Cultural significance of Chhattisgarh:***

Chhattisgarh holds a rich connection to tribal heritage, with 34% of its population belonging to tribal communities (Dixit, 2023). This heritage is expressed in the state's distinct tribal art forms, including intricate paintings, traditional architecture, metal crafts, music, dance and various artisanal practices. Yet, despite this depth, many aspects of Chhattisgarh's tribal culture remain unknown and underappreciated on a larger scale, often overshadowed by other state associations.

Alongside its tribal culture, Chhattisgarh is also renowned for its high-quality Kosa silk, produced in Janjgir-Champa. This silk has gained international recognition, even being exported to European countries for its unique quality and craftsmanship (BTSSO, 2018).

There are numerous other culturally significant landmarks across the state which can contribute to a rich cultural tapestry, laying the foundation for Chhattisgarh's unique identity on a broader scale.

- ***Significance of Chhattisgarh in forest reserve and biodiversity:***

Chhattisgarh's vast forest cover, which constitutes nearly 40% of its area, is central to its identity and ecological health. The state's forests are dense and diverse, ranging from tropical moist deciduous to dry deciduous forests, with teak and sal trees being especially prominent. These forests serve as essential green lungs for the region and contribute significantly to India's forest reserves (Chhattisgarh State Centre for Climate Change, 2024).

The state is home to a rich variety of wildlife, spread across eight wildlife sanctuaries and one biosphere reserve, including famous reserves like the Indravati Tiger Reserve, Udanti-Sitanadi Wildlife Sanctuary and the Achanakmar Wildlife Sanctuary, which is part of a larger biosphere reserve recognised by UNESCO. These protected areas host a remarkable diversity of species, including endangered animals like the Bengal tiger, leopards, gaur, sloth bear and the rare wild buffalo, which is Chhattisgarh's state animal. Additionally, the forests house over 2,000 animal species, as well as numerous bird species, reptiles and amphibians (Chhattisgarh State Centre for Climate Change, 2024).

1.4 Significance of Bilaspur:

Bilaspur is a key city in Chhattisgarh, serving as the state's Law Capital and the Zonal Headquarters of both the South Eastern Central Railway and South Eastern Coalfields Limited. While Raipur functions as the political and commercial capital, Bilaspur plays a critical role in the state's administrative, economic and infrastructural landscape.

Strategically located, Bilaspur lies within proximity (50–200 km) to many of Chhattisgarh's most significant cultural, historical and natural landmarks, positioning it as an ideal hub for showcasing the state's diverse heritage. Despite its importance, Bilaspur remains underrepresented at the national level and Chhattisgarh continues to be identified largely by its natural resources, an image that overlooks its cultural richness.

Elevating Bilaspur as a cultural and historical centre would help redefine Chhattisgarh's identity, adding depth to the state's image alongside Raipur's commercial role. This dual-city approach could promote a more balanced narrative highlighting both industrial strength and cultural heritage.

Such a repositioning would support sustainable tourism, stimulate regional development and create broader awareness of Chhattisgarh's historical contributions and multifaceted identity.

Fig. 1: Bilaspur as the potential site
Fig. 1a: Maps showing location of the new state of Chhattisgarh in India.
Fig. 1b: Shows the landmarks of the city of Bilaspur in Chhattisgarh.

Fig.1 shows the map of Chhattisgarh and an overview of the significant landmarks around Bilaspur that exemplify Chhattisgarh's cultural, historical, natural, industrial and political legacy, underscoring.

2. Aim & Objectives:

This dissertation aims to define and reinforce the new identity of the state of Chhattisgarh through the city of Bilaspur.

Objectives:

- To study and understand the significance of the different historical and cultural landmarks of Chhattisgarh.
- To assess the current conditions of existing places of heritage value and the status of these landmarks.
- To determine the optimal design and spatial needs required to foster various activities related to the reinforcement of the region's culture and history.

3. Methodology:

To accomplish the study's objectives, Various research methods will be employed to gather and analyse the essential data for this study. A systematic approach is adopted to gather information and derive solutions for the problems and issues related to the topic.

By employing these methods, we aim to provide a comprehensive basis for the study's analysis:

- Literature review to study the spatial requirements in various environments
- Architectural case studies of cultural centres, museums, exhibition spaces and tourism hubs.
- Study the technical requirements for the space needed
- Interviews with experts and local people

4. Literature Review:

India is renowned for its iconic landmarks such as the temples of Khajuraho and the palaces of Rajasthan which draw global attention for their historical and architectural grandeur. Yet, beyond these celebrated sites lie countless lesser-known towns and regions with equally rich cultural and historical value. These hidden gems temples, ruins, heritage villages and forts offer a deeper, more diverse view of India's civilisational legacy.

One such underrecognised state is Chhattisgarh, home to a wealth of historic sites, ancient temples and natural beauty. Despite their significance, many of these landmarks remain unfamiliar to people outside the region.

To reframe Chhattisgarh's identity, Bilaspur can serve as a cultural gateway. By highlighting its proximity to diverse historical and natural sites, Bilaspur can help bring national attention to the state's rich heritage. Promoting these lesser-known landmarks will not only boost tourism but also encourage preservation efforts by government and local bodies.

Raising awareness about Chhattisgarh's cultural assets can help foster a renewed identity for the state, one rooted in heritage and contribution to India's broader cultural fabric while setting a precedent for other overlooked regions to gain similar recognition.

4.1 How built spaces helps to construct identity of a city:

Architecture plays a vital role in shaping a city's identity by defining its physical form, cultural memory and visual character. Through material, visual and rhetorical sign systems, architecture connects the past with the present and communicates a city's values and heritage (Jones & Svejenova, 2017).

Cities like Barcelona and Boston exemplify how architectural landmarks become cultural symbols. Barcelona's Sagrada Família and Park Güell reflect its artistic legacy, while Boston's colonial landmarks, like the Old North Church, anchor its identity in the American Revolution (Ibid, 2017). These structures not only shape the urban landscape but also reinforce collective memory.

Material elements such as topography and iconic buildings link city identity to history. Visual features like style, colour and spatial arrangement further define a city's uniqueness. Meanwhile, rhetorical narratives surrounding architecture such as Gaudí's

association with Catalan pride add symbolic meaning and deepen public connection to the place (Ibid, 2017).

Together, these elements help cities maintain continuity while evolving. Architecture thus serves as both a cultural anchor and a dynamic expression of identity, shaping how cities are experienced, remembered and projected globally.

4.2 Reinforcement and Recognition of the State's Identity through Public Participation:

Public participation in cultural and public spaces plays a crucial role in helping Chhattisgarh reinforce and broaden its identity. By involving the community in events such as festivals, traditional performances and exhibitions, the state's rich cultural heritage is actively preserved and promoted. This participation helps maintain cultural practices and traditions, ensuring they remain alive and relevant while also showcasing them to a wider audience. As a result, the historical and cultural narratives of Chhattisgarh gain greater recognition beyond its borders.

These public spaces also serve as platforms for creating a shared identity. When people engage in cultural activities together, they strengthen their connection to their heritage, fostering a sense of pride and belonging. The collective experience of celebrating Chhattisgarh's unique culture reinforces the state's identity, both within the local community and on a national level. At the same time, this public involvement enhances tourism by attracting visitors who seek to experience the vibrant cultural life of Chhattisgarh. Tourists who participate in these activities are introduced to the state's deep history and cultural diversity, helping to build a broader recognition of Chhattisgarh's identity.

4.3 Multi-Purpose Cultural Complexes to define Cultural identity of a State:

The Government of India's Multi-Purpose Cultural Complexes (MPCCs) scheme has played a vital role in reinforcing state-level cultural identities. These complexes serve as cultural hubs, supporting traditional arts, music, dance, literature and fine arts particularly in regions lacking adequate infrastructure (Government of India, 1992).

By providing modern facilities like auditoriums, exhibition spaces and performance venues, the scheme enables artists to showcase their work, revives declining traditions and connects younger generations to their heritage. MPCCs also promote inclusivity, hosting public programs that foster cultural exchange and community engagement. Additionally, upgrading historic centres such as Rabindra Bhawans enhances tourism and cultural visibility, strengthening both local economies and a state's national and global image. Through infrastructure, public participation and artistic support, MPCCs have become key instruments in sustaining and celebrating India's diverse cultural landscape (Government of India, 1992).

5. Architectural Case Studies:

Studying architectural case studies of tourist centres, markets, cultural venues and museums reveals how built spaces can reinforce a city's identity. These examples highlight how architecture preserves cultural and historical essence while serving diverse users, locals, tourists and artists alike. Well-designed public spaces foster social interaction, cultural exchange and economic vitality, illustrating how thoughtful design can both meet practical needs and express the spirit of a place.

Table - 01 highlights key aspects derived from these studies, forming a foundation for defining spatial needs, functional layouts and capacity planning for the proposed building program.

Inferences

The literature review highlights that while India is globally known for its iconic cultural landmarks, regions like Chhattisgarh remain underrepresented despite their rich historical and cultural significance. Promoting lesser-known sites in Chhattisgarh, can help bring national recognition to the state's heritage and diversify the broader narrative of Indian culture. Architecture plays a vital role in shaping identity by linking the past and present through visual, material and symbolic expressions. Built environments not only reflect historical memory but also help create a sense of place and belonging. Public participation in cultural spaces and events further reinforces this identity by keeping traditions alive and encouraging community engagement. Government initiatives like the Multi-Purpose Cultural Complexes (MPCCs) have proven effective in strengthening cultural infrastructure, promoting inclusivity and sustaining traditional arts across under-resourced regions. Additionally, architectural case studies of cultural centres and public spaces reveal the importance of thoughtful design in addressing user needs, accommodating footfall and fostering cultural exchange. Together, these insights emphasise the need for culturally rooted, community-driven and functionally responsive design strategies to strengthen Chhattisgarh's identity while supporting its growth as a cultural and tourist hub.

Table 1: Key aspects derived from Architectural case studies

Various Practical, Quantitative and Qualitative Aspects from Case Studies		
Sr.No.	**Architectural Case Studies**	**Aspects from Each Case Studies**
	Dilli Haat, Janakpuri	This case study shows that cultural spaces can preserve regional identities while promoting local artisans. It proves that integrating crafts, cuisine and performances creates immersive experiences. Such models strengthen cultural awareness, boost tourism and foster national unity through shared traditions.
2.	Bharat Bhavan, Bhopal	This case study highlights the role of architecture in integrating multiple art forms within a single space. Its multifunctional design fosters cultural dialogue, creative expression and community involvement, making it a dynamic model for nurturing the arts and engaging the public in the cultural life of a region.
3.	Madhya Pradesh Tribal Museum, Bhopal	The museum demonstrates how thoughtful architectural design can bridge tradition and modernity, using space and form to celebrate tribal culture. It emphasises how built environments can preserve intangible heritage while making it accessible and engaging for contemporary audiences.

6. Design Description: Thiyan - The Multipurpose Cultural Campus

Thiyan, a word rooted in Chhattisgarhi tradition, refers to a communal gathering, a space for stories, songs, rituals and shared cultural experiences. Inspired by this concept, Thiyan is envisioned as a living, dynamic campus that celebrates the arts, crafts, music, folk games, festivals and traditions of Chhattisgarh.

Proposed in Bilaspur, the design establishes a vibrant cultural and tourist hub that highlights the state's rich heritage through immersive exhibition spaces, performance areas and traditional craft displays. It also creates a platform for local artists, ensuring cultural continuity and community participation.

By leveraging Bilaspur's strategic location near historic sites, Thiyan positions the city as a gateway to Chhattisgarh's legacy. The project redefines the state's identity moving beyond its industrial image to one rooted in cultural richness and artistic expression and reinforces its recognition at regional and national levels.

6.1 Design Concept

Chhattisgarh is home to a diverse range of cultures and belief systems that differ significantly from other regions of India. Like every Indian state, its identity has been shaped by distinct climate, geography, lifestyle and traditions. This unique identity can be defined through four primary aspects: History, Culture, Tribal Significance and Wildlife Biodiversity.

Upon deeper study, it becomes evident that while regional cultures across India are highly diverse, they also share common threads universal values and belief systems that create unity in diversity. This raises a fundamental question: How do such varied cultures across a vast country share foundational principles?

The answer lies in exploring traditions at the grassroots level, where one finds recurring cultural codes and moral frameworks passed down through generations. These enduring values trace back to the ancient concept of the Saptarishi: The Seven Sages of India, regarded as the original carriers of wisdom and societal guidance. Their teachings form the philosophical foundation of many Indian traditions and continue to influence cultural unity across regions like Chhattisgarh today.

Fig. 2 illustrates how diverse regional cultures and traditions converge through shared foundational principles at the grassroots level, ultimately rooted in the concept of the Saptarishi.

The Saptrishi Concept

The Saptarishi the seven revered sages of ancient Indian tradition are regarded as guiding pillars of civilisation. Each sage embodies a core principle essential to a harmonious society, such as knowledge, expression, spirituality, leadership and sustainability. These timeless values, passed down through generations, have shaped the moral and cultural fabric of India. Architecturally, they can be

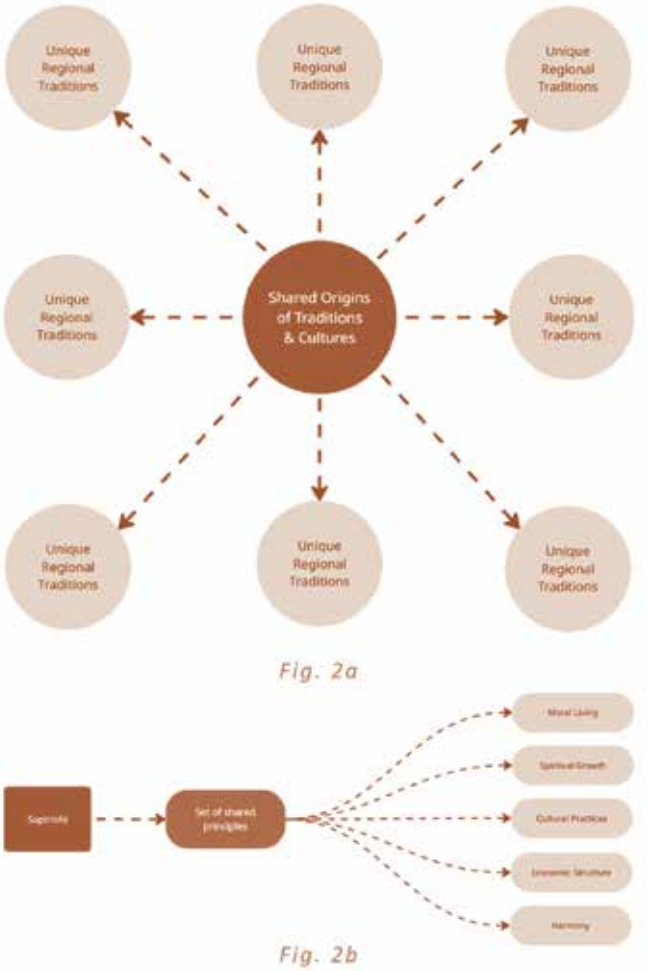

Fig. 2: Shared foundational principles at the grassroots level
Fig. 2a: Shared roots in diverse traditions
Fig. 2b: Illustrates the origin of the shared principles which is Spatarishi

interpreted as symbolic anchors, each representing a vital domain that influences our way of life and collective identity.

This concept forms the basis of the thesis. It explores how, despite immense cultural diversity, India's regions remain deeply interconnected through shared values rooted in ancient wisdom. The study investigates how these enduring principles continue to shape regional identity through cultural expression and belief systems.

Using Chhattisgarh with its rich heritage and distinct traditions—as a lens, the project examines how architecture can embody these ideals. While grounded in Chhattisgarh's context, the broader vision is to propose a universal architectural framework that is adaptable to diverse cultural landscapes across India, yet consistently rooted in the enduring guidance of the Saptarishi.

Table-02 outlines the seven core principles represented by the Saptarishi and their role as essential sources of knowledge and wisdom at the grassroots level.

Table 2: The seven core principles represented by the Saptarishi

Characteristics of each Saptarishi		
S.No.	**Rishi (Sage)**	**Characteristics**
1.	Bhrigu	Knowledge and Learning
2.	Atri	Arts and Expression
3.	Angiras	Ritual and Heritage
4.	Vashishta	Leadership and Governance
5.	Pulastya	Craft and Skill Development
6.	Pulaha	Spirituality and Well Being
7.	Kratu	Sustainability and Innovation

Universal System of Design

The Saptarishi framework in this thesis is not merely an inspiration; it is envisioned as a design system, a philosophical toolkit rather than a stylistic approach. While the seven guiding principles derived from the Saptarishi remain constant at the grassroots level, the architectural expressions adapt according to the specific context defined by geography, climate, culture and regional identity.

To conceptualise this, as depicted in Fig. 3, the Saptarishi principles can be imagined as a constant source of light, while the regional context such as that of Chhattisgarh acts as a unique lens through which this light passes. As the light filters through each lens, it takes on a different hue, representing context-specific architectural elements and spatial responses. The principles stay universal, but their manifestation changes with each lens, allowing the design to be deeply rooted in its surroundings while grounded in timeless values.

