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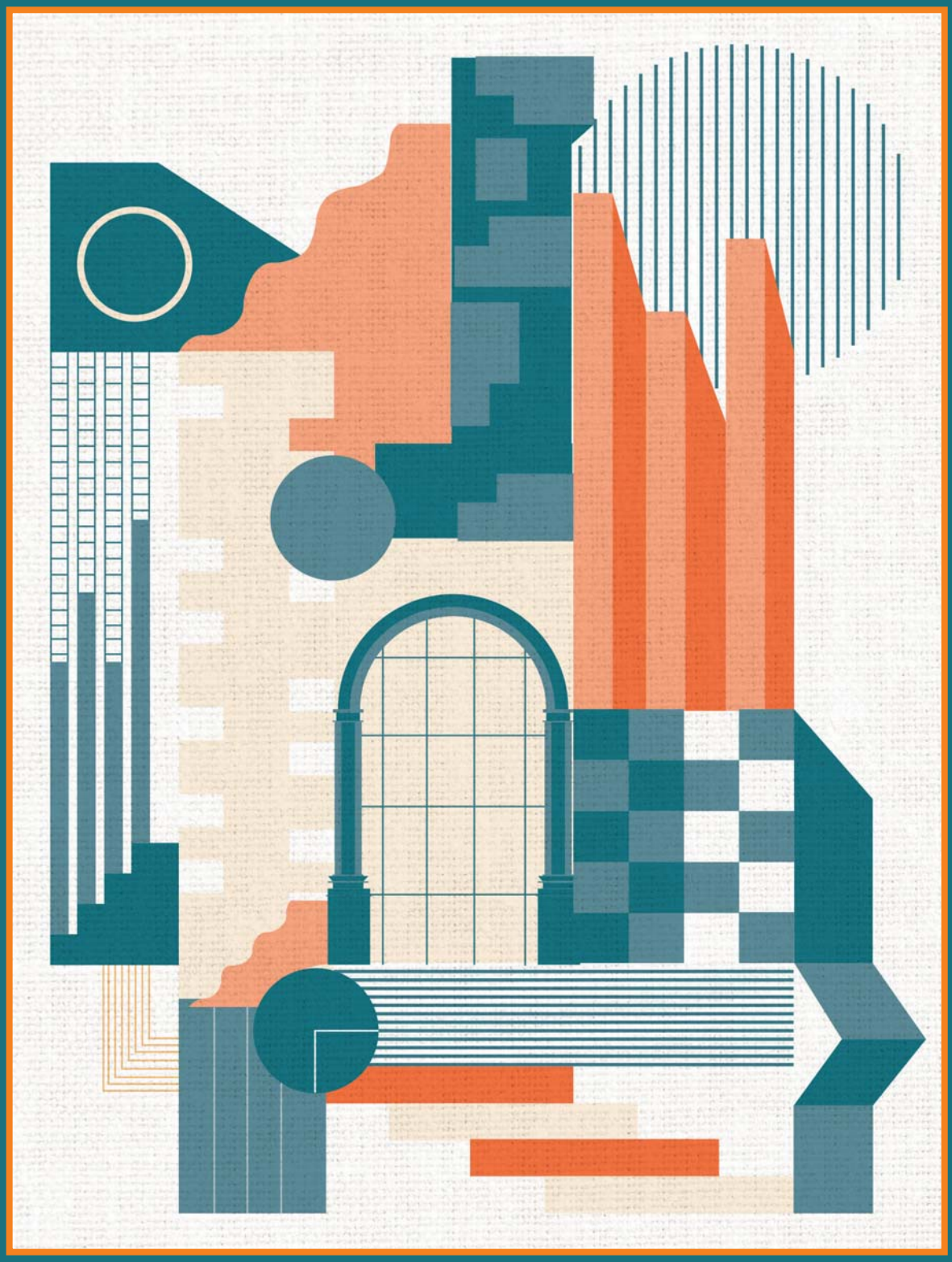

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GOA CHAPTER

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KUALA LUMPUR | 15-19 November 2024

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DIVERSECITY for Humanity and Sustainable Growth

The objectives of the UIA 2024 International Forum Kuala Lumpur (UIA2024KL) is to provide opportunities for the public, architects, urban planners and policy makers to participate in a series of enriching programmes invigorating discussion on culture, heritage, sustainability, equity and ecology to achieve humanity and sustainable growth.