This adaptability forms the essence of a universal design system, one where foundational principles offer a stable conceptual core, yet the architecture evolves organically in response to the cultural and environmental conditions of any given region. In this thesis, the focus is on Chhattisgarh, but the framework can be extended and reinterpreted for diverse contexts across India.

Fig. 3: The Saptarishi as a source of knowledge, with its core principles remaining constant while elements adapt to the geographical context.

Form Development

The architectural form of the design is derived from the celestial arrangement of the Saptarishi constellation. Inspired by the symbolic alignment of the Seven Sages in the night sky, the initial zoning began with the creation of seven distinct blocks, each corresponding to one of the Rishis as shown in *Fig. 4.*

Fig. 4: Form development diagram; Fig. 4a: The site zoning is inspired by the spatial arrangement of the Saptarishi constellation
Fig. 4b: These zones are further translated into seven distinct block/ cores within the design; Fig 4c: This zoning approach results in seven interconnected blocks unified by a central public plaza, reinforcing spatial harmony and interaction

6.2 Site Plan

The site is located in Bilaspur, Chhattisgarh, along the Bilaspur Katghora National Highway, offering excellent connectivity to the city and surrounding regions. Spanning 19,000 sq.m, the site is currently vacant and earmarked for public use in the Bilaspur Development Plan 2031.

Lined with lush green trees, the site benefits from a natural buffer that reduces traffic noise and enhances its visual appeal making it ideal for a cultural and tourist hub.

6.3 Seven Cores in Design

As Fig. 5a shows, the design features seven core zones, each derived from one of the Saptarishi principles as follows:

Pulaha Block (पुलह):

The Pulaha Block serves as the pedestrian entry (Fig. 5b) to the design, embodying the principle of "moving forward towards mindfulness." It acts as a transitional pause space, inviting visitors to reflect and reset before entering the cultural campus encouraging a shift in perspective and state of mind.

Kratu Block (कृतु):

Located just after the pedestrian entry, the Kratu Block marks the threshold of transformation, symbolising the principle of Energy and Renewal. A water pond (Fig. 5c) at this point draws from a Chhattisgarhi tradition of washing hands before entering a home signifying purification and positive energy. Here, water becomes a medium of activation, preparing visitors to engage with the cultural campus through a refreshed and open perspective.

Angira Block (अंगीरा):

The Angira Block, rooted in the principle of Ritual & Heritage, serves as the tourist information centre and tribal café as (Fig. 5d). Visitors are introduced to Chhattisgarh's diverse cultures and traditions,

Fig. 5a

Fig. 5b Fig. 5c Fig. 5d Fig. 5e

Fig. 5f Fig. 5g Fig. 5h

Fig. 5: The seven blocks of design
Fig. 5a: Features seven core zones, each derived from one of the Saptarishi principles.
Fig. 5b: Pulaha Block (पुलह); Fig. 5c: Kratu Block (कृतु); Fig. 5d: Angira Block (अंगीरा); Fig. 5e: Bhrigu Block (भृगु); Fig. 5f: Pulastya Block (पुलत्स्य)
Fig. 5g: Arti Block (अत्री); Fig. 5h: Vashistha Block (वशिष्ठ)

while the café celebrates its culinary legacy past and present. A shaded canopy evokes the traditional image of meals under trees during festivals and the adjacent public plaza hosts events and gatherings, extending the living tradition of communal celebration.

Bhrigu Block (भृगु):
Following the Café and Tourist Information Centre is the Bhrigu Block, the Digital Museum (Fig. 5e). Rooted in the principle of Preservation of Knowledge, this space showcases and archives Chhattisgarh's history, culture, tribal heritage, wildlife and biodiversity.

Pulastya Block (पुलत्स्य):
Next is the Pulastya Block, which houses workshops and a library (Fig. 5f). Aligned with the principle of Craft, Skill and Transmission of Knowledge, this block features hands-on spaces for traditional arts such as Tribal Painting, Kosa Silk weaving and Dhokra Metalwork—celebrated crafts of Chhattisgarh.

Arti Block (अत्री):
Following the workshops is the Atri Block, which features a Little Theatre (Fig. 5g) aligned with the principle of art and expression. This space hosts cultural and traditional performances, while guest rooms above the theatre accommodate artists and workshop facilitators.

Vashistha Block (वशिष्ठ):
Next is the Vashistha Block, which houses the Multipurpose Hall (Fig. 5h), embodying the principle of Thoughtful Leadership & Societal Balance. This space is designed for seminars and workshops focused on educating future generations about Chhattisgarh's governance history and fostering balanced, thoughtful leadership.

6.4 Floor Plans and Sections:
Fig. 6 illustrates the ground floor plan, showcasing seven distinct blocks, each arranged around its own circular courtyard. At the core of the design is a central plaza that seamlessly unites these blocks, fostering a cohesive and interconnected spatial experience. The ground floor accommodates key functions including a cafeteria, digital museum, administrative offices, workshops, a little theatre, and a multipurpose hall. The first-floor plan (Fig. 7), features a library along with accommodation for artisans and guests. Fig. 8 presents the sections.

6.5 Construction System:
The construction system is based on load-bearing walls made from brown-yellow sandstone blocks, a material abundantly available in Bilaspur. This

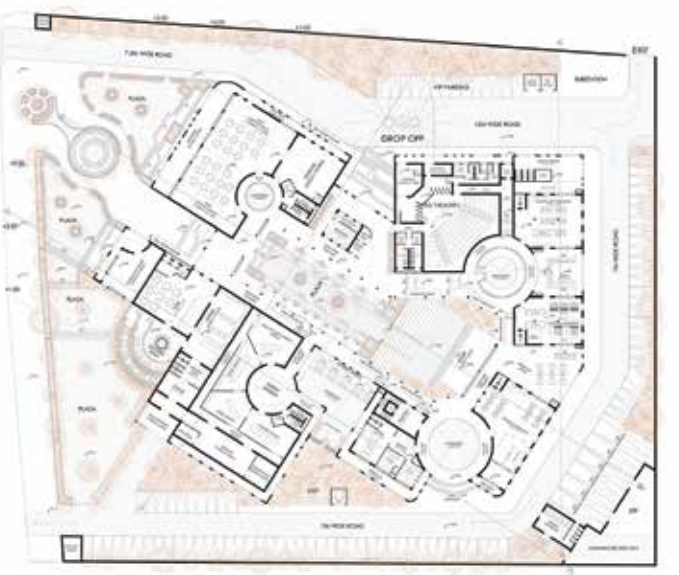

Fig.6: Ground Floor Plan

Fig.7: First Floor Plan

method not only reduces transportation costs but also aligns with building techniques well-known to the local workforce, ensuring ease of execution. For the roofing, clay pot tiles are used, a traditional method employed by various tribes in Chhattisgarh, which enhances the design's vernacular character while providing thermal comfort as shown in Fig. 9a. The roof structure incorporates a bamboo truss system, utilising another locally available resource, further reinforcing the sustainable and context-responsive nature of the design.

6.6 Sustainable Systems:
A landscaped terrace is incorporated into the design to minimise direct solar heat gain on the roof surface, as illustrated in Fig. 10a. This feature

Fig.8: Sections
Fig.8a: Section - S01
Fig.8b: Section - S02

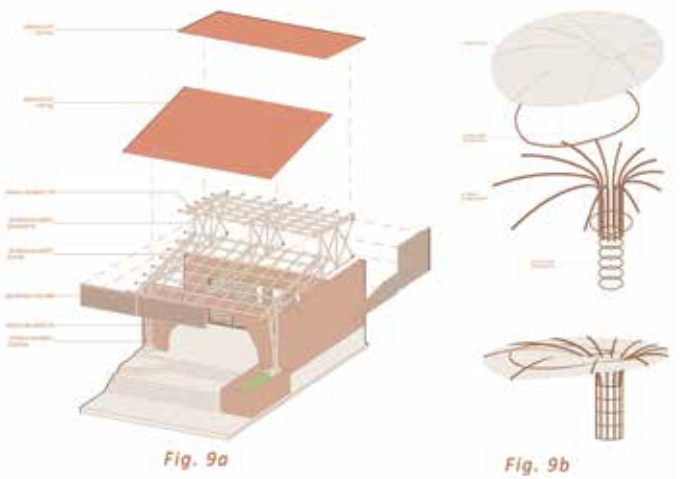

Fig.9: Construction System
Fig. 9: Roof Construction Systems
Fig.9a: Clay pot tile roof.
Fig.9b: Tensile cloth canopy

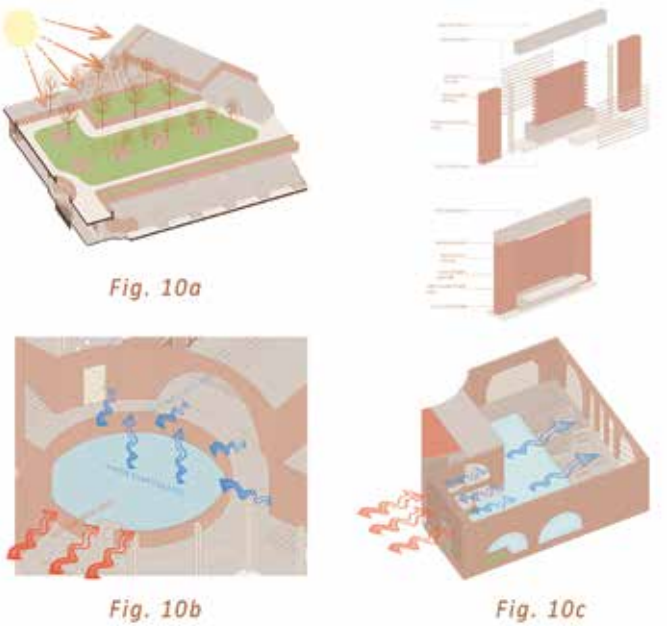

Fig. 10: Sustainable systems
Fig.10a: Terrace Landscape
Fig.10b: Evaporative Cooling
Fig.10c: Deki Cooling System

not only improves thermal performance but also enhances the aesthetic quality of the building. Multiple water bodies are strategically placed across the site to naturally reduce ambient temperatures. Given Bilaspur's hot and dry climate, where hot winds prevail during summer, the water bodies help cool the surrounding areas as air passes over them as shown in fig. 10b. Additionally, a Deki cooling system is integrated along the south and west façades, effectively mitigating heat penetration and maintaining comfortable indoor temperatures throughout the year as shown in fig. 10c.

7. Design Overviews & Conclusions:

The design is divided into seven thematic zones, each derived from the principles of one of the Saptarishis covering areas such as mindfulness, energy, heritage, knowledge preservation, skill transmission, artistic expression and societal leadership. These zones not only organise the physical space but also reflect the philosophical foundation of the design.

While the project is deeply anchored in the traditions and identity of Chhattisgarh, the concept is envisioned as a universal design system. By interpreting the timeless wisdom of the Saptarishi through the lens of local geography, climate and culture, the framework remains adaptable to other regional contexts across India. The result is a culturally rooted and environmentally responsive space that blends ancient principles with contemporary needs.

ALL TABLES AND IMAGES COURTESY: AUTHOR

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ARTICLE

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Conceptual Framework for Preparation of Pedestrian Plan for Cities in Kerala

By Amrutha N.

Walking is the basic mode of transportation, benefiting large communities in developing nations like India. Despite the numerous advantages of walking, transportation plans are shifting from people- centric to vehicle-centric approaches, highlighting the need for pedestrian planning. This study formulates a conceptual framework for preparing pedestrian plans, focusing on methodology, content, and key concepts. The objectives include identifying parameters for pedestrian plan preparation, studying existing policies, regulations and provisions for pedestrians and formulating a conceptual framework for cities in Kerala. The primary research method involved plan evaluation, analysing pedestrian plans from Seattle and Sacramento, and reviewing the pedestrian study of Gandhi Bazar, Bangalore to understand Indian initiatives. Pedestrian-related aspects from the Mobility Plan of major cities in Kerala provided insights into the Kerala scenario. Key findings indicated the necessity of establishing a clear policy framework emphasising safety, connectivity and the maintenance of pedestrian infrastructure, alongside education and enforcement programs. The assessment of existing conditions revealed high pedestrian demand in the city centre retail zones, institutions, transport stations and recreational spaces, which should be prioritised for improvements. The study also highlighted the inadequacy of current pedestrian infrastructure, including sidewalks, crosswalks, curb ramps, traffic signals, signage and street lighting, necessitating substantial upgrades. Vulnerable populations, including children under 15, seniors over 65, and disabled individuals, face significant barriers, requiring focused interventions. Strategies to enhance walkability include sidewalk improvement programs, traffic-calming measures and pedestrian priority zoning, which would increase safety and accessibility. Recommendations also involve establishing pedestrian zones in central business districts and residential neighbourhoods, with regular maintenance activities like sidewalk cleanliness and timely upgrades. These findings provide a structured approach for urban planners and policymakers to enhance pedestrian infrastructure, promoting safer and more accessible urban environments in Kerala.

1. Aim and Objectives

The primary aim of this study is to develop a comprehensive conceptual framework for pedestrian plans specifically tailored for cities in Kerala. To achieve this aim, the study is organised around several key objectives. First, it seeks to investigate the essential elements and considerations necessary for effective pedestrian planning. This involves studying various attributes that are critical for designing and implementing successful pedestrian plans. Second, the research aims to examine how pedestrian-oriented planning has been approached in other countries by reviewing relevant literature and case studies. This comparative analysis will help identify successful methodologies and practices that could be adapted for Kerala. Third, the study will analyse current provisions and regulations related to pedestrian infrastructure in India and Kerala. By assessing existing policies, provisions and regulations, the study highlights gaps and opportunities for improvement. Finally, based on these insights, the study intends to formulate a tailored conceptual framework for pedestrian planning that addresses the unique needs and contexts of cities in Kerala.

2. Research Questions

The study is guided by several research questions designed to address the core aspects of pedestrian planning. These include:

- Why is it important to plan specifically for pedestrians?
- What are the various attributes that should be considered when preparing a pedestrian plan?
- And how can communities benefit from the implementation of such a plan?

These questions are central to understanding the rationale, requirements, and potential advantages of pedestrian planning.

3. Scope and Limitations

The scope of this study is defined by the current context in which cities in Kerala lack well-organised and implemented pedestrian policies. The development of the conceptual framework aims to provide a structured guide for pedestrianising these cities, addressing existing gaps and proposing improvements. However, the study has certain limitations. It focuses exclusively on pedestrian planning and does not consider the integration of bicycle infrastructure, which is often included in more comprehensive urban mobility plans in other countries. This limitation means that the study will not address the broader context of multi-modal transportation planning, which could affect the overall applicability of the findings in contexts where bicycle infrastructure is also a significant consideration.

4. Literature Review

Various literature related to pedestrianisation and pedestrian plans were reviewed to understand the basics. The knowledge about walkability and accessibility are important to prepare plans. This section also reviews pedestrian plans, factors affecting plans, steps in preparing plans, contents of plan, etc. Various elements of pedestrianisation are discussed in the pedestrian design guidelines. Coming to the Indian context, it is essential to know the existing policies and regulations which is concerned with pedestrians.

a. Benefits of Pedestrianisation

Effective pedestrian accommodation enhances quality of life and health, strengthens communities, increases safety for all modes of transportation, reduces congestion, offers recreational benefits and benefits the environment (T. Litman, 2021). This can be achieved by providing a safer and more inviting pedestrian environment, to encourage more people to undertake walking trips and to facilitate modal shift from other means of transport. In this context, the provision of new and improved crossing facilities to make pedestrian journeys safer and more convenient is important (D. Appleyard, 1989). Walking has various other benefits also such as improving quality of life, ensuring safety, accessibility, community livability, heritage preservation and efficient land use.

b. Walkability

Walkability is a term used to describe and measure the connectivity and quality of walkways, footpaths or sidewalks in cities. It can be measured through a comprehensive assessment of available infrastructure for pedestrians and studies linking demand and supply (R. Southworth, 2001)

Various indicators of walkability were understood through literature review. Indicators are residential density, retail ratio, land-use mix, intersection density, ease of street crossings, presence of sidewalks and their characteristics, integration with transit, street scale and streetscape quality, road classifications, walkability safety ratings and student routes.

c. Accessibility

Accessibility (or just access) refers to the ability to reach desired goods, services and activities. Poor walking conditions can contribute to social exclusion, that is, the physical, economic and social isolation of vulnerable populations. Pedestrian access to public transit is an important accessibility factor. Accessibility can be evaluated using resident surveys, field surveys and Geographic Information Systems (GIS) to determine the portion of important destinations (medical services, shops, schools, jobs, government offices, etc.) that can be conveniently reached by walking or walk-transit-trips, particularly by disadvantaged populations (WHO, 2007).

d. Existing Pedestrian Analysis

In order to analyse existing pedestrian condition, any of the methods like GIS method or questionnaire survey can be adopted. GIS derived type in measuring walkability consists of indices such as residential density, land-use mix, retail floor area ratio and street connectivity (M. Asadi-Shekari et al, 2015).

e. Pedestrian Plan

Establishing a pedestrian plan will benefit communities to encourage walking and in turn become a healthier and more livable community. A pedestrian master plan (PMP) is a public document developed through public participation, visioning and analysis of current conditions, laying out a community's vision for future pedestrian activity, identifying the actions required to make that vision happen, tying actions with funding sources and committing agencies and stakeholders to its implementation and use. All cities have pedestrian problems and issues but different solutions are being implemented by pedestrian plans. Knowing what pedestrians' desire is an important factor when considering how to go about improving or developing pedestrian plans. Pedestrian plans establish the programs, policies, design criteria and projects that will further enhance pedestrian safety, comfort and access in their neighborhoods (Kittelson & Associates, 2010). Certain factors need to be considered while preparing pedestrian plans. These are:

1. Principles of pedestrian network planning - policies for walking and cycling should incorporate five basic principles regarding trips which are that they should be direct, coherent, comfortable, safe and enjoyable (Seattle Department of Transportation, 2014).
2. Characteristics of pedestrians - Typical walking speeds for each category of pedestrians is that for a fit adult walking at about 1.5 m/s, the maximum average distance of walking is observed as 500 m. Whereas for elderly person walking speed will be 1.0 m/s to 1.2 m/s and typical speed used in crossing assessments will be 1.2 m/s (ITDP, 2014).
3. Classification of Pedestrian activity area - pedestrian activity areas are classified into pedestrian districts, activity centres/ commercial corridors, school walking area, transit corridors and others.
4. Factors affecting pedestrian demand analysis - understanding pedestrian activity patterns helps to identify investment areas for pedestrian comfort and safety. Estimating pedestrian demand can help understand where pedestrians can be expected based on land use patterns, employment and population densities, roadway network connectivity, proximity to schools and similar demographic and built environment factors and allows the city to plan and prioritise accordingly (NIUA, 2013).
5. Surveys for pedestrian plan - there are different kinds of surveys done for identifying the character of pedestrians and the anticipated interest of pedestrians for the future. They are vehicle volumes, available gaps in traffic, vehicle speeds, number of pedestrians, behaviour of drivers and pedestrians and pedestrian attitude survey.
6. Contents of Pedestrian Plan

   - Existing pedestrian conditions: Key pedestrian facilities and centres of pedestrian activity should be mapped and described. Pedestrian infrastructure facilities need to be assessed. Data on walking rates, if available, is required. Results from surveys of existing sidewalk and crossing conditions must be analysed. Analysis of pedestrian collision data and summary of input from community outreach activities further leads to identification of key pedestrian generators and attractors.
   - Policies and objectives: This describes how the pedestrian plan has been coordinated and is consistent with other local or regional transportation, air quality, or energy conservation plans. Existing and new pedestrian policies and objectives must be studied.
   - Geographic Information System (GIS) analysis: Identify areas throughout the city with high pedestrian use. Identify Pedestrian Focus Areas (PFAs), based on the examination of five features that are more likely to generate pedestrian use: educational institutions, existing light rail stations, markets, neighborhood destinations, parks and libraries.
   - Pedestrian Design Guidelines: Various pedestrian design guidelines such as sidewalk guidelines, crossing treatments and traffic calming must be studied and analysed.
   - Recommended Pedestrian Facilities: Different locations and zones of pedestrian improvements must be mapped and described. Sidewalk inventory map, pedestrian potential model, pedestrian route network map, pedestrian plan projects, pedestrian demand index map, pedestrian priority area map, etc. are different types of maps that help in the preparation of a Pedestrian Plan.

7. Steps for preparing pedestrian plan are shown in figure 1.

Figure 1: Steps for preparing a Pedestrian Plan
Source: Author

Pedestrian design guidelines - Pedestrian plans provide design guidelines too. Different elements of pedestrianisation are taken into consideration and standards are provided for them. The various elements of pedestrian design are footpaths/sidewalks, crossings, signage, medians and pedestrian refuge areas, provision for the disabled pedestrian, school zone safety and pedestrian grade-separated crossings, as seen in figure 2. Since the pedestrian flow is determined by land use, the width of sidewalk varies according to the respective land use. While some type of land use or built use invite large pedestrian activities, some other kind of land use or built use act as low pedestrian generators. The following sidewalk widths can be applied for the following land uses:

- Residential areas: 2 m
- Commercial/mixed use areas: 2.5 m
- Commercial nodes: 4 m

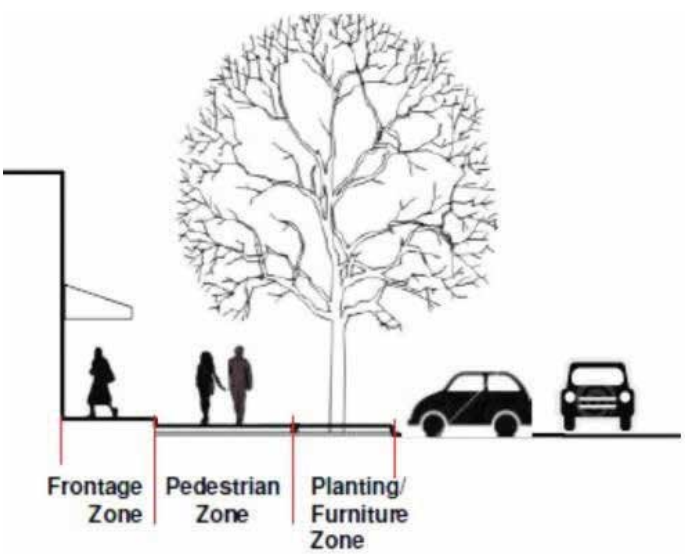

Figure 2: Pedestrian zone on road layout
Source: Author

Some of the elements in road designing which cater accessibility, connectivity, safety and comfort are given in figure 3.

Accessibility	Connectivity
• Curb height • Ramp gradient • Width of handrail opening at pedestrian crossing • Tactile paving at ingress and egress of a footpath or median refuge • Subway/FOB entrance opening • Stair case gradient	• Design of street corners • Location of pedestrian crossing • Alignment of footpath • Location of pedestrian subway/FOB access
Safety	**Comfort**
• Lighting of footpath, street corners and pedestrian crossings • Gradients for footpaths and ramps • Zebra markings • Table tops • Access management – placement of bollards and railings • Traffic/pedestrian signals? Hawking space	• Allocation of footpath width for walking, plantations and offset. • Provision of pedestrian utilities, street furniture like benches etc. along the footpath.

Figure 3: Elements in road design
Source: Author

9. Existing Policies and Regulations in India: Various legal aspects are related to pedestrians in India such as the Indian Penal Code, 1860 to the Motor Vehicle Act, 1988 to the recent National Urban Transport Policy, 2006. The demerits of all these are that the legislations cater to the motorised road user only, not particular for pedestrians. IRC guidelines for pedestrian facilities and Rules of the Road Regulation 1989 provide standards for road users. Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995 include requirements for disabled in road design. National Policy on Urban Street Vendors recognises street vendors as an integral part of street design. Urban Development Plans Formulation and Implementation (UDPFI, 2015) provide rules regarding width of pathway.

5. Case Studies

Literature case studies were done in three contexts: international, national and Kerala scenarios. In international scenario, a case study of an established pedestrian plan was chosen. Seattle pedestrian plan which was recognised as platinum level rating for the walk communities and Sacramento city pedestrian master plan where innovative planning technology was applied were taken as case studies. In the pedestrian plan, the methodology adopted, contents and the factors that affect pedestrian plan were studied. In the national context, pedestrian study of a market place in Bangalore was taken as case study. In Kerala context, since we do not have any pedestrian plan, various aspects related to pedestrians and walkability were studied from the mobility plan. Mobility plans of Thiruvananthapuram and Kozhikode cities were studied.

A. City of Sacramento Pedestrian Master Plan

Sacramento, a city in the United States, used an innovative pedestrian planning technique for preparation of plan. The methodology that was adopted is shown in figure 4. Existing conditions were analysed in detail for identification of issues. Analysis of pedestrian demand score map and pedestrian deficiency score map provide an insight to the pedestrian improvement and composite map. From the analysis, projects are identified like sidewalk and crosswalk priority locations and improvement of commercial corridor.

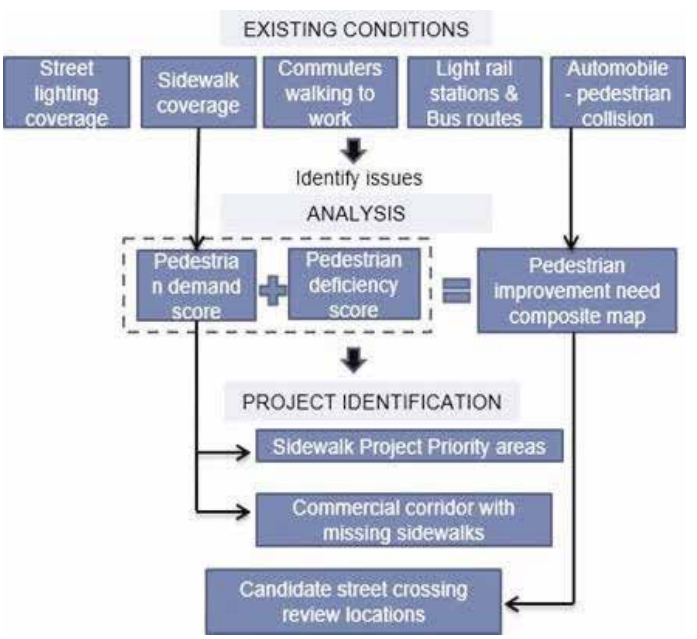

Figure 4: Flowchart illustrating methodology of preparation of Sacramento pedestrian plan

Source: Adapted by Author from City of Sacramento Pedestrian Master Plan, 2006

The policies and actions proposed by plan are under 5 headings: connectivity, travel-way character, context character, education and pedestrian safety. Connectivity is established by connecting residential areas to commercial and other public spaces, connection over barriers like rail, roads, waterways and freeways. Under travel-way character, design elements like sidewalk buffers, lighting standards, pedestrian- friendly standards, wider sidewalk in high pedestrian activity areas, etc. are proposed. Context character is improved through walkable land use patterns, including transit oriented development (TOD) and mixed use development. Provision of clear, direct and attractive internal pedestrian networks that connect buildings, neighbourhoods and commercial centres to the adjacent sidewalk are also important. Education is established through awareness programs like "Walk to School" Day. Safety is ensured by the use of guidelines, design intervention to minimise crossing distance and timing for crossing times.

B. Seattle Pedestrian Plan

Seattle, city in United States was recognised at Platinum level for their commitment to improving walkability and pedestrian safety by Pedestrian and Bicycle Information Center (PBIC) (Directorate of Urban Affairs, 2021). Destinations that get people walking such as transit stations, parks, schools, grocery stores and libraries, play a key role in creating vibrancy. However, not all destinations generate the same levels of pedestrian activity. So locations were classified into high, medium and low potential demand locations. The methodology adopted for preparation is shown in figure 5.

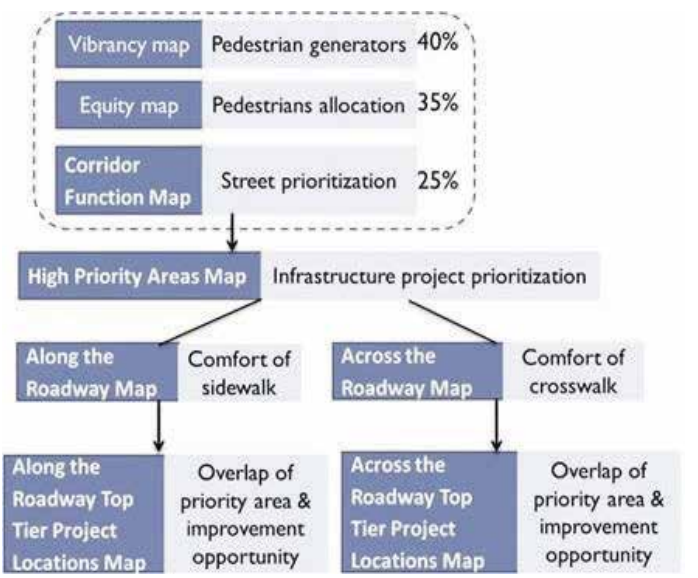

Figure 5: Flowchart illustrating methodology of the preparation of Seattle Pedestrian Plan

Source: Seattle Pedestrian Master Plan, 2009

Pedestrian infrastructure project prioritisation is done from analysing vibrancy map (where people walk), equity map (locations of people who walk) and corridor function map (street prioritisation). In existing conditions, sidewalk and crosswalk comfort are studied. This is overlaid with high priority areas map and sidewalk and crosswalk project locations maps.

Policy and program recommendations include completing and maintaining pedestrian system, improving walkability on all streets through walkable zone with better accessibility and design standards. Other recommendations cater safety through traffic-calming and visible intersections. Complete streets and creating public spaces are recommended to encourage people to walk.

C. Gandhi Bazar Pedestrian Study, 2011

Gandhi Bazar is an important street in Bangalore city in Basavanagudi locality. It is a bustling market throughout the year. This study is chosen since it a pedestrian study at micro-level in the Indian context. Pedestrian study was carried out in a systematic manner. It can be illustrated as shown in figure 6.

Various surveys were done to understand the real-life situation. Opinion surveys, road side interviews, volume counts, road network inventory surveys, speed and delay surveys, bus stop passenger counts, etc. are the surveys that were carried out and the groups of people who were targeted for the survey were pedestrians/ shoppers / visitors, hawkers and shop owners. Indian streets are characterised by the hawkers and vendors who make the streets lively. But there is a resulting issue towards pedestrian community since pathways are encroached by the hawkers/vendors. Delhi Government has tackled this issue by putting forward urban street design guidelines which solve the issues for hawkers. The pedestrian study resulted in short-term and long-term proposals. Long term proposals include full pedestrianisation of a 300 m stretch and partial pedestrianisation of an 800 m stretch.

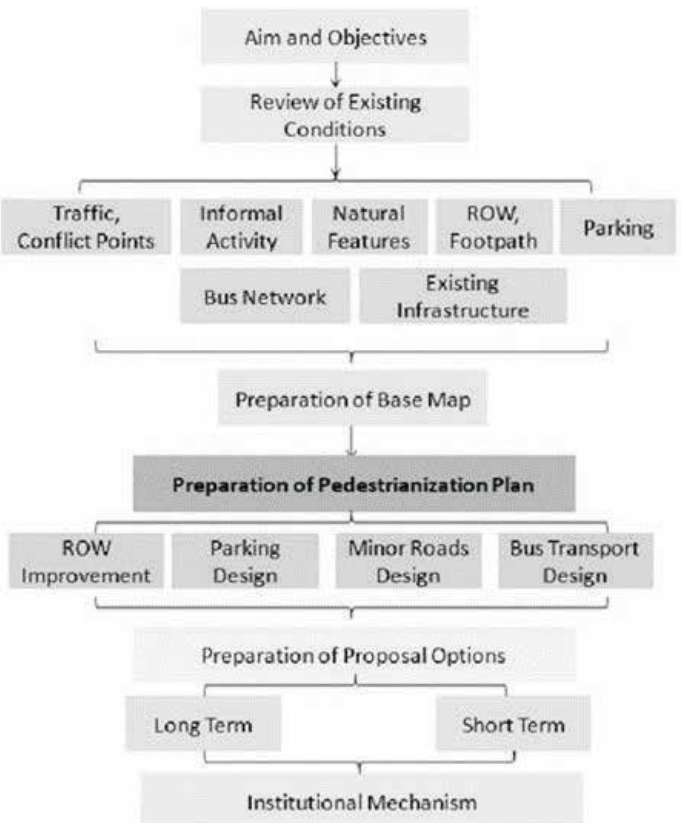

Figure 6: Flowchart illustrating methodology of pedestrian study
Source: Gandhi Bazaar Pedestrianisation Study, 2011

D. Comprehensive Mobility Plan for Thiruvananthapuram City, 2015

Thiruvananthapuram, the capital of Kerala State has 60% of major road corridors with footpath within the CBD and 10% of them have a footpath width more than 1.2 m on both sides. Mode share of Non-Motorised Transport (NMT) in Thiruvananthapuram is 5% and walkability is 10%. Issues identified were that footpaths are encroached by hawkers and vendors. Thus pedestrians were forced to walk on carriageway. Fatality rate for pedestrian is 13%. Mobility improvement measures include provision of footpaths, development of pedestrian grade-separated facilities, canal walk and pedestrianisation in the core area.

E. Comprehensive Mobility Plan for Kozhikode City, 2015

Kozhikode city is one of the major cities in northern Kerala. 81% of major road corridors are devoid of footpath with minimum width as 1.2 m. Pedestrian subway at Palayam is dysfunctional. Foot Over Bridge (FOB) in front of Mofussil Bus Terminal and Kozhikode Medical College hospital is found to be underutilised. Mode share of NMT in Kozhikode is 16% and walkability is 14%. Issues identified were that footpaths were encroached by hawkers and vendors, absence of footpaths and unregulated pedestrian crossings is one of the major issues in Kozhikode city. Road surfaces are deteriorated by spillage of water and garbage by fruits/vegetables/ food stalls. Fatality rate for pedestrian is 58%. Mobility improvement measures include that all arterial streets should have ≥ 75% of their lengths having non-obstructed footpaths, all other sub-arterial and local streets should have 50-75% of their lengths having footpaths, at grade pedestrian crossings at max interval of 75-250 m and footpaths, FOB and pedestrian only streets.

6. Data Analysis and Findings

A. Goals identification for pedestrian plan

Primary goal is identified as safety which includes physically disabled and senior citizens. Importance to be given in creating connected pedestrian network. Pedestrian infrastructure should be attractive and maintenance of the same is also very important.