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SUB-THEMES

Sub-theme 1
Culture and Heritage

Sub-theme 2
Density and Sustainable Growth

Sub-theme 3
Equity and Ecology

EXTENDED DEADLINES

NEW EXTENDED KEY DATES

- 01 July 2023: Open call for papers submission;
- **31 December 2023: Deadline for abstracts submission;**
- 31 January 2024: Notification of abstracts acceptance;
- **30 April 2024: Deadline for Full Paper submission with abstract;**
- 31 May 2024: Notification of Acceptance / Authors receive feedbacks;
- 30 June 2024: Deadline for authors to submit revised papers if asked to do so by peer reviewers;
- **31 August 2024: Final paper submission by authors;**
- 15 – 19 November 2024: Presentation of Paper at the UIA 2024 International Forum Kuala Lumpur

Submission procedures available https://uia2024kl.majournal.my
UIA2024KL website > https://www.uia2024kl.org

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EDITOR'S NOTE

Dear Fellow Members of the Indian Institute of Architects,

The month of July respects professional services rendered for citizens of India by postal workers, doctors and chartered accountants on 1 July. On 10 July as a reminder to all governments, organizations, and individuals about the importance of reducing reliance on non-renewable resources and transitioning towards cleaner and more resilient energy systems we acknowledge Global Energy Independence Day. World Population Day observed on 11 July brings to the fore the issues related to population. To recognise the need of skilled workforce in the world, on 15 July we observe World Skills Day and to be aware of the emerging system of international criminal justice we note the World Day for International Justice on 17 July. Looking at the importance of friends in the life of every individual, 30 July is celebrated as International Friendship Day.

The July issue of JIIA starts with an abstract representation on the cover which demonstrates the skyline as a collage of architectural styles, showing towering skyscrapers casting shadows over colonial structures, and bustling streets weaving through historic neighbourhoods. It continues to enrich our experience by looking at interesting research-related assessment tools for determining sustainability through eco-footprint and the environmental performance of cities. This issue further discovers the science and intent of the Golden Ratio and modular system along with understanding the 'Kahnian' grammar. This includes various signature styles such as the play of geometry, monumentality, the skyline in buildings, vast open spaces, relationships to earth-water-sky and more significantly, materiality. It also shows an interesting narrative to understand how the beliefs and ideas of a cultural tradition have been synthesized into a structure and the sketches section shows the artist's deepened understanding of the built environment. There is a photo story of mixed-styled doorways in Voharawads captured through the camera lens. So it is an interesting read for all our IIA members.

We at IIA, would like to thank all the participants for their overwhelming response for submission of research papers in great numbers. It is overwhelming to see the quality of the research papers submitted to the IIA ANVESHAN Research Conference. We urge the selected researchers to register themselves for the Conference by paying the registration fees so that your research can reach peer scholars and a wider IIA audience through the Conference Publication. We appeal to all IIA members, especially in Kerala, to attend IIA ANVESHAN to encourage our fellow researchers. This is very important for the collaborative growth of the educators and practitioners of architecture in India. We eagerly await you all on 29-31 August 2024 at MCAP, Thiruvananthapuram, Kerala for the grand success of Anveshan.

An appeal to all IIA members to contribute to JIIA with articles, projects, research papers and most importantly, in terms of sponsorship and funding. Thank you for your continued support and readership.

Prof. Vinit Mirkar
Editor, JIIA

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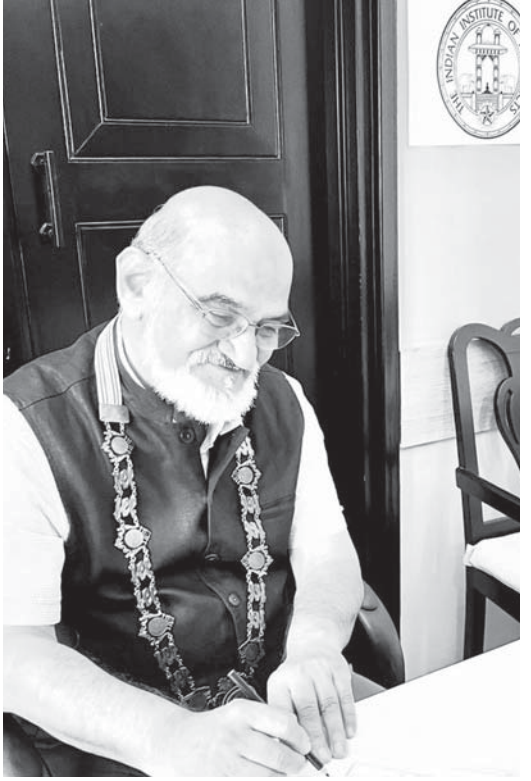