B. Elements of walkability

Sidewalks and crosswalks are the most important elements. Curb ramps which facilitate accessibility, street furniture, traffic signals are other important elements.

C. Study of existing conditions

Pedestrian demand locations are the most important condition to be studied which mainly includes land-use characteristics of the area. Existing pedestrian infrastructure and pedestrian population are also important. Topography is a variable to be considered in cities of Kerala.

D. Pedestrian demand

Pedestrian demand is highly concentrated on central shopping districts, institutions such as educational, health, government, transport stations and open spaces or parks.

E. Policy and program recommendations

Policy and programs facilitating accessibility and safety are of high importance. Maintenance of infrastructure facilities is as important as construction. Education and enforcement programs can have good results.

7. Results and Discussion

Pedestrianisation has an important role in sustainable city planning. Pedestrian facilities should be planned in an integrated manner so as to ensure a continuous pedestrian flow. The basic aim should be to encourage people to walk in a city through various strategies favouring pedestrian activity.

A. Framework for preparation of pedestrian plan

From the analysis, methodology for preparation of pedestrian plan is prepared as shown in figure 7. Walkability of a city relies on its pedestrian infrastructure facilities such as land-use mix, road classifications, ease of street crossings, presence of sidewalks and their characteristics etc. It can be seen that the most successful pedestrian plans revolve around the people in the community. Preparation of pedestrian plan follows a series of steps outlined in figure 8.

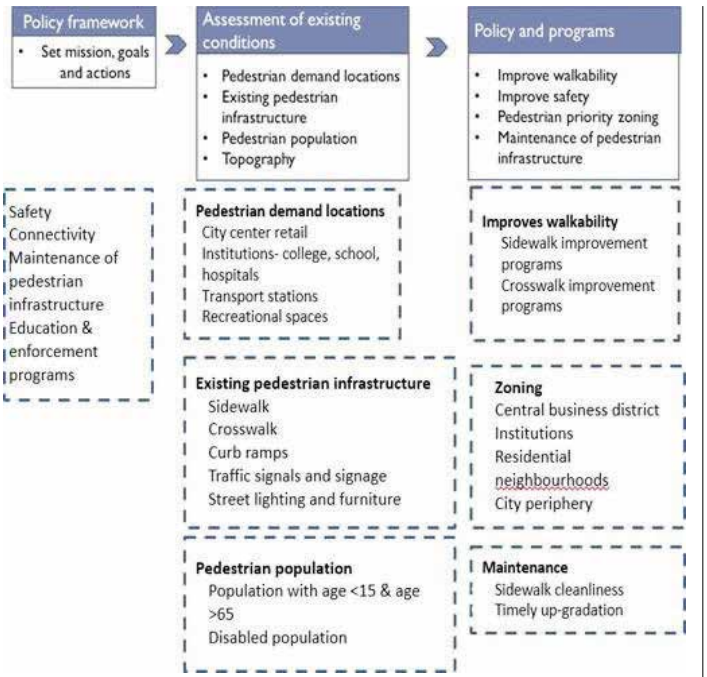

Figure 7: Framework for preparation of Pedestrian Plan
Source: Author

Figure 8: Flowchart showing steps followed in preparation of the Pedestrian Plan
Source: Author

B. Policy recommendations

- From car-oriented cities to pedestrian-oriented cities: Place pedestrians at the top of the transportation hierarchy. Re-allocate road space by narrowing roads and widening sidewalks in pedestrian-only districts (Tiwari & Jain, 2022).
- Promote mixed development: Land use patterns that integrate street and pathway connectivity and ensure the proximity of housing, schools, transportation hubs, jobs and community resources to one another have been shown to positively impact how much community members walk.
- Congestion charge to reduce traffic: Congestion charging is practiced in many European countries so as to decrease the use of private motorised vehicles.
- Undersupply of parking space: Pedestrianising a street does not necessarily require the removal of cars but decreasing private vehicles to the city centre along with improving public transportation can be adopted through undersupply of parking spaces.

- Ensure safety of pedestrians: People are less likely to walk in their communities if they experience them as unsafe. Low rates of crime, low measures of perceived violence and high levels of neighbourhood trust are all correlated with high rates of walking and physical activity.
- Development of institutional framework specifically for pedestrian plan preparation: There must be a responsible committee for preparing pedestrian plans and for the maintenance of the same.

8. Conclusions and Recommendations

Conventional transportation planning practices treat walking as a minor transport mode and recognise only modest benefits from improved walkability and increased walking activity. Latest documents on mobility stress on the provision of pedestrian facilities and followed increase in walk mode share. This study provides a comprehensive document that can be applied under a wide variety of applications and diverse conditions in Kerala. This framework provides a guide for city planners to develop pedestrian plans. Pedestrian plans for Indian cities are important for the sustainable and healthy future cities. Implementation of this framework will improve pedestrian accessibility, mobility, connectivity, and safety.

Note:

This study was carried out under the guidance of Ar. Shailaja Nair, whose insights and mentoring were invaluable to its development.

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ARTICLE

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Bridging Voices
The Now of Design

By Ar. Ajmal Sha Basheer

1. Introduction

Community engagement in architectural design has gained increasing attention in recent years due to its potential to create more inclusive, sustainable, and culturally resonant environments. This approach emphasizes the importance of involving diverse community voices in the design process, ensuring that the resulting spaces genuinely reflect and serve their inhabitants. Despite the growing recognition of its benefits, there remains a significant gap in the literature regarding the comprehensive understanding of effective community engagement methods, particularly across diverse contexts ranging from rural villages to urban centres.

Broader Importance of the Problem

The role of community engagement in architecture is critical for fostering social cohesion, cultural sensitivity, and environmental stewardship. As highlighted by Forester in "Planning in the Face of Power," engaging communities in the design process can empower marginalized groups, ensuring their needs and preferences are addressed (Forester, 1989). Similarly, Arnstein's "A Ladder of Citizen Participation" provides a foundational framework for understanding the different levels of citizen involvement, emphasizing the importance of genuine participation rather than tokenism (Arnstein, 1969). These works underline the transformative potential of community engagement but also reveal the challenges in achieving meaningful participation.

Identified Gap in Literature

While the theoretical underpinnings of community engagement are well-established, there is a lack of detailed studies examining the practical application of these principles across varied contexts. Key texts such as Anthony's "Designing for Diversity" and Farr's "Sustainable Urbanism" offer critical perspectives on inclusive and sustainable design practices (Anthony, 2001; Farr, 2007). However, there is a need for more empirical research that documents successful case studies and explores the methods and outcomes of community-engaged design in both rural and urban settings. This gap in the literature highlights the necessity for research that not only examines participatory design processes but also provides actionable insights for architects and planners.

Research Question and Aim of the Study

Given the identified gap, this study aims to answer the following research question: How can community engagement be effectively integrated into architectural design to create inclusive, sustainable, and culturally resonant environments across rural and urban contexts? The primary goal of this research is to explore the methods and benefits of participatory design processes, examine strategies for effective collaboration between architects and community stakeholders, identify challenges to meaningful engagement, and propose solutions to overcome these barriers.

Importance and Implications of the Study

This study aims to inspire architects, planners, and policymakers to adopt inclusive and participatory design approaches. Integrating community engagement ensures designed spaces reflect and serve their inhabitants, addressing diverse needs across India's urban and rural areas. The study advocates for policy development supporting community engagement, capacity building for

professionals, and culturally sensitive strategies. These measures can create environments that meet immediate community needs while contributing to long-term sustainability and resilience. Ultimately, this research highlights the transformative potential of community engagement in creating just, sustainable, and inclusive spaces, leading to stronger, more equitable environments and a more harmonious society.

1.1 Aim and Objectives

Aim

The primary aim of this study is to explore how community engagement can be effectively integrated into architectural design to create inclusive, sustainable, and culturally resonant environments across rural and urban contexts. Specifically, the research seeks to understand the methods and benefits of participatory design processes, strategies for effective collaboration between architects and community stakeholders, and the challenges to meaningful engagement and answer the question: How can community engagement methods be optimized to enhance architectural design and ensure it meets the diverse needs of its users?

Objectives

To achieve the aim of this study, the following specific objectives have been identified:

1. Investigate Participatory Design Processes: Examine various methods of participatory design to understand how community input can be effectively integrated into architectural projects.
2. Analyze Strategies for Collaboration: Identify and evaluate strategies for effective collaboration between architects, planners, and community stakeholders, emphasizing both urban and rural contexts.
3. Identify Challenges to Engagement: Explore the challenges and barriers to meaningful community engagement, particularly in marginalized and resource-constrained communities.
4. Assess the Impact on Social Cohesion: Evaluate the impact of community-engaged design on social cohesion within communities, considering both urban and rural settings.
5. Evaluate Cultural Sensitivity: Determine how community engagement can enhance the cultural sensitivity of architectural designs, ensuring they reflect local traditions and values.
6. Examine Environmental Sustainability: Assess how community knowledge and participation can contribute to environmentally sustainable design practices.
7. Develop Recommendations: Formulate practical recommendations for architects, planners, and policymakers to promote more inclusive and participatory design approaches.

Derivation from Existing Theories/Data

These objectives are derived from a review of existing theories and empirical data on community engagement, participatory design, and sustainable development. The theoretical frameworks of Arnstein's (1969) "Ladder of Citizen Participation" and Forester's (1989) "Planning in the Face of Power" provide a foundation for understanding the dynamics of community engagement and its potential for empowerment. Additionally, the work of scholars such as Roy (2009) and Mitra (2019) on participatory planning and cultural sensitivity in the Indian context has informed the development of these objectives.

Scope

The scope of this study encompasses a wide range of geographic and cultural contexts, focusing on both rural and urban environments. It aims to provide a comprehensive understanding of community engagement methods in architectural design and their impact on creating inclusive, sustainable, and culturally resonant spaces. The study includes a detailed review of theoretical frameworks, analysis of scholarly articles, and examination of selected case studies to offer actionable insights and recommendations.

Limitations

The limitations of this study include the reliance on secondary data, which may not capture all nuances of community engagement practices. Additionally, the selected case studies, while exemplary, may not be representative of all possible contexts and may be subject to biases inherent in the original documentation. Furthermore, the study's focus on published literature may overlook informal or undocumented community engagement practices that are equally significant. Despite these limitations, the research provides a valuable foundation for further empirical studies and practical applications in the field of architectural design.

2. Literature Review

2.1 Theoretical Frameworks of Community Engagement

Community engagement in design has been extensively studied through various theoretical

frameworks. Sherry Arnstein's (1969) "Ladder of Citizen Participation" is seminal in categorizing levels of public involvement, from tokenistic consultation to citizen control. Arnstein emphasizes that genuine community participation involves power redistribution, enabling citizens to influence decisions that affect their lives. John Forester (1989) in "Planning in the Face of Power," highlights the importance of addressing power imbalances within participatory processes. Forester's work underscores the need for planners to facilitate dialogue among stakeholders, ensuring marginalized voices are heard.

In the Indian context, Ananya Roy (2009) critiques top-down development models, advocating for participatory planning that recognizes the agency of marginalized communities. Roy argues that inclusive planning processes are crucial for achieving social justice in urban development. Mitra (2019) extends this argument, emphasizing culturally sensitive engagement strategies that consider India's diverse social and cultural contexts. These frameworks provide a basis for understanding the dynamics of community engagement and its potential for empowerment.

2.2 Benefits of Community Engagement

Research consistently highlights the numerous benefits of community engagement in design. Participatory design processes enhance social cohesion by fostering ownership and belonging within communities. Community engagement also improves cultural sensitivity, ensuring designs are culturally appropriate and responsive to local needs. Additionally, community knowledge of local environmental conditions informs sustainable design practices. Community input enriches the design process, leading to more functional and user-friendly spaces. These benefits underscore the transformative potential of community-engaged design in creating spaces that genuinely reflect and serve their inhabitants.

2.3 Challenges of Community Engagement

Despite its benefits, community engagement faces several challenges, particularly in the Indian context. Power imbalances between communities, bureaucracies, and developers can marginalize certain voices, limiting the effectiveness of engagement processes (Roy, 2009). Resource constraints, including limited financial and human resources, can hinder effective communication, capacity building, and implementation of community-driven initiatives (Fernandes & Heller, 2014).

Social fragmentation, characterized by socioeconomic and cultural divisions within communities, poses another significant challenge (Mitra, 2019). Achieving consensus in such diverse settings can be difficult, impacting the overall success of participatory processes. Additionally, there is often a lack of awareness about the benefits and processes of community engagement, further complicating efforts to involve communities in design (Satterthwaite, 2007).

2.4 Empirical Evidence from Case Studies

Case studies provide empirical evidence of the impact of community engagement in architectural design. The participatory urban planning initiatives in Medellín, Colombia, serve as a notable example. These initiatives have transformed marginalized neighborhoods through active community involvement, resulting in improved social cohesion and urban environments that reflect the needs and aspirations of residents (Echeverri & Orsini, 2010).

In the Indian context, community-driven design initiatives in rural areas demonstrate the potential of participatory approaches to enhance cultural sensitivity and sustainability. For instance, the work of the Hunnarshala Foundation in post-earthquake reconstruction in Gujarat involved extensive community participation, leading to culturally appropriate and resilient housing solutions (Mistry & Berardi, 2012). These case studies illustrate that active community

involvement in the design process can lead to environments that better meet community needs and reflect cultural values.

2.5 Major Conclusions

The major conclusions drawn from the literature underscore the importance of genuine community engagement in achieving inclusive and sustainable design outcomes. Forester (1989) concludes that empowering communities leads to more equitable and effective planning processes. Arnstein (1969) emphasizes that meaningful participation is essential for achieving true community control and ownership of projects.

Anthony (2001) concludes that diversity in design practice enhances the accessibility and inclusivity

of built environments. Farr (2007) argues that sustainable urbanism is inherently tied to participatory processes that align environmental stewardship with community needs. These conclusions highlight the multifaceted benefits of community-engaged design and provide a theoretical foundation for the present study.

In conclusion, the literature provides a robust foundation for understanding the significance of community engagement in architectural design. By integrating community perspectives, architects and planners can create spaces that genuinely reflect and serve their inhabitants, contributing to the development.

3. Methodology

3.1 Research Design

The research design is based on a qualitative approach that combines a review of secondary data with case study analysis. The qualitative approach was chosen to provide an in-depth understanding of the complex and context-specific nature of community engagement in architectural design. This methodology allows for the exploration of diverse perspectives and experiences, which are crucial for understanding the dynamics of community participation.

3.2 Setting of the Study

The study focuses on the Indian context, encompassing both urban and rural settings. The research includes case studies from urban areas like Medellín, which, although outside India, provides relevant insights due to its successful participatory urban planning initiatives.

Additionally, rural areas in India, such as those impacted by the Hunnarshala Foundation's community-driven design initiatives, are examined. These settings provide a comprehensive view of how community engagement can be implemented across different contexts.

3.3 Sampling Strategy / Case Study Selection Criteria

Case studies were selected based on their relevance to the research objectives and their demonstrated success in community engagement practices. The selection criteria included:

1. Demonstrated use of participatory design processes.
2. Evidence of collaboration between architects and community stakeholders.
3. Documented outcomes related to social cohesion, cultural sensitivity, and environmental sustainability.
4. Availability of detailed documentation and evaluation reports.

The case studies from Medellín and Gujarat were chosen because they represent different scales and contexts of community engagement, providing a broad perspective on the topic.

3.4 Methods / Tools for Data Collection

Data collection methods included a comprehensive literature review and analysis of secondary data sources. The literature review covered theoretical frameworks, scholarly articles, and previous case studies on community engagement in architectural design. Secondary data sources included published reports, academic papers, and project documentation from the selected case studies.

3.5 Documentation of Data

Data was documented systematically to ensure accuracy and consistency. A database was created to organize and store all relevant information, including theoretical frameworks, case study details, and findings from previous research. This database facilitated the analysis and comparison of different sources of information.

3.6 Data Analysis Framework

The data analysis framework involved thematic analysis to identify common themes and patterns related to community engagement in architectural design. Thematic analysis is a method for systematically identifying, organizing, and offering insight into patterns of meaning (themes) across a dataset (Braun & Clarke, 2006).

Inclusion criteria:

- Projects with documented evidence of significant community engagement.
- Availability of detailed project documentation and outcomes.
- Recognition by scholarly articles or architectural awards.

Exclusion criteria:

- Projects with minimal or no community involvement.
- Lack of sufficient documentation or data for analysis.

4. Data Analysis and Findings

4.1 Thematic Analysis

The primary method of analysis used in this study is thematic analysis. This approach involves identifying recurring themes and patterns related to community engagement in architectural design. The analysis is organized into the following sub-sections, each corresponding to a specific aspect of community engagement:

Methods of Community Engagement

The analysis reveals several methods of community engagement used in the selected case studies. In Medellín, Colombia, participatory urban planning involved extensive public consultations, workshops, and community meetings. These methods ensured that diverse voices were heard and incorporated into the design process (Echeverri & Orsini, 2010). In Gujarat, community-driven design initiatives utilized local knowledge and skills, with villagers actively participating in the construction and decision-making processes (Gnanadason, 2015).