Dear Fellow Members,

This July, we have completed one year of our tenure.

Looking back, we see that we have achieved many milestones, the foremost being the revamping of the IIA Journal with quality of articles and research papers. The cover pages are eye-catching and more Indianized and indigenously designed by students and faculty of architecture colleges. This has gone a long way in controlling the cost factor essential to offset the previous financial backlog of earlier Journals. Every issue is attractive and more readable, thanks to the dedicated JIIA Team.

There is growth in membership numbers, due to which new Sub-Centres and upgradation of existing Sub-Centres are taking place. Every Chapter, Centre and Sub-Centre are arranging events at the local and national levels.

Two of the national events of IIA, NatCon and IIA Awards have taken place. This has led to the *Design Yatra* of shortlisted entries of IIA Awards which will be held at various places, and for which every Chapter has shown willingness to host this exhibition in their home-states.

The first of this series is being held at IIA Indore Centre from 10 August 2024 for which IIA Madhya Pradesh Chapter has taken initiative.

It is also the first time that IIA has organised the ANVESHAN International Research Conference at Marion College of Architecture and Planning at Thiruvananthapuram, Kerala from 29 to 31 August. I am sure it will be a successful event.

From 27 – 28 September, IIA Goa Chapter is hosting the Young Architects Festival (YAF) at Alila Diwa, Majorda Goa.

In the month of November, from 8-10, the International Conference of Women Architects has been arranged at the Temple City of Bhubaneshwar in Odisha.

I invite and welcome all members to these events, to participate and contribute to the growth of the Institute.

Warm Regards,
Ar. Vilas Avachat

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Mumbai
A Symphony of Juxtapositions

Mumbai, the city of contrasts, stands as a testament to the juxtaposition of old and new, tradition and modernity. Its skyline is a collage of architectural styles, where towering skyscrapers cast shadows over colonial structures, and bustling streets weave through historic neighbourhoods. Amidst the chaos of urban life, pockets of tranquillity emerge in the form of verdant gardens and serene waterfronts, offering a respite from the city's relentless energy.

In Mumbai, every street corner tells a story of contrasts. The opulence of South Mumbai, heritage buildings stand in stark contrast to the busy markets and crowded lanes of its bustling bazaars. The gleaming glass facades of corporate towers stand side by side with the crumbling facades of old *chawls*, reminding us of the city's dichotomous identity.

Yet, amidst these contradictions, Mumbai thrives with a vibrancy that is uniquely its own. Its streets pulse with the rhythm of life, as diverse communities come together in a kaleidoscope of cultures, languages and traditions. From the glitz and glamour of Bollywood to the gritty realities of its slums, Mumbai embraces its contradictions with an unyielding spirit.

At its core, Mumbai is a city of resilience and adaptability, where contrasts converge to create a tapestry of experiences. It is a place where the past coexists with the present and where the promise of the future beckons amidst the chaos of the present. In Mumbai, contrasts aren't just a part of life – they are the very essence of what makes the city so endlessly captivating.

Arshad Ashraf is a Final Year B.Arch. student and Ar. Shruti Verma (A21459) is a faculty at the Asian School of Architecture and Design Innovations (ASADI), Kochi.
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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

google form link: https://forms.gle/Ru4JBLSHwaYEBTcg7

(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.

An Exploratory Research on the Applications of Urban Metabolism and Circular Economy in Cities

By Dr. Nirmita Mehrotra and Mr. Kabir Mehrotra

Abstract

Assessment tools for measuring sustainability through eco-footprint and the environmental performance of cities have been the recent thrust area of research. It may help in decision-making, setting priorities on more resource-efficient strategies to curb further environmental degradation and in a way initiate the restoration of ecological balance. It is the only prerogative today to incorporate and validate Urban Metabolism (UM) as a modeling and assessment tool; to design a circular economy for the creation of smart and sustainable cities. This paper presents a comprehensive review of the methodological choices and outlines a common ground for environmental sustainability assessment through Urban Metabolism and Circular Economy strategies linking cities and environmental research, exploring possible pathways and links of input-output used for different sectors worldwide at multiple levels. The research reviews the UM tools as applied by different scholars and states the list of environmental benefits of closed-loop sustainability and pathways for the emergence of resilience.

Keywords: *Urban Metabolism, Circular Economy, Urban Sustainability, Resilience.*

1. Introduction

Global Policy Framework requires assessment of carbon footprint in a measurable approach in order to promote Zero Carbon Buildings (ZCB). Much work has been done on Energy efficient practices (EEP), Green Building rating systems and Energy Conservation Building codes (ECBC) for residential and commercial buildings. However, the role of municipalities is yet limited to issuing building permits for new constructions and fails to actualise implementation of ZCB goals due to the lack of modelling and assessment tools for the different urban development choices and decisions undertaken from time to time.

With three-fourths of the world's population living in cities and an increasing concentration of people living in urban areas, this is posing a threat to the economic and social well-being of the community through over-loading the existing urban infrastructures and the natural ecosystems. In the context of Green House Gas (GHG) emissions, the building sector accounted for one-third of the total global energy-related CO2 emissions in 2019 (UNEP 2012). Rising emissions in the buildings and construction sector emphasise the urgent need to de-carbonise the power sector and the usage of carbon-neutral building materials. Urban Metabolism has recently gained importance in order to assess the livability of cities and reduce dependence on resources.

While cities are striving hard to meet the Sustainable Development Goals, it is necessary to understand and assess the resource inflow and outflow systematically (Mehrotra, 2014, 2018). The focus of the world is shifting from linear to circular systems where the former consumes an infinite supply of new resources and the latter takes input from used resources. Waste generated (output) in the circular system

is recycled, recovered and reused as a resource. Technological development has intensified the use of natural resources to the limits of exploitation and extinction. Fig. 1 explains the uses of the metabolic tool at an urban level.

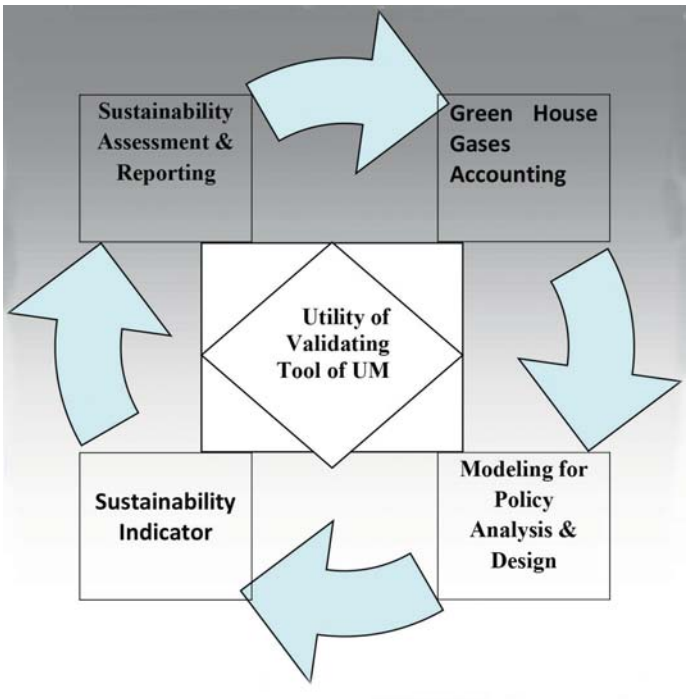

Fig. 1: Four Uses of the Urban Metabolism Tool
Source: Adapted from UNEP (2012)

The increasing rate of urbanisation has induced a severe stress on the ecological balance, creating various types of vulnerabilities at the settlement level. Built environment exerts a major pressure on nature, particularly when it is not perceived as harmonious with nature. In this perspective, the role of cities and the built environment is vital for reusing and recycling resources and seeing its transition to a circular economy. There are four basic flows within a city, such as water, materials, energy and nutrients which have complex connectivity and high exchange rates at the regional level. Energy consumption patterns are important determinants of CO2 and other GHG emissions. Every city has specific demand and supply chains to meet them from varied resources.