Benefits and Outcomes of Participatory Design

The findings indicate that participatory design processes result in numerous benefits. In Medellín, the participatory approach led to significant improvements in urban infrastructure and public spaces, fostering social cohesion and reducing crime rates (Brand & Dávila, 2011). In Gujarat, community-driven projects enhanced cultural sensitivity and environmental sustainability, as the designs were closely aligned with local traditions and ecological conditions (Gnanadason, 2015).

Challenges to Community Engagement

Power imbalances, resource constraints, social fragmentation, and lack of awareness were common obstacles. The analysis indicated that marginalized communities often struggled to have their voices heard due to existing power dynamics between developers, bureaucracies, and local populations. Limited resources also hindered effective communication and capacity building, essential for successful community engagement. Social fragmentation within communities, due to socioeconomic and cultural differences, posed challenges for achieving consensus.

Strategies to Overcome Challenges

The case studies also provide insights into strategies for overcoming these challenges. In Medellín, building strong partnerships between local governments, NGOs, and community groups helped address power imbalances and resource constraints (Brand & Dávila, 2011). In rural India, leveraging local networks and resources, along with continuous community education and capacity-building efforts, proved effective in mitigating logistical challenges (Gnanadason, 2015).

Impact on Social Cohesion, Cultural Sensitivity, and Environmental Stewardship

The thematic analysis underscores the positive impact of community-engaged design on social cohesion, cultural sensitivity, and environmental stewardship. In Medellín, the participatory projects strengthened community bonds and fostered a sense of ownership and pride among residents (Brand & Dávila, 2011). In Gujarat, the alignment of design with local cultural and environmental contexts enhanced the sustainability and acceptance of the projects (Gnanadason, 2015). Participatory design processes enhance social cohesion by fostering a sense of ownership and belonging, which strengthens social bonds and encourages collective action, as seen in the transformation of crime-ridden neighborhoods in Medellín and improved social relationships in Gujarat blending traditional techniques with modern needs to preserve cultural heritage. Moreover, community involvement in design processes promotes environmental stewardship, utilizing local knowledge to inform sustainable practices, as demonstrated by the use of traditional materials in rural projects and community-led green initiatives in Medellín. Despite these benefits, challenges such as power imbalances, resource constraints, and social fragmentation must be addressed to ensure meaningful and effective community engagement.

4.2 Findings

By integrating community engagement in architectural design enriches the design process and results in spaces that genuinely reflect and serve their inhabitants. Key findings include:

1. **Effective Methods of Engagement:** Public consultations, workshops, community meetings, and leveraging local knowledge and skills are effective methods of community engagement.
2. **Significant Benefits:** Participatory design processes lead to improvements in infrastructure, public spaces, social cohesion, cultural sensitivity, and environmental sustainability.
3. **Challenges and Strategies:** Power imbalances, resource constraints, and logistical challenges are common barriers, but can be mitigated through strong partnerships, leveraging

local resources, and continuous community education.

4. **Positive Impacts:** Community-engaged design positively impacts social cohesion, cultural sensitivity, and environmental stewardship, creating more resilient and adaptable urban and rural landscapes.

4.3 Findings from Case Studies

The case studies from Medellín and Gujarat provided concrete examples of successful community engagement in architectural design. These findings emphasize the transformative potential of community engagement in creating resilient, adaptable, and inclusive environments.

Medellín

Medellín's participatory urban planning initiatives, such as the construction of public libraries and parks, demonstrated the power of community engagement in urban development. Community members actively participated in the planning and implementation stages, resulting in spaces that met their needs and preferences. The projects led to reduced crime rates, enhanced social cohesion, and improved quality of life for residents. The success of Medellín's approach underscores the importance of involving communities in urban planning to create sustainable and vibrant cities.

Hunnarshala, Gujarat

In Gujarat, the Hunnarshala Foundation's projects exemplified how community-driven design can address local needs and promote sustainability. By involving local artisans and using traditional materials, these projects not only preserved cultural heritage but also enhanced environmental sustainability. Community members' active participation ensured that the designs were functional, culturally appropriate, and well-accepted. These initiatives highlighted the potential for rural communities to take charge of their development, fostering self-reliance and resilience.

4.4 Summary of Findings

The data analysis confirms that community engagement in architectural design enhances social cohesion, cultural sensitivity, and environmental sustainability. Challenges such as power imbalances and resource constraints highlight the need for targeted strategies. Case studies from Medellín and Gujarat show that active community involvement results in environments that genuinely reflect and serve inhabitants. Integrating community engagement is crucial for creating just, sustainable, and inclusive spaces. Empowering communities to shape their environments ensures that built spaces reflect their needs, values, and aspirations. The study concludes that community engagement aligns professional expertise with grassroots insights, leading to more resilient and adaptable communities.

5. Results and Discussion

This section presents the findings of the study and evaluates their implications in relation to the aim and hypothesis. The results are drawn from the thematic analysis of secondary data, including theoretical frameworks, scholarly articles, and detailed case studies of community engagement in architectural design. The discussion interprets these results, emphasizing their theoretical and practical consequences.

5.1 Results

Methods of Community Engagement

The study identified several effective methods of community engagement in architectural design. Public consultations, workshops, and community meetings were widely used in urban contexts like Medellín, Colombia, where these methods facilitated extensive community participation. In Gujarat, leveraging local knowledge and skills proved effective, with villagers actively participating in the design and construction processes.

Benefits and Outcomes of Participatory Design

Participatory design processes were found to offer numerous benefits. In Medellín, these approaches led to significant improvements in urban infrastructure and public spaces, enhancing social cohesion and reducing crime rates. In Gujarat, community-driven projects increased cultural sensitivity and environmental sustainability, as the designs were closely aligned with local traditions and ecological conditions.

Challenges to Meaningful Engagement

The analysis revealed several challenges to meaningful community engagement. Power imbalances and resource constraints were common barriers in both urban and rural settings. In Medellín, some community members felt marginalized despite the participatory processes. In rural India, logistical challenges such as remote locations and limited access to resources hindered effective engagement.

Strategies to Overcome Challenges

The case studies provided insights into strategies for overcoming these challenges. In Medellín, building strong partnerships between local governments,

NGOs, and community groups helped address power imbalances and resource constraints. In Gujarat, leveraging local networks and resources, along with continuous community education and capacity-building efforts, proved effective in mitigating logistical challenges.

Impact on Social Cohesion, Cultural Sensitivity, and Environmental Stewardship

Community-engaged design had a positive impact on social cohesion, cultural sensitivity, and environmental stewardship. In Medellín, participatory projects strengthened community bonds and fostered a sense of ownership and pride among residents. In Gujarat, the alignment of design with local cultural and environmental contexts enhanced the sustainability and acceptance of the projects.

5.2 Discussion

Linking Results to Aim and Hypothesis

The aim of this study was to explore how community engagement can be effectively integrated into architectural design to create inclusive, sustainable, and culturally resonant environments across rural and urban contexts. The hypothesis posited that participatory design processes would enhance social cohesion, cultural sensitivity, and environmental stewardship while overcoming barriers through strategic approaches. The results support these hypotheses, demonstrating the multifaceted benefits of community-engaged design and the strategies needed to address common challenges.

Theoretical and Practical Implications

The findings have several theoretical and practical implications. Theoretically, they reinforce the significance of participatory design frameworks such as those proposed by Arnstein (1969) and Forester (1989). Practically, they highlight the need for architects and planners to adopt inclusive and participatory approaches to design, ensuring that community voices are integral to the planning and implementation processes.

Key Results and Their Significance

The key results of this study emphasize the importance of community engagement in creating spaces that genuinely reflect and serve their inhabitants. The significant improvements in urban infrastructure and public spaces in Medellín demonstrate the transformative potential of participatory design. Similarly, the enhanced cultural sensitivity and environmental sustainability of projects in Gujarat illustrate the benefits of aligning design with local contexts.

Original Contributions and Corroborations with Previous Studies

This study makes an original contribution by synthesizing insights from diverse geographic and cultural contexts, providing a comprehensive analysis of community engagement in architectural design. The findings corroborate previous studies by Arnstein (1969) and Forester (1989), reinforcing the importance of genuine community participation. Additionally, the study highlights practical strategies for overcoming barriers to meaningful engagement, contributing to the existing body of knowledge on participatory design.

5.3 Importance and Implications of Findings

The findings have significant implications for architects, planners, and policymakers. The benefits of community engagement—enhanced social cohesion, cultural sensitivity, and environmental sustainability—emphasize the need for inclusive and participatory design approaches. Aligning professional expertise with grassroots insights ensures that spaces genuinely reflect and serve their inhabitants. Addressing the challenges to community engagement is crucial. Policymakers must promote frameworks for effective participation, while architects and planners should develop skills for engaging diverse communities. Culturally sensitive practices ensure that all voices are heard and that design processes are inclusive. Community engagement is essential for creating just, sustainable, and inclusive environments. Empowering communities to shape their own futures leads to stronger, more resilient, and equitable urban and rural spaces. This research enhances the understanding of community-engaged design and offers valuable insights for practitioners and policymakers implementing participatory approaches.

6. Conclusions and Recommendations

This study explored the critical role of community engagement in contemporary architectural design in India, focusing on bridging diverse voices to foster resilient and adaptable communities. The aim was to understand the methods and benefits of participatory design processes, identify effective collaboration strategies between architects and community stakeholders, and address challenges to meaningful engagement.

6.1 Summary of Findings

The research confirmed that community engagement significantly enhances social cohesion, cultural sensitivity, and environmental sustainability in both urban and rural settings.

Participatory design processes foster a sense of ownership and belonging among community members, leading to stronger social bonds and cooperation. Engaging diverse stakeholders ensures that built environments are culturally sensitive and responsive to local needs. Moreover, community knowledge and involvement contribute to more sustainable and environmentally friendly design outcomes.

6.2 Practical Significance

Real-life phenomena explained by the results include the successful transformation of crime- ridden urban neighborhoods into vibrant, cohesive communities, as seen in Medellín, and the effective integration of traditional building techniques with modern design in Gujarat. These examples demonstrate the potential of community-engaged design to address complex social and environmental challenges.

6.3 Unresolved Problems and Future Research

Despite the positive outcomes, several challenges to community engagement remain unresolved. Power imbalances, resource constraints, social fragmentation, and lack of awareness are significant barriers that must be addressed to ensure effective participation. Marginalized communities often struggle to have their voices heard, and limited resources hinder effective communication and capacity building.

Future research should focus on developing metrics to evaluate the impact of community engagement on design outcomes and exploring innovative methods for involving communities in the design process. Additionally, further studies are needed to address the challenges of power dynamics and resource limitations, ensuring that all community members can participate meaningfully in the design process.

6.4 Recommendations

Based on the findings, the following recommendations are proposed:

1. **Promote Policy Support**: Policymakers should create supportive frameworks that facilitate community engagement in architectural design and urban planning. This includes providing resources for capacity building and ensuring that marginalized communities have a voice in the decision-making process.
2. **Capacity Building for Architects and Planners**: Architects and planners should be trained in participatory design methods and culturally sensitive engagement strategies. This will help them effectively collaborate with diverse communities and integrate local knowledge into design processes.
3. **Culturally Sensitive Engagement Strategies**: Engagement strategies should be tailored to the cultural contexts of the communities involved. This includes respecting local traditions and practices and incorporating traditional building techniques and materials into modern designs.
4. **Development of Evaluation Metrics**: Future research should develop metrics to evaluate the impact of community engagement on design outcomes. This will provide a clearer understanding of the benefits and challenges of participatory design and inform best practices for future projects.

By adopting these recommendations, architects, planners, and policymakers can enhance the impact of community engagement in architectural design, creating more just, sustainable, and inclusive environments in both urban and rural India.

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ARTICLE

Outlining Guidelines for Resiliency in Master Planning

A Study of Hilly Terrain

By Ar. Divya Gupta

1. Introduction

Perhaps the major issues related with land development is the adjustment of the rate and measure of spillover utilising streams and waterways. Both, urbanisation and agricultural development has been increasing over the years. The effect of this change is much significant leading to property harm from flooding. Water quality is degraded and channel disintegration is heightened. Territory is debased and the picturesque nature of the riparian climate is compromised. That as well as these issues, particularly the flooding and property harm have customarily welcomed on a rash of responses from the political and engineering community. The resultant alleged remedial measures they conjure are regularly more harming than the issues they are intended to address. In addition to other things, streams have been dumped and channeled underground, wetlands depleted and dams raised trying to control storm water and flooding, all at extraordinary cost to the general population and the climate. Capable land use planning and configuration need in administration instead of a control way to deal with storm water. Therefore, the aim of this study is to formulate guidelines and effective strategies towards the water management leading to conservation planning of natural landscape systems by prioritising the watersheds.

1.1 Objectives

- To study the climate and changing weather patterns of Uttarakhand which led to its current state.
- To understand all the influencing factors and their interdependency affecting form of any watershed.
- To research about the computation methods of every related term for assessing potential areas of watershed.
- To examine the selected case studies and understand the water management techniques, which have been applied after complete analysis of watershed.
- To formulate the guidelines after combining the findings from literature and case studies.

1.2 Research Questions

- How does the water runoff vary as per different soil and vegetation type?
- What are the needed calculations which are being done for analysing any watershed?
- How changing weather of Uttarakhand over the years led to exploitation of natural resources?
- What are the water management techniques, which have been applied in similar context before?

1.3 Scope

The research will cover the detailed study of factors influencing the form of watershed and the relation of natural landscape elements with water run-off. Quantification of the Data will be generated for one of the Primary Case studies in detail, to understand all the respective management techniques applied to preserve the surface water.

1.4 Limitation

The whole study will be limited to water resilience as it is the vital guideline for organising the land so that each drop of water that falls is shipped and

coordinated as a component of water resilience through different procedures and configuration including swales, recharge trenches, ponds, lakes, streams amongst other different techniques. The research will also be limited to the particular geographic region i.e., Uttarakhand state.

1.5 Identified Literature Studies:

- Landscape Planning—Environmental applications (Fifth edition)

  Author: William M. Marsh

- Water resources management in the Himalayan region states

  Author: Jagdish Bahadur (1998)

- Climate Change in Uttarakhand: Current State of Knowledge and Way Forward

  Author: M/s Bishen Singh Mahendra Pal Singh, Dehradun (2015)

- Uttarakhand action plan on climate change (UAPCC) by Government of Uttarakhand (2014)

- Land and Water Resources Management Using Remote Sensing and GIS-A Case Study of Hilly Watershed.

  Author: Dr. Santosh Pingale, Deepak Khare, Mahesh K. Jat

- Drainage morphometric analysis for assessing form and processes of the watersheds of Pachamalai hills and its adjoinings, Central Tamil Nadu, India. (2018)

  Author: A. Prabhakaran, N. Jawahar Raj

2.0 Literature Review - Basics of Drainage Basin

A drainage basin is a region of land where water from downpour or snowmelt depletes downhill into a waterway, like a stream, lake, dam, estuary, wetland, ocean or sea. The drainage basin incorporates all the surface water from downpour overflow, snowmelt, hail, slush and close by streams that run downslope towards the common outlet, just as the groundwater under the earth's surface.

Drainage basins have well-defined boundaries. The line that isolates two adjoining seepage bowls is known as a drainage divide. Drainage divides are frequently steep mountain slopes. At the point when downpour falls on one side of the divide, it will stream into a specific drainage basin, and if assuming, the water falls on the contrary side of the separation, it will stream into an alternate drainage basin as seen in Figure 1.

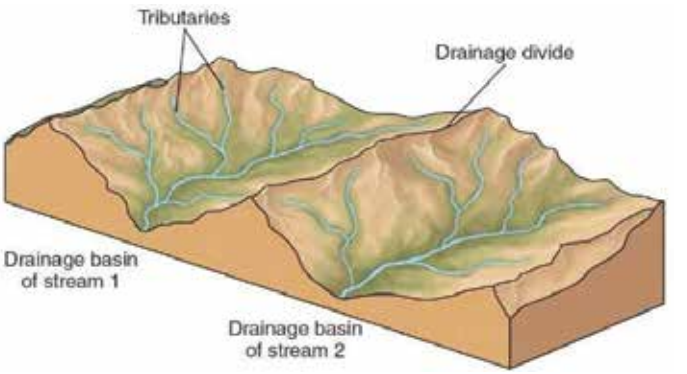

Figure 1: Drainage basin of two different streams
Source: https://worldrivers.net/2020/03/25/drainage-basins/

2.1 Delineating Watershed Boundaries

All watershed delineation approach is that you`re drawing strains on a map to discover watersheds boundaries. These are usually drawn on topographic maps by the usage of statistics from contour strains. Contour strains are strains of identical elevation, so any factor alongside a given contour line is the equal elevation. 1) The number one strains on a topographic map are known as contour strains, and as said before, they constitute factors of identical elevations. Some of those strains are numbered, and those numbers are the elevations of these contour strains. 2) Streams and rivers are proven with the aid of using blue strains. Solid blue strains display perennial streams, and the dashed blue strains display what are envisioned to be intermittent streams. 3) Contour strains factor upstream (they shape form of what seems like a V) as they go over a flow or river. 4) If the contour lines are closely compacted, the terrain will be steeper. If loosely placed, then they're the flatter terrain.

2.2 Characteristics of The Drainage Basin

- Drainage basin - the location of land tired through a river.
- Catchment location - the location in the drainage basin.
- Watershed - the threshold of highland surrounding a drainage basin which marks the boundary among drainage basins.

To channel the water to a single point, there is a need of collecting the water within the area. Thus, then drainage basin comes into play and acts like a funnel. There will always be a separation between two drainage basins because of the topography alteration. And that separation line would be called as drainage divide, making up a succession of higher geographical features (such as a ridge, hill or mountains) forming a barrier.

2.3 Factors Affecting Characteristics of Drainage Basin

Basin size - This impacts the lag time – a huge drainage basin will suggest that water takes a long term to journey thru tributaries or the ground to attain the channel. Conversely, a small drainage basin means that water has a shorter distance to journey and could bring about a shorter lag time.

Basin shape – When all the points are equally placed from the channel, that is called circular drainage basin and can cause a shorter lag time and better high discharge. Elongated drainage basins are characterised via way of means of longer lag instances and decrease peak discharge because the water drains from the furthest reaches of the watershed to the channel.

Elevation and slope – If a river valley have not much steep slopes, then it provides longer lag instances and it decrease the peak discharge but if the valley has the steep slopes, then water moves fast to the channel because of the gravity action.

Rock type - Rock type creates an impact and affect the rate of drainage in any basin. Permeable rock assists percolation: -

- Porous rock (sandstone, chalk) lets in water to percolate thru the pore areas.
- Pervious rock (limestone) lets in water to journey alongside joints and bedding planes in the rock.
- Impermeable rock (granite, shale, clay) impedes drainage via way of means of limiting percolation.

Soil type - Soil types control the charge of infiltration, soil moisture storage and charge of through flow. Sandy soils have excessive quotes of infiltration because of extraordinarily huge air areas or voids among soil particles, while clay soils and silts have small pore areas which permit little or no through flow.

Drainage density- To calculate drainage density, the length of the streams of each order is added and the sum is divided by the area of sub watershed. Those basins which have impermeable rocks and soil has high drainage density because water runoff is very high and it does not percolate well into the ground. Water travels faster to the channel and gives high discharge. And on the opposite hand, the drainage basins which has permeable surfaces, allow water to percolate and thus has low drainage density.

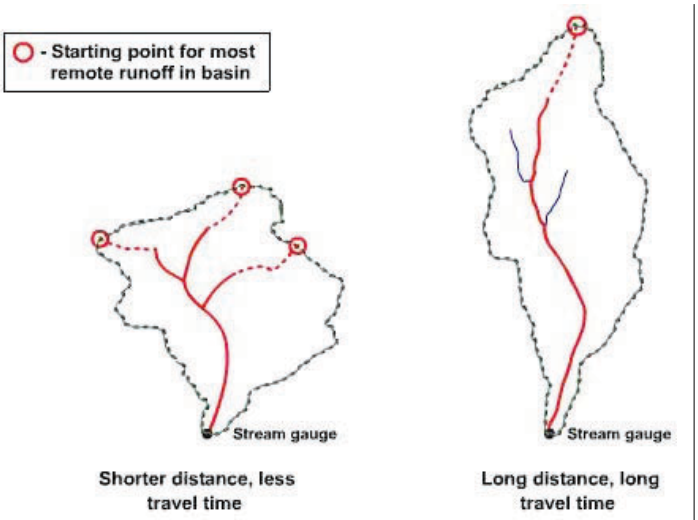

Figure 2: Time taken for different basin shapes
Source: http://www.faculty.luther.edu/~bernatzr/RainfallRunoff/comet/hydro/basic/Runoff/print_version/03- basinproperties.htm

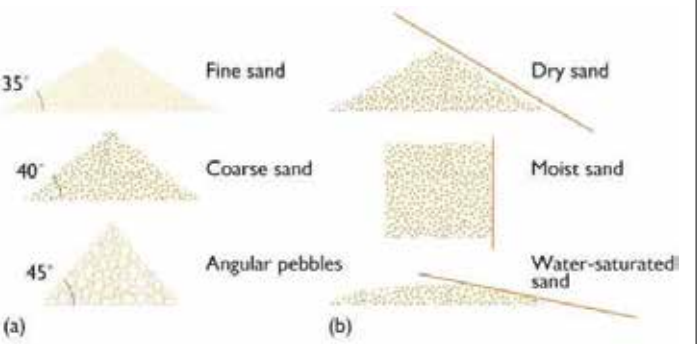

Figure 3: Angle of Repose varies for different materials
Source: https://slideplayer.com/slide/12772676/

Meteorological Factors:

These play an important role in the controlling the amount of discharge in a drainage basin.

Rainfall type- If rainfall happens for a longer duration; it saturates the soil completely. The soil reaches to the saturation point where it can't absorb more water. Then water flows down further, leading to less infiltration and high runoff.

Rainfall intensity- Surface runoff gets increased during heavy rainfall because it helps in exceeding the infiltration capability of soil, leading to growth in water discharge.

Human Factors:

Urbanisation- Urbanisation clearly means development of buildable areas, thus it helps in reducing infiltration to zero, if impermeable surfaces are being used. Thus, water moves very quickly into the drain channel because ground fails to absorb it.

Deforestation- It means cutting of trees which results in decreased plant cover resulting into less evapotranspiration and interception. Without plant

cover, it will also increase the chances of soil erosion because the trees are not bounded to the surface.

Afforestation- This process is the planting of trees (frequently as a smooth engineering technique for flood management and soil erosion).

2.4 Interpreting Slope Steepness and Form

Composition and Steepness - For any earth fabric, there may be a maximum angle, known as the angle of repose, at which it may be appropriately willing and past which it's going to fail. The angle of repose varies broadly for different kinds of materials, from ninety degrees in sturdy bedrock to much less than 10 degrees in a few loose, unconsolidated materials.

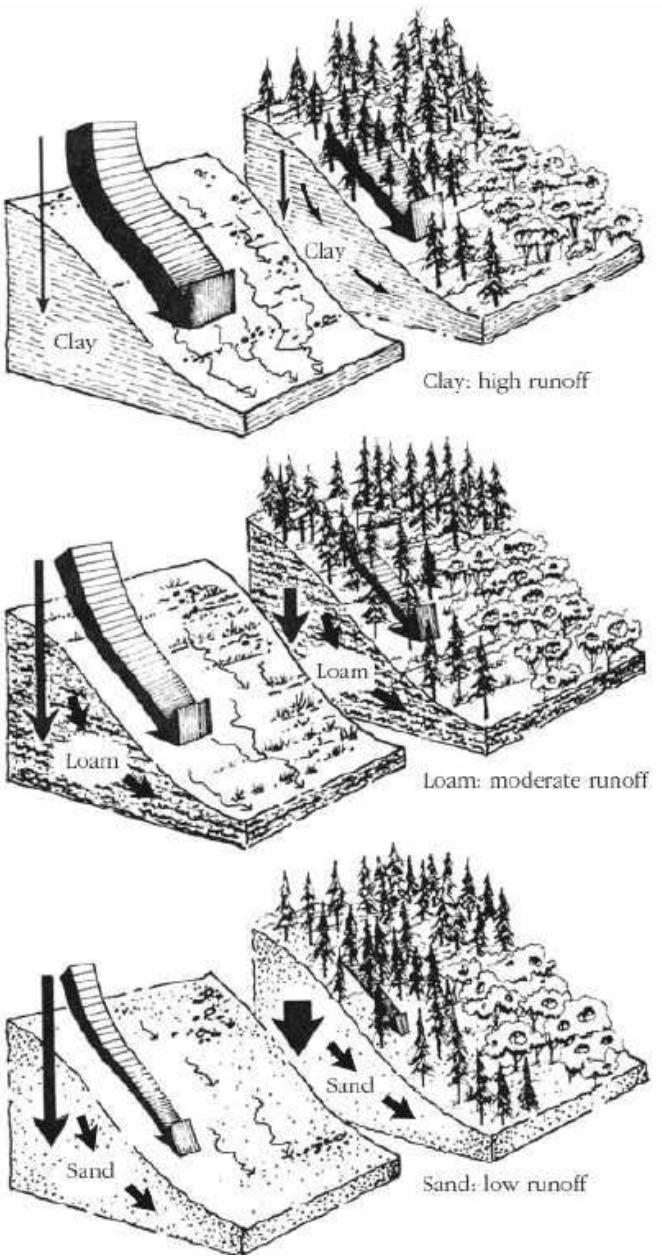

Figure 4: Schematic illustration showing the relative changes in over land flow runoff with soil type and vegetation on sloping ground
Source: Landscape Planning Environment by William M. Marsh

3. Consideration of Drainage in Assessing Slope Stability

Drainage is one of the major aspects in assessing slope stability. Though frequently difficult to evaluate, runoff processes, soil water, and groundwater may have a said influence on slope situations and stability. Although maximum rainfalls and runoff occasions are incapable of weakening slopes, in particular vegetated ones, heavy rainfalls can cause soil saturation, remodeling ground surface right into a muddy slurry liable to shallow mudflows.

Slope and Runoff: The overall quantity of rainfall on a slope absolutely decreases at steeper slope angles due to the fact the slope surface (catchment) place uncovered to the sky is smaller for steeper slopes. For a vertical cliff, there's no catchment place. Some mild slopes can be greater risky than nearby steep slopes due to huge upslope contributions of runoff.

3.1 Relation of soil and vegetation type with water runoff

Trees and other vegetation in urban areas considerably reduce urban-water runoff. As rain falls upon vegetation, it clings to the rough surfaces of leaves, branches, and trunks. By intercepting and slowing precipitation hitting the ground, vegetation substantially reduces the volume and rate of storm water runoff. Steep slopes have high runoff water velocity. When the slope is longer (length), surface area for water collection also increases and therefore increases the run-off volume. In clayey soil, as the particles are closely compacted and does not allow water to percolate. Hence it has higher run off whereas sandy soil with loose particles allow water to percolate. Hence, it has lower run off. The different types of soils have different run off, clearly shown in Figure 4 below.

STEEPNESS	COMPOSITION
<10%	Consolidated bedrock
10-25%	Fractured bedrock
25-50%	Rock rubble
50-100%	Sand, Gravel, Loam
>100%	Compact clay

Table 01: Ground composition categorised as per slope steepness
Source: https://soilsofsask.ca/soil-survey-soil-characteristics/slope.php

3.2 Drainage metamorphic analysis by various computation methods

In the Himalayas, weather variation is predicted to create an effect on water resources in a substantial manner. The exclusive troubles at macro degree in

a watershed and different elements affecting water run-off are considered.

Both urbanisation and agricultural growth delimits the surface runoff, ensuring important in more magnitudes and frequencies of maximum flow in streams. Responsible land use making plans and layout require a controlled method to runoff from the landscape, the stuff we name stormwater. Stormwater control starts with an evaluation of the modifications in runoff delivered on through land improvement.

Three elements are of finest concern: land cover (flora and land use), soil composition and slope. As a widespread rule, overland go with the drift and increase with slope, decreases with soil natural content material and particle size, will increase with floor insurance through difficult floor fabric together with concrete and asphalt, and reduces with vegetative cover.

Co-efficient of runoff - For a specific amalgamation of those elements, a coefficient of runoff may be assigned to various surfaces. This is a dimensionless range between zero and one. Zero that defines the percentage of a rainfall to be had for overland flow after achievement of the infiltration process.

Computing Runoff from A Small Watershed:
The runoff generated with inside the form of overland flow or storm water from a small water- shed may be computed by easy manipulation referred to as the rational technique. This technique is primarily based totally on a formulation that mixes the coefficient of runoff with the depth of rainfall and the coverage of the watershed. The final result offers the high discharge (most charge of flow) for one rainstorm on the mouth of the watershed:

$$Q = A \bullet C \bullet I$$

Q = discharge in cubic feet per second (or cubic meters per second) A = area in acres

C = coefficient of runoff

I = intensity of rainfall in inches or feet per hour (or centimeters per hour)

The time taken for runoff to displace from the perimeter to the mouth of the watershed, called the concentration time, changes with the size.

Computational Procedure: Given that the pertinent records are accessible, the subsequent process can be used to compute the maximum discharge (Qp) from a particular rainstorm. The end result offers you the runoff leaving the watershed in a channel on the immediate maximum flow.

Topography and Vegetation	*Open Sandy Loam*	*Clay and Silt Loam*	*Tight Clay*
Woodland			
Flat (0–5% slope)	0.10 or less	0.30	0.40
Rolling (5–10% slope)	0.10–0.20	0.35	0.50
Hilly (10–30% slope)	0.20–0.30	0.50	0.60
Pasture			
Flat	0.10	0.30	0.40
Rolling	0.16	0.36	0.55
Hilly	0.22	0.42	0.60
Cultivated			
Flat	0.30	0.50	0.60
Rolling	0.40	0.60	0.70
Hilly	0.52	0.72	0.82

* These are representative values. Local values typically vary, especially seasonally.

Table 02: Co-efficient of runoff for different land types
Source: Landscape Planning Environment by William M. Marsh.

1. Define the fringe of the watershed and quantify the watershed area.
2. Subdivide the watershed in keeping with cover types, soils, and slopes. Assign a coefficient of runoff to every subarea, and quantify its area.
3. Determine the percentage of the watershed represented through every subarea, and multiply this figure through the coefficient of runoff of every land cover. This provides you a coefficient adjusted in keeping with the scale of the subarea.
4. Sum the adjusted coefficients to decide a coefficient of runoff for the watershed as a whole.
5. Determine the concentration time by the usage of the graph and the stream speed formula.
6. Select a rainfall value for the area and rainstorm desired. Using this value and the concentration time, perceive the precise rainfall amount from the curves.
7. Multiply the watershed area by the coefficient of runoff and via way of means of the rainfall intensity, to acquire the maximum discharge in cubic ft per second.
8. The overall extent of discharge (Qv) produced because of a rainstorm also can be computed with the rational method. The method for extent of water runoff is

$$Qv = A \bullet C \bullet R$$

Where,
A = drainage area
C = coefficient of runoff
R = total rainfall

In this case the full one-hour rainfall value is used, and we solve for acre feet, cubic feet, or cubic meters. This is a simpler computation because it does not involve deducing concentration time and rainfall intensity. It is useful in estimating gross differences in pre- and post-development runoff as seen in Figure 5.

3.3 Computing soil erosion from runoff

An estimate of soil loss to runoff may be quantified with the aid of using all 4 of the foremost elements influencing soil erosion. For this we use an easy formulation known as the universal soil loss equation, which offers us soil erosion in tons per acre in line with per year:

$$A = R \bullet K \bullet S \bullet C$$

Where,

A = soil loss, tons per acre per year R = rainfall erosion index

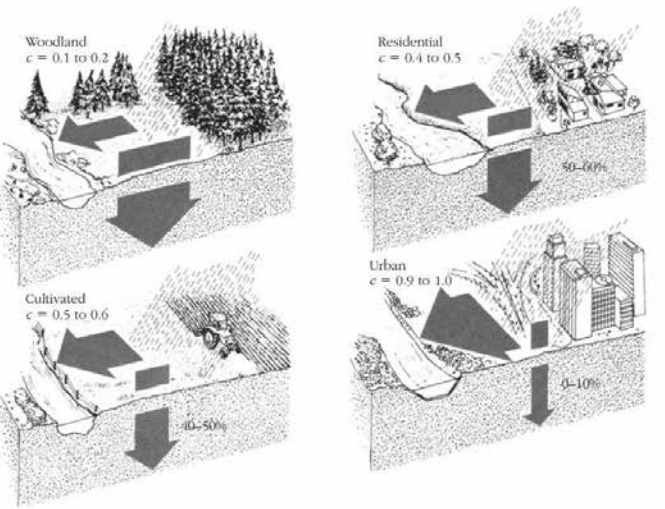

Figure 5: Changes in the coefficient of run off with land use and land cover: forest, cultivated, and residential
Source: Landscape Planning Environment by William M. Marsh

K = soil erodibility element

S = slope element, steepness and length C = plant cover ratio

K Factor: Soil kind is expressed in terms of an erodibility element, or K element, that is a degree of a soil's susceptibility to erosion with the aid of using runoff quantity.

3.4 Mitigation measures

The mitigation measures used are easy and small scale, and majority of it aimed at (1) conserving an uncovered soil in place; (2) blocking off sediment-encumbered runoff from flowing into water functions along with streams, ponds, or wetlands; or (3) filtering muddy water thru material or straw. Measures encompass the location of silt (cloth) fences, straw bales, and berms around buildable zones, using fiber nets and material along with burlap on slopes, and using sedimentation (sump) basins to collect and separate muddy water.

In addition, numerous conventional measures, the use of stakes and woody cuttings, may be hired to control erosion. One measure, known as contour bunding or wattle fencing, includes putting stay live cuttings along with willows alongside the contour of the slope and staking them in place. The willow bundles can be partly buried to shape small terraces that capture runoff and sediment. Refer Figure 6. Properly done, the cuttings need to sprout roots, which give strength and stability to slope and reduce runoff.

4. Uttarakhand state - decoding climate change and perception

Uttarakhand is known to be a freshwater reserve

Figure 6: Bio Engineering techniques for soil stabilisation
Source: Ar. Akshay Kaul workshop

among 15 perennial glacier fed rivers and over a dozen glaciers. The whole state is being unfolded over 5.4 million ha, out of which 4.6 million ha is classified as hilly region and 7.5 lakh hectares is classified as plains. Of these total areas, 3.5 million hectares have forest cover. The state has temperate climate with some seasonal variations in temperature. The climate and vegetation vary maximum with respect to elevation.