2. Significance of Study

SDG 12 has 11 targets and 13 indicators comprising resource efficiency and climate responsibility. Particularly, the environmental stresses during extraction, processing and discarding after processing and usage adversely affect global sustainability. It is important to reconfigure the energy systems through their production, consumption patterns and by-products to the immediate environment. High carbon embodied materials with an adverse environmental impact may be omitted and replaced with local, less energy-intensive and green materials. Our latest problem is not the scarcity of materials but its abundance. The usage of recycled building materials with a cradle-to-cradle (C2C) approach can save not only on raw materials but also on GHG emissions released during extraction, manufacturing and transportation. Integration and synthesis of material flow accounting (MFA) is useful for developing a scientific understanding of the impacts of resource dependence at every level. These may lead to modifications in Building Codes and other building regulations at the municipal level, to emphasise zero waste and zero footprint as a mandatory requirement.

Urban metabolism has evolved through a field of industrial ecology where the water-energy-food nexus can be developed through input-output flows both quantitatively and qualitatively. The Urban metabolism framework connects multidisciplinary areas from the socioeconomic aspects to the environmental system of natural science along the socio–temporal axes where the urban activities diversify from the core city to fringe areas or hinterlands. Cities are referred to as living organisms using vital resources such as air, water and food for survival and also release by-products which have the potential for recycling and reuse. With the increasing population, cities' dependence on the surrounding hinterland has increased beyond the limit of revival. Exhausting resources beyond the threshold limit has begun the risk of environmental degradation. Here Urban Metabolism brings together all the activities of the city in a single model. The rate of metabolism is affected by many factors such as urban morphology, density, biodiversity, green areas, mode of transportation, production and consumption patterns, climate, age of buildings, rate of emission of by-products, etc.

The urban ecosystem comprises material and energy flow through different processes of resource accumulation, transformation and depletion. In this respect, the four pillars of sustainability have to be looked at from a circular point of view. Table 1 explains the connection of the four pillars of sustainability i.e. Economics, Social Processes, Environment and Institutions to circularity. Environmental Impact indicates the impact of energy used and its consumption patterns, transportation means, GHG emissions, treatment of pollutants, waste management and recovery of resources. Social Processes indicate responsible behaviours of the community and individuals. Urban Economy requires decoupling of

Table 1: The Four Pillars of Sustainability
Source: Adapted from Geissdoerfer et al., (2017)

Areas	Attributes of Circularity
Economics	Production patterns, Resource consumptions, Stocks and flows, Resource depletion, Emissions and Pollutants.
Social Process	Equity and environmental justice, Society and individual awareness, Capacity building, Training, Incentives and Subsidies to modify behaviour patterns.
Environment	Zero Carbon Building (ZCB), GHG emissions, CO2 equivalent, Waste production and recycling, Zero Footprint and Zero Emission by alternate Energy and Fuels.
Institutions	Participatory Mechanism to inculcate the practice of Metabolism, Citizens Engagement and Empowerment through network and collaboration.

materialism and environmental degradation with economic growth, a shift from an economy based on industrial production to a knowledge-based economy. Sustainability at the Institutional level, indicates the mechanism of stakeholders' participation and citizens' engagement, network governance and collaborations for ensuring circularity.

3. Research Objectives

Pincetl et al. (2012) developed a framework for urban metabolism with explicit system boundaries and system input and output for analysis of policy and technology impacts. Incorporating different urban sectors, i.e. water, carbon etc. with a reductionist approach finally enables an adaptation of heterogeneous solutions and their consequences. Objectives of the research are stated below -

1. To develop a conceptual understanding of Urban Metabolism (UM) and its usage in urban sectors and application for the assessment of sustainability and its components by breaking the links between intensified urban growth and resource depletion in order to build climate change resilience.
2. To discuss the urban application of Metabolism and Circular Economy for connecting loops in a cycle.
3. To discuss various techniques of modelling and assessment adopted by scholars worldwide, for measurement of eco-footprint for industrial corporations, municipalities and neighbourhoods, and to assess the impact of regional development policies on environment degradation.