Findings: The followed modifications in temperature (1 to 30 degrees C) and precipitation (-10 to+10%) recommend that upward thrust of 20 degrees C in temperature might also additionally make growth of the runoff by 28%. Mountain springs were pronounced to say that it will be dried up mainly due to erratic rainfall in previous years. The differences suggest that global warming and Climate change has affected snow-glacier melt and runoff pattern in the Himalayas.

Different maps have been studied for different seasons (Figure 7) i.e., summer, winter, pre monsoon and post monsoon. Data for every month is studied by these maps. Maximum and minimum temperature have been analysed with respective months.

4.1 Case study: Devanya Hills, Bhimtal, Uttarakhand:

Devanya is an upscale 2nd domestic hill development in Bhimtal, Uttarakhand in Dev Bhumi, 'Land of the Gods', the assets spread at some point of 90 acres of herbal splendour and luxurious Himalayan forests.

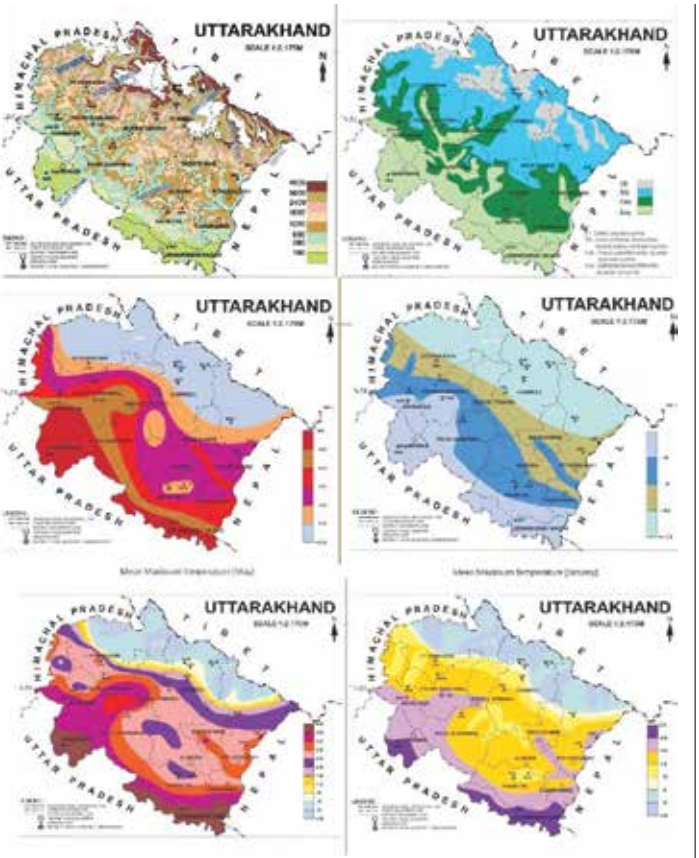

Figure 7: Climatic Data for Uttarakhand
Source: Assessing landscape restoration in Uttarakhand, By IUCN

Watershed mapping and strategy has been implied in this case study. After demarcating every watershed, rainfall harvesting potential of each watershed is being calculated to optimise the potential of rain fed areas and overlapped with vegetation map. Watershed protection areas are being marked after the study which led to hill ecological planning.

4.2 Computation of data of Devanya Hills

WS 01 – 64041600 L	WS 08 – 2143510 L	WS 14 – 3516690 L
WS 02 – 7297280 L	WS 09 – 5332500 L	WS 15 – 4390400 L
WS 03 – 9758480 L	WS 10 – 19473740 L	WS 16 – 5190060 L
WS 05 – 38368230 L	**WS 11 – 57199700 L**	WS 17 – 20131350 L
WS 06 – 81207960 L	**WS 12 – 66425260 L**	WS 18 – 9309650 L
WS 07 – 13734330 L	WS 13 – 8007160 L	**WS 19 – 62764500 L**

Calculating discharge from small watershed (Pre development vs. post development):

The selected watershed is WS 19. The pre development total capacity was estimated to be **62764500**

L. When post development strategies are applied, then the discharge is again calculated as follows: Q = A x C x I

Parameter	Hot weather Season (March to May)	Southwest Monsoon (June to September)	Post Monsoon (October & November)	Winter Season (December to February)
Atmospheric Pressure		Minimum		Maximum
Temperature	Maximum			Minimum
Humidity	Minimum	Maximum		
Cloud cover		Maximum	Minimum	
Rainfall		Maximum (78% of total rainfall)	Minimum (3% of total rainfall)	
Thunderstorms / Hailstorms	Maximum	Maximum		Minimum in December
Fog			Maximum	Maximum
Wind speed	Maximum		Minimum	
Cyclonic Storms affected in last 10 years	Not affected	Mostly affected	Little affected	Not affected

Table 03: Analysis Table with four climate classifications
Source: Author

Where, average co efficient run off (C) is calculated as 0.85, as majorly surfaces comprised of dense forest, agricultural lands and orchards.

Thus, Total discharge is = 46150.35 x 0.85 x 1600 = **62764489 L = 62764.48 cum.**

Thus, it proved to be a balanced project with a difference of 11 litres.

5. Methodology

Data Analysis and Findings

- The project was designed with respect to natural landscape layers i.e., water availability, slope, soil and vegetation.
- The natural topography is not being altered too much. The water drainage movement is kept as natural without any interference.
- No built structures were proposed within watershed protection areas.
- Dense forests spaces do not have human interference.
- The different sub watersheds have been marked and Rainwater harvesting potential is calculated as per water runoff, which gives us the higher water potential zones.
- Overlay of all the layers is being done and protection areas being marked where water needs to be conserved.
- Proposal of swale, retention ponds, gully plugs are included after detailed study of site.
- The buildable areas, pathways (circulation route) are being marked with respect to slope analysis.
- Other than water management strategies, erosion is also controlled by different bio engineering techniques.

Involvement of local people

- Local people were also involved in building capacity workshop.
- Awareness is being created by Architect by involving them in slope stabilisation techniques. The calculation gives us the major watershed areas where rainwater harvesting potential is high. So, watershed protection is being done in such a way that rainwater could be stored more.

6. Results and Discussion

Concluded influential factors to be taken care of and Guidelines (In making):

A. Pre proposal/ development

(a) Regional guidelines: Before beginning with any assignment in hilly context, the designated weather observation has to be performed along with knowledge variant of rainfall sample, temperature, humidity and wind speed. During

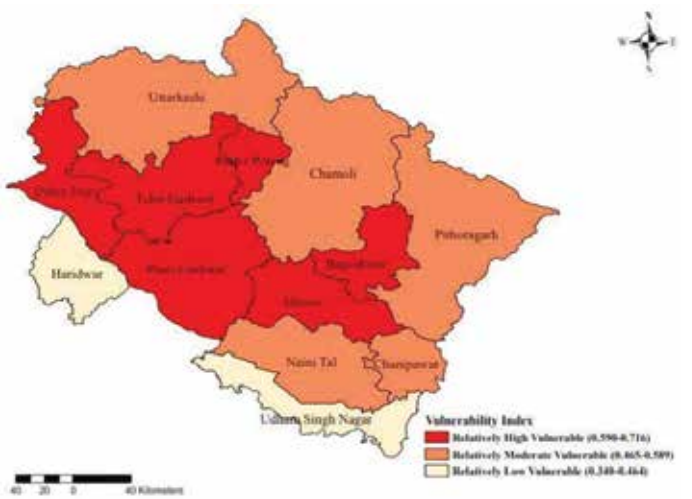

Figure 8: Vulnerability index of Uttarakhand state
Source: Assessing landscape restoration in Uttarakhand, By IUCN

Southwest Monsoon, erosion control and moisture control strategies have to be applied.

(b) On site guidelines:

- Choose layout schemes that lend themselves to supply the overall control of storm water.
- To design source control schemes, mimic predevelopment run off structures and techniques applied.
- Where ever possible, disconnect human made channels completely with natural channels.
- Where disconnect isn't always possible, maximise the gap of storm water tour from the site online to a collection chamber or stream.
- Disconnecting downspouts and yard drains from the storm water system.
- Diversion channels that direct storm water away from storm water transportation systems.

B. Existing surface and sub surface drainage study:

- Understanding present drainage flow with the assistance of identity of ridges and valleys and nearest water assets if available.
- Existing surface drainage and sub surface drainage have to no longer be modified in any respect on this context in any other case probabilities of abrasion and flooding grow to.

C. Slope considerations:

- Analysing slopes and essentially minimal slopes need to be extended primarily based totally on drainage skills of surfaces and most slopes need to be reduced primarily based on soil and climatic pattern.

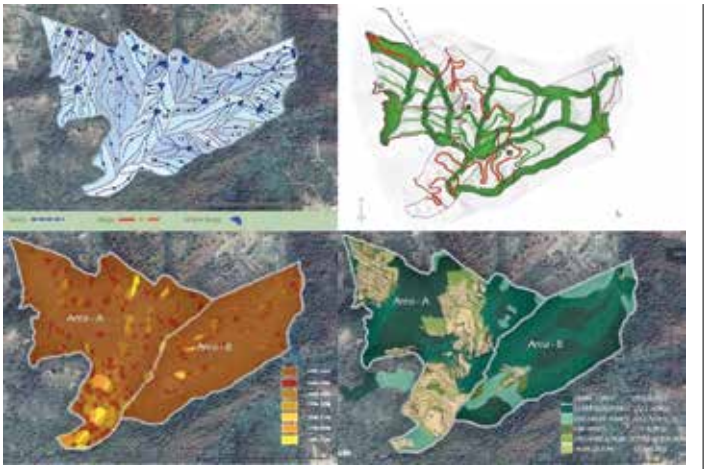

Figure 9: Case study: Devanya Hills, Bhimtal, Uttarakhand
Source: Ar. Akshay Kaul workshop

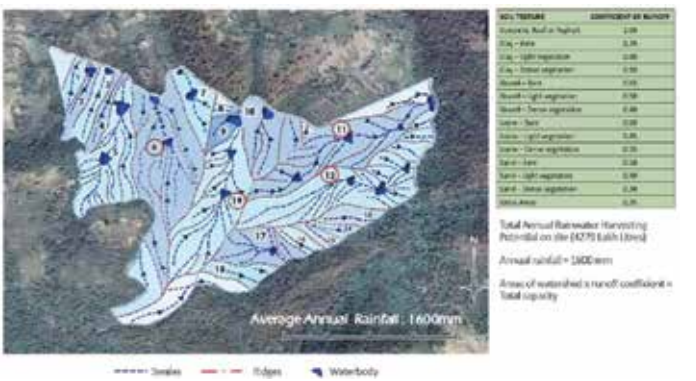

Figure 10: Watershed Computation
Source: Author

- Interpretation of slope steepness and shape with the aid of using analysing angle of repose and soil considerations.

D. Interrelation of slope and soil:

- A poorly compacted mass of saturated clay and silt can also additionally provide as low angles as (8 %), while the equal mass with decreased water content material can maintain extra angles than 100%.
- On sandy slopes, the presence of forest cover can boom the inclination with the aid of using 10 to 15 degrees, generating a solid slope condition.

E. Inter relation of rainfall and slope:

- Total extent of rainfall on a slope in reality decreases at steep slope angles.

F. Land alteration guidelines:

- Grading requirements and important gradient need to be sorted at the same time while modifying land.
- Planning the development in order that it produces very little growth in storm water discharge.

G. Protection Areas:

- Utilise or offer buffers, which include forests and wetlands, to shield collection regions and stream regions from development.
- In coping with stream systems, the first precedence is to shield the headwater regions, and the second one is to shield the watershed as an entire towards hydrologically abusive land uses.

H. Calculation measures

- Calculating water run off to know the potential zones where water could be recharged.
- Morphometric analysis computing different densities, run off and frequency gives an idea of proposal of water management techniques.

I. Inter relation of vegetation, water runoff and slope

- The water run off changes as per the land cover time. It increases with the decrease of vegetation cover. Vegetation should not be removed on steep slopes (if present). Techniques to bind vegetation should be applied i.e., bio engineering, contour bunding etc.

J. Demonstration of best planting period

- Planting season and monsoon season go hand in hand. Staggered trenches and pits for planting made months before the season to ensure rain fed irrigation.

K. Storm water management techniques

- Mechanism of different storm water management approaches need to be understood i.e., detention, retention, infiltration and filtration.
- Bio-retention features such as wetlands and tree canopies that intercept rainfall and take up storm water runoff.
- Infiltration facilities such as permeable swales, trenches, and dry wells that enhance soil intake of surface water.

7. Conclusions and Recommendations

After analysing all the factors affecting drainage basin, it was understood that all the layers of mapping affect the characteristics. It becomes important to overlay slope with soil and vegetation as they are interrelated with each other. But then again, it will vary as per different climate and elevation data. Thus, by selecting an ideal case study example where computation methods were being followed was carried out.

This research covers the climatic data of state and as well as the perception of people of Uttarakhand, which was overlapped with literature studies, where different parameters were studied. The live study consists of calculation where, it proved to be an ideal project for water resiliency. Thus, after combining learnings from all three perspectives, guidelines are being carried out, which talks about site scale guidelines only. This research can be further carried out by covering the regional scale guidelines.

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Ar. Divya Gupta, an alumna of SPA Vijayawada has established herself as a pioneer in Raipur, Chhattisgarh, leading the state's first specialised landscape architecture firm, PrakTattva Spaces Pvt. Ltd. Her involvement with prestigious multinational companies like IREO, SPRE, Godrej, and Adani for over five years adds significant value to her skill set. Additionally, her role as a visiting professor at NIT Raipur reflects her commitment to nurturing the next generation of landscape architects.
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ARTICLE

Rethinking Sustainability in Architecture

Beyond Green Ratings and The Bandwagon Effect

Can architecture transit from checklists and cosmetic fixes to authentic ecological and human responsibility?

By Ar. Mahesh Bangad and Janhavi Dudhane

A less green building, a more green building and then the least green building... Is being green solely about the appearance? Or does it hold deeper significance in terms of environmental impact, resource efficiency, occupant well-being, long-term sustainability, reduced carbon footprint, and innovative design that minimises waste and maximises natural resources? (Figures 1a, 1b and 1c)

Introduction

'Sustainability' is the new trend; it's everywhere these days. It also has become a buzzword in architecture— stamped across brochures, sprinkled across design presentations and enshrined in building rating systems. However, a question still lingers aback the glossy labels and stunning renders: Is this what sustainable architecture actually entails? Examining whether the current approach to sustainability is meaningful or merely performative must be done immediately as global temperatures rise and social inequality widens.

The Illusion of "Green"

Certifications like LEED, GRIHA and IGBC which have provided a structured language for assessing sustainability, are not impervious to abuse. In practice, what we often see is the greenwashing of design for a better PR— where superficial gestures substitute for systemic responsibility. A few energy-efficient appliances, a patch of vertical greenery or a certificate on the wall can create the illusion of sustainability. Yet these may hide a deeper reality: high embodied carbon materials, exploitative construction practices or unsustainable maintenance systems. Sustainability has become a marketing strategy and bandwagon by developers and institutions for brand value more often than for ecological ethics.

The repercussions of greenwashing are extensive. They are not limited to only undermining sustainable design's integrity but also to shifting our attention away from the real issues that need to be resolved. By focusing on these cosmetic superficial fixes or "the band-aid solutions", we are ignoring the underlying causes of social injustice and environmental deterioration.

Taught but not Practiced

Though "sustainable materials" like lime plasters, bamboo and rammed earth are taught in architecture schools, they are rarely used for large-scale applications in the real world. After graduation, the values that we are taught are usually disregarded by firms and companies because of budgetary constraints, client choices or simply lack of conviction. The gap between what we are taught and what we are given the ability to create is widening. Worse, even the "sustainable materials" we promote may not be truly sustainable if sourced unsustainably or used without cultural and climatic relevance. Learning without critical evaluation results in blind replication, rather than informed action. This discrepancy emphasises how sustainable design education needs to take a more sophisticated approach. By emphasising critical thinking and real-world application, we can equip future architects with the skills to create truly sustainable buildings that prioritise both people and the planet.

More than the Environment: A Human Lens

The most underappreciated reality in the field of Architecture is that sustainability involves not only the environment but also the people who build, use and inhabit spaces. Goals like reduced inequality (SDG 10), decent work (SDG 8), good health and well-being (SDG 3), and sustainable communities (SDG 11) are just a few of the goals clearly articulated in the UN Sustainable Development Goals (SDGs), which go far beyond energy and water. A structure that is constructed with underpaid labour or is inaccessible to low-income groups despite being energy-efficient cannot be considered truly sustainable. By adopting a human-centred approach to sustainability, one can design structures that support social justice and equity while reducing their negative effects on the environment. This requires a fundamental shift in how we design and build, prioritising the needs and well-being of all stakeholders involved.

Metrics vs. Meaning

Even though measurable ratings offer a certain level of accountability, they also turn sustainability into a numerical game. A project may rack up enough points for certification but still fall short in real-world resilience or community benefit. What scores higher—rather than what works better—drives a lot of design choices. And when ecological solutions are detached from cultural and social contexts, they risk becoming tokenistic. We need a shift in mindset—from ticking boxes to asking hard questions: Who benefits? Who is excluded? Who maintains it? What are the ecological and human costs?