4. Literature Review

Kennedy et al. (2007, 2011) embarked on "The Changing Metabolism of Cities" as the sum total of the technical and socioeconomic processes that occur in cities, resulting in growth, production of energy and elimination of waste. Urban Metabolism has roots in Industrial ecology where the study of material and energy flows is associated with the extraction and transformation of resources and patterns of consumption and disposal, which influence the environment and economy.

Unsustainable Consumption of resources is one of society's major challenges today, which has been highlighted by the Sustainable Development Goals, particularly SDG 11 and SDG 12, which aim to ensure sustainable consumption and production patterns. Urban Metabolism and Circularity require the 9R concept (refer to Fig. 3) - Reduce, Reuse, Recycle, Recover, Refuse, Repair, Repack, Refurbish and Remanufacture for reduction in consumption to achieve sustainable development. It develops frameworks and accounting methods to quantify resource flows and energy consumed in urban growth.

The Ellen MacArthur Foundation (EMF) developed RESOLVE for circular economy and eventually moved to the framework for circular cities (refer to Fig. 2) for the creation of smart sustainable cities. RESOLVE defines circular economy as one that provides a mechanism for multiple value creation and decoupling consumption of finite resources by following six actions as below -

1. To curb environmental degradation by the use of Green energy and ecological restoration.

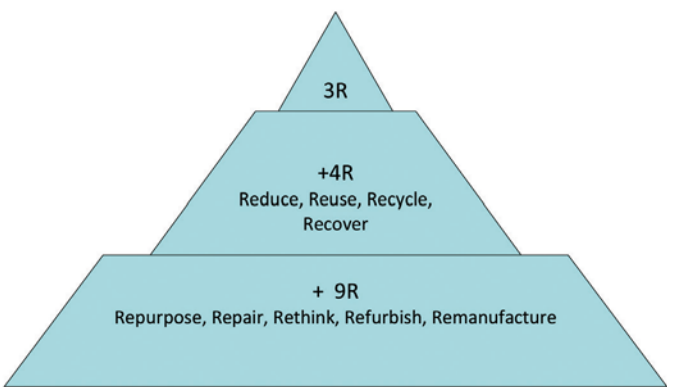

Fig. 2: Development Framework for Circular Cities
Source: Adapted from Ellen MacArthur Foundation (2012)

2. Reduction of waste at source, by creating new innovative usage through 9 R.
3. To curb the use of fresh resources and encourage waste utilisation.
4. Performance optimisation of services rendered by a product.
5. De-materialise resource use by delivering utility virtually.
6. Propagation of consumption patterns which have low resource dependence.

Kalmykova et al. (2016) used three alleys of systematic research for Urban Metabolism – a) Sustainable design for efficiency; b) Optimal utilisation of resources at different levels and identifying possible links between stakeholders; c) Resource efficiency and optimal distribution for well-being and development of overall resilience. As the consumption of construction materials has been growing exponentially with urbanisation, policies may emphasise an investment shift towards the recycling and reuse of Construction and Demolition Waste (C&D) and reduction in the consumption of raw materials. The municipality of Parato under the European Union circular cities project created web portals to connect people in need of construction materials to people having construction and demolition waste. Shahrokni and Solacolu (2015) developed a real-time feedback on energy and material flow of Sweden and Stockholm Royal Seaport, from household level to the urban district.

Andreoni (2020) used the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) approach to compare the profiles of 18 countries and enumerate the relationship between energy usage and economic growth under varied policy implications. D'Amico et al. (2021) advocated digitisation tools like sensors, real-time monitoring systems, actuators, digital cameras, real-time tracking systems, Big Data analysis, Artificial Intelligence, Cloud Computing, Smart Grids, IOT infrastructures, Augmented Reality, Block Chain, 5G wireless communications, social media platforms and other information and communication technology for smart and sustainable cities deriving circularity of Urban Metabolism. The intensive and evasive use of digital technologies has brought a paradigm shift from a linear system to a circular perspective, which also requires co-design initiatives and monitoring at different stages of development. In this purview, Kissinger and Stossel (2019) identify and confirm the correlation between the quality of metabolism and the resilience of the city.

The concept of Urban Metabolism is directly borrowed from biology and biochemistry and applied to urban studies (Castan Broto et al., 2012). It assesses the impact of the urban system on the environment. These are the sum of the total processes involved in resource mobilisation, transformation and consumption required for a city to function and grow over a period of time, together with the resultant production of waste and release of pollutants (Barles, 2009). The policies implemented in the last two decades focused exclusively on the shift to Green Power and reduction in carbon emissions; where consumption of materials has been allowed to grow unchecked. The increase in material consumption also causes increased indirect embodied CO2 emissions and additional waste.

Circular Economy (CE) emphasises on goals of resource efficiency, products designed to ease recycling, reuse, disassembly and remanufacturing, and replace conventional linear wasteful models used to drive the global economy. In order to deploy the CE framework for the general assessment of city sustainability three main types of energy and material flows at the urban/metropolitan level that have to be evaluated (Ghisellini & Ulgiati, 2020) are as follows - Primary material and energy resources, viz. Construction material, fuel, food, goods and water with a focus on waste prevention, minimum input flow, useful flow from one production sector to another (reuse, exchange), and waste and residues from production and consumption sectors (recovery and disposal).

4.1 Circular Economy, Sustainability and Resilience

Circular economy gained momentum in the areas of clean production, resource conservation, recycling and sustainability. Resource efficiency and waste minimisation (Lucertini & Musco, 2020) sets the path for Sustainable development Goals; mainly SDG 12, SDG 6, SDG 7, SDG 8, SDG 11 and SDG 13. SDG 12 aims to ensure sustainable consumption and production patterns through the principles of circular economy, requiring application at different scales; from individual material to supply chains, household energy consumption to waste management at neighborhood level and zero footprint at the regional level by generating energy from alternate resources including waste.

Circular cities integrating the CE and UM approach can decouple environmental degradation from economic growth, address the needs of the poor through circularity and develop indicators for urban resilience and sustainable cities (refer to Fig. 3). Presently the concept of sustainability in urban

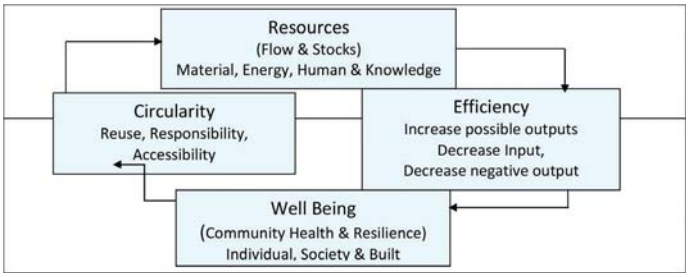

Fig. 3: Urban Metabolism to Resilience
Source: Adapted from Kissinger and Stossel (2019)

planning and policy-making has been focusing on Urban Metabolism mainly through water, carbon emission, energy and material flow within the city. Geissdoerfer et al. (2017) state the similarity between sustainability and circular economy, as both are intra and intergenerational commitments, integrate non-economic aspects into development and keep innovation at the core with value co-creation opportunities (refer to Table 2). Both of them have regulations and incentives as core implementation tools, as technological solutions are important but often pose implementation problems. The institutional role is important to ensure awareness among the communities and the implications of circularity at the grassroots level in order to curb water stress and other resource depletion and develop environmental resilience. Transitioning to a closed-loop circular system from an open-ended linear system requires business model innovations, implementation tools like regulations and incentives, and technological solutions.

A circular economy (CE) can be a closed loop eliminating the input of new resources and the utilisation of all waste output from the system decoupling economic growth from natural resource depletion. CE is a multi-dimensional concept requiring a trans-disciplinary approach. Here, analysis also requires two overlapping approaches - systematic and hierarchical order (Gonzalez et al., 2013). The former emphasises different levels of circularity whereas the latter identifies the best practices at the Micro, Meso and Macro Levels (Ghiselline et al., 2020).

i. Micro Level – Eco design products, Companies, Consumer
ii. Meso Level - Eco-Industrial Parks, Corporates, Associations, Supply Chain
iii. Macro Level - Eco-City, District and Municipal levels in sectors like food, construction, power and production of goods.