One can design structures that genuinely meet the needs of people and the environment by putting meaning above metrics. This demands a more comprehensive approach to sustainable design, one that puts the welfare of people and the environment first and takes into account the long-term effects of our design choices.

The Wisdom we've Forgotten

Sustainable thought is not new to India or its people. Vernacular architecture from various regions demonstrates how people coexist with resources and the environment, whether through courtyards, *jaalis*, wind catchers, wind breakers, mud walls, or shaded roads. These were systems of comfort and survival, not design trends. Yet in the race to modernise (and monetise), we've ignored time-tested wisdom for short-term, surface-level "green" solutions. It's time to recover and reimagine these strategies— not to gaze fondly at the past like it's some sepia-toned daydream, not as romantic nostalgia, but as living, evolving practices (Figures 2a and 2b).

Figure 1a: Suvarnabhumi Airport's Green Roof in Bangkok, Thailand
Source: https://www.tropicalsky.co.uk/far-east-holidays/thailand/the-ultimate-guide-to-getting-around-thailand

Figure 1b: Bosco Verticale in Milan, Italy
Source: https://en.m.wikipedia.org/wiki/File:Bosco_Verticale_Milano.jpg

Buildings that are meaningful, contextual and sustainable can be designed by embracing our cultural heritage and borrowing a page or two from traditional design. A thorough awareness of the local climate, culture and community needs is necessary for this.

But to remember that design isn't just about looking backwards; it's about remixing the best of the past with what we need right now (Alexander, 1977).

Reclaiming Responsibility

Today's architects need to take back their responsibility as cultural, ethical and environmental stewards in addition to their role as designers. Checklists alone cannot impart the humility, honesty and dedication to long-term thinking necessary for true sustainability. It entails designing for ecological harmony, equity and adaptability in addition to awards and aesthetics. Afterall as designers, we aim to build spaces for everyone to use and enjoy—not just Instagram influencers. We must challenge the status quo, question the green-washed narratives, and most importantly—listen. To the land. To its people. To the past. And to the futures we wish to shape.

Buildings that not only reduce harm but also contribute positively to the environment and society can be produced by architects and designers reclaiming their responsibilities. This demands a fundamental change in design philosophy that prioritises the welfare of both people and the environment. As Christopher Alexander (Alexander, 1977) proposes in *Pattern 104: Site Repair*, buildings should "always be placed on those parts of the land which are in the worst condition, not the best." This aligns with sustainable land use — unlike modern rating systems that often greenwash isolated buildings on ecologically sensitive sites (Figure 3).

To conclude, it is important to reinterpret sustainability in the context of architecture, since it includes not only environmental but more layers such as social and economic factors. It is about designing buildings and environments that are not just environmentally friendly, but also fair, accessible and helpful to the community. This redefinition requires a holistic approach that considers the entire lifecycle of a building, from design and construction to operation and maintenance. Honestly, if we're just slapping solar panels onto some ugly box, we're missing the point. Sustainability involves designing structures and areas that are not only environmentally friendly but advantageous and accessible to all. However, it also entails making certain that structures are planned and built in a way that advances human welfare, social justice and community involvement.

By moving beyond the bandwagon effect and superficial fixes, a built environment can be created that truly serves the needs of both people and the planet. Right from sketching the rough plans to hammering the last nail, and all the check ups after, the script needs to be flipped on how we handle it all. This requires a fundamental change in the way that buildings are planned, constructed and maintained. It calls for a dedication to long-term planning, teamwork and creativity. The moment for change is now. As architects, designers, builders, stakeholders and emerging future of the rapidly advancing technology, we have a unique opportunity to shape the future of our built environment. It's time to reclaim role as stewards of the built environment and create a more sustainable future for all. This entails:

Figure 1c: Bullitt Center in Seattle, USA
Source: https://living-future.org/case-studies/bullitt-center-2/

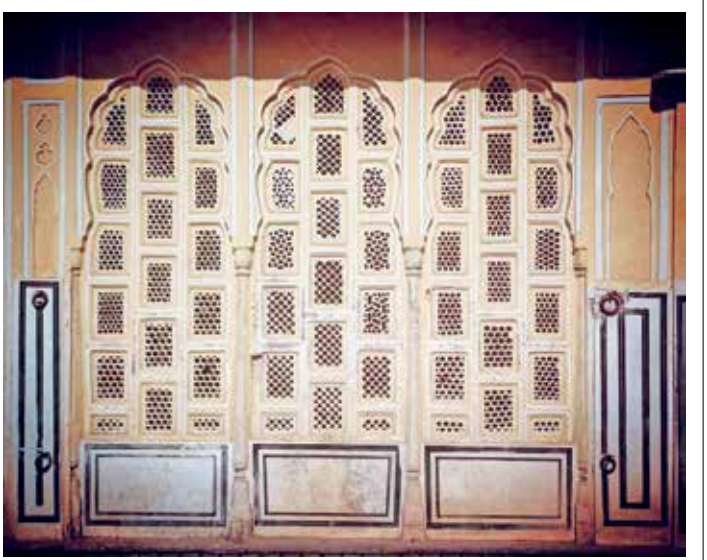

Figure 2a: Traditional Indian Architectural Techniques
Source: Author

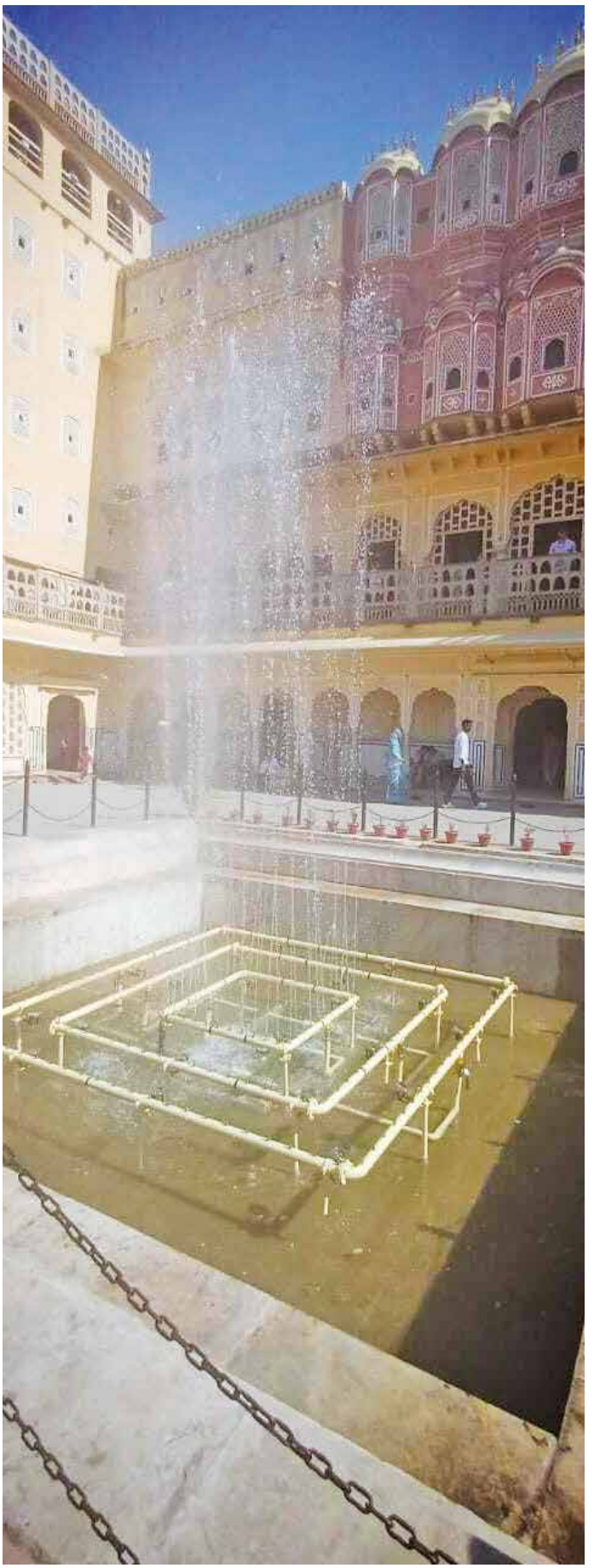

Figure 2b: Traditional Indian Architectural Techniques
Source: Author

Figure 3: Image generated using Meta AI
Source: Retrieved from https://www.meta.ai/

- Adopting a comprehensive strategy for sustainability that takes into account social, economic and environmental aspects
- Giving community involvement, social justice and human welfare top priority in planning and building.
- Fostering collaboration and knowledge-sharing among stakeholders to spur innovation.
- Making investments in training, education and capacity-building to advance knowledge of sustainable building and design.
- Promoting laws and rules that encourage green building and sustainable development.

By working together, a built environment can be created that not only minimises harm but also contributes positively to the environment, society and the economy. It's time to seize this opportunity to shape a more sustainable future for generations to come.

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Janhavi Dudhane is a forward-thinking second-year architecture student at BNCA, Pune. She is driven by a passion for designing environmentally-conscious spaces that seamlessly blend form and function. With a keen interest in 3D modelling and visualisation, her ultimate goal is to minimise ecological footprints and bring sustainable designs to life.
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POEMS

By Ar. Abhijit Natu

POEM 1- LONDON O LONDON

Piercing the landscape rises the Shard,
Glorious Tower looking down this odd
In the background winks the London Eye
Reflects the Thames this Low and High.
Wandering through the facades of stone,
Edging stand the New and the Old,
Glassy neighbours of the classical veterans
London O London, London O London.
Tubes metros and oyster cards,
Take us far and away from its Heart
Lies below the Cathedral St Paul
Remains of Wren the Master of Art.

Poem 1: The London Bridge

Poem 1: The London Eye

Poem 1: The Shard

POEM 2- LANDSCAPE CHANGE

They call it rain garden
In the midst of concrete,
It says it was all garden
Before concrete reigned.
They now want it diverse
In the sea of lawn,
It says it was a biome
Before the turf rolled on.
They insisted on exotic
Though it did not sustain,
Now the native is shying
To express its pain.
Attempts to dominate
The landscapes pristine,
Withers away the life
That holds within.

Poem 2: Native species and community

Poem 2: Lawns lacking biodiversity

ALL IMAGES COURTESY: AUTHOR

Abhijit Natu is Principal at the BKPS College of Architecture with teaching experience of more than 28 years. His areas of interest include poetry, Indian Music. He likes to engage in interdisciplinary research and understanding architecture and landscape through music and literature. He received Excellence in Architecture Award from IIA in Research Paper Category in 2022 and Best Teachers Award from the Pune University in 2011. He likes writing in Marathi on Architecture and has been organizing State Level Marathi Conference on Architecture at BKPS COA in collaboration with the Regional Office of DTE, Pune.
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15th COUNCIL MEETING OF THE TERM 2023-2025 AT IIA HO MUMBAI ON 26-07-2025.

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31	Ar.Sejal Bharat Yadav	Maharashtra	A30342
32	Ar.Pratik Rajendra Gadge	Maharashtra	A30343
33	Ar.Umesh Gopal Agrawal	Maharashtra	A30344
34	Ar.Anshumati Parag Sarwate	Maharashtra	A30345
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36	Ar.Devika Shankar Bhongle	Maharashtra	A30347
37	Ar.Danish Jalil Sheikh	Maharashtra	A30348
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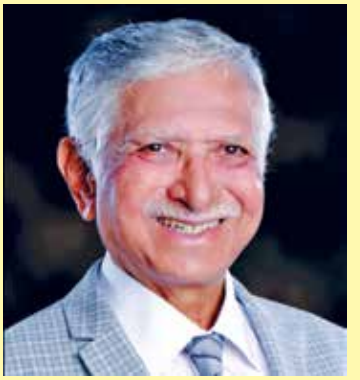

Ar. H.C. Thimmaiah
(6 November 1944 – 7 August 2025)

It is with profound sorrow that I write this note on behalf of the Indian Institute of Architects and in my personal capacity as a past President of this esteemed institution, to extend my deepest condolences on the sad demise of Ar. Hottengada Cariappa Thimmaiah.

Ar. Thimmaiah was not only a stalwart of our profession but also a visionary leader whose contributions have left an indelible mark on the architectural landscape of India. As a former President of the Indian Institute of Architects, he served with distinction, guiding the Institute with wisdom, integrity, and an unwavering commitment to the advancement of the profession.

His leadership was marked by a rare blend of professional excellence and human warmth. He inspired generations of architects with his clarity of thought, deep respect for design, and passion for institutional growth. His tenure was one of inclusiveness, progress, and dignity—values that continue to shape the Institute today.

He served the Institute for a very long period of time and served as the President of the Institute during 1994-96. He represented the Institute and the country in several national and international organisations.

He was a highly decorated personality both by the profession as well as government and other organisations, notable among them being the *Rajyot Sewa Award* by the Karnataka Government in the year 1996 and *IIA President's Gold Medal* for his life-time contribution to the profession of Architecture in the year 2020. He leaves behind a void which will be difficult to fill and his contributions to the profession and to the society shall be remembered long after he has gone.

More than his professional achievements, those who had the privilege of knowing Ar. Thimmaiah personally will remember him as a gentleman of grace, humility, and quiet strength. His passing is an irreplaceable loss to the architectural fraternity and to all who were touched by his life and work.

I have personally known Ar. Thimmaiah Since Feb. 1996 when I along with Ar. Arun Virmani visited the IIA HQ for the first time to make a presentation before the Council chaired by him as President IIA, regarding the preparations for SAARCH 1996.

Ever Since he has been a mentor, guide, trusted friend and a loving elder brother.

On behalf of the entire IIA family and in my personal capacity along with my wife Lata, I offer our heartfelt sympathies to you in this moment of grief. May you find strength in the enduring legacy he leaves behind and comfort in the love and respect he earned from so many.

May his soul rest in eternal peace.

With deepest condolences,

Ar. Divya Kush (F08141)
Past President
The Indian Institute of Architects
Email : divyakush@yahoo.co.in

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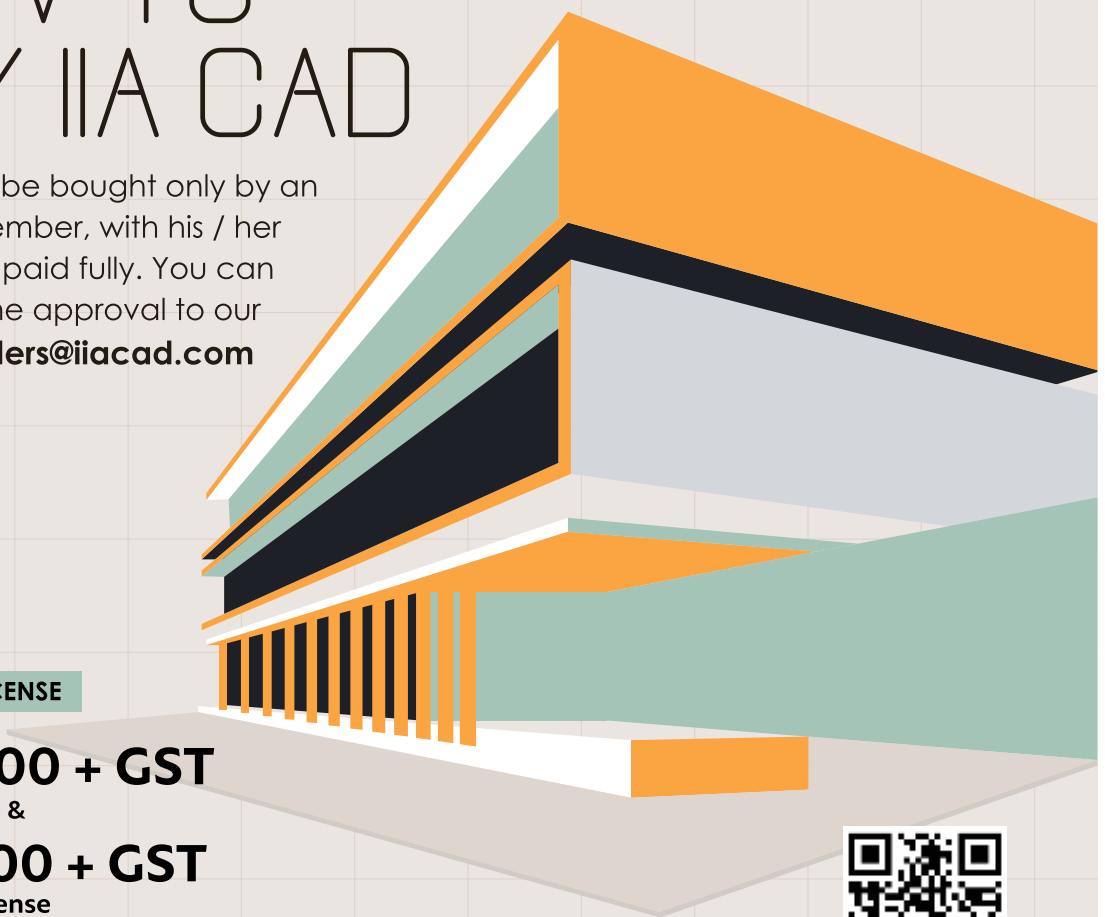

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