5. Tools and Methodology for Assessment

Belon-Saint-Pierre et al. (2017) conducted Urban Metabolism based reviews of 112 cities using common assessment methods, from accounting approach, input-output analysis (IOA), eco-footprint analysis, Life Cycle Analysis (LCA) to simulation and hybrid methods. In the last two decades, several reviews of these methods have been produced, which shows the shift from simple accounting of material and energy flow to methods which provide

Table 2: Difference and Overlap between Sustainability and Circular Economy
Source: Adapted from Geissdoerfer et al. (2017)

Area	Sustainability	Circular Economy
Origin	Environmental movements	Cradle-to-cradle, regulatory movement.
Goals	Open-ended, linear resource generation	No new input. Waste generated used as resource.
Motivation for implementation	Diffused and diverse	Better use of resources, waste revival as resource, linear to circular, incentive.
System in focus	Horizontal	Hierarchical focus on economy.
Benefit for	Environment, Economy and Society	Economic actors at core, central role of private business.
Time Frame	Open-ended	Set optimisation and threshold limits for fresh input and use of waste as resource.
Roles and Responsibilities	Actions and Roles exist in silos.	Policy makers, innovative business models possible for Industrial and Urban transformation. Inclusive and Participatory.
Commitment goals	Looking forward to future generation and availability of resources.	Risk diversification, value creation opportunity. Integration of economic and non-economic aspects into development.

Table 3: Comparison of different Assessment Tools and Applications
Source: Authors

Method	Scale of Application	Remarks /Applications
Life Cycle Analysis (LCA)	Micro and Meso (Products, Supply Chain)	Production processes and their impact environment impacts at various stages.
Material Flow Analysis (MFA)	Macro (World, Country Region)	Account for stocks.
Complex System (System Dynamics)	Macro/ Meso	Can model market potential, can explore relationship between system structure and Market dynamics
Sankey Diagram	Meso to Micro Level	Carbon Accounting and GHG Emission, Energy input-output. Web traffic Analysis, C&D Waste monitoring
BRIDGE	Micro level	Integrating Urban Metabolism and GIS Platform
MUSIASEM	Multi Scale Analysis	Ecological Footprint by connecting environmental elements, Economic variables and structure of Society.

indicators depicting the environmental impacts of these metabolic flows on the city sustainability (Kennedy et al., 2011; Zhang, 2013; Mostafavi et al., 2014). Numerous modelling and visualisation tools have been under use to show patterns of energy demands, supply sources, consumption patterns, rejected loss of energy and discarded materials during transmission and processing through input and output data in five energy demand sectors, i.e. residential, commercial/ institutional, industrial, transportation and agriculture. This also shows that potential improvement is possible to enhance Energy Efficiency Practices in the Built Environment at the neighbourhood and city level.

Generation of data is a very important aspect of the Urban Metabolism study. This requires Agricultural Aerial Survey, Fossil fuels and emission, Freight demand Model, Illegal Dumping Data etc. Fuzzy Delphi is also used as a method to develop evaluation factors for circular metabolism and to integrate it with Analytical Network Process (ANP) to evaluate and prioritise development strategies for Urban Development. Based on Fuzzy Set theory, nine indicators are identified in the Social Economics and Environment sectors. Pistoni and Bonin (2017) developed the UM framework for the evaluation of sustainability and conducted semi-structured interviews with architects, urban planners, designers and environmental engineers at the metropolitan and neighbourhood scale of Rotterdam and Amsterdam respectively.

Brunner and Rechberger (2016) used Material Flow Analysis (MFA) to measure the flow of materials within the system and the resulting output from the system to other systems in the form of waste discharges and pollution. Urban Material Flow Analysis (MFA) calculates resource flows by physical weight and volumes, on multi-scales and can identify strategies for dematerialisation at the city and regional scale. Metabolism studies are based on complex quantification and mathematical modelling to measure resource consumption and output of energy and materials within bounded systems. China has circular economy promotion laws with implementation at three functional levels, viz. eco-industrial parks, firms/companies and Municipalities (Yuan et al., 2006). On multi-scales, this provides a basis for material flow management and dematerialisation strategies on the regional and city scale.

Material Flow Analysis (MFA) describes a system such as a city or a country in terms of its input and output physical flows of materials in space and time for better decision-making regarding waste management, material availability constraints or material disposition. MFA is used to define general circularity metrics such as a cyclical use rate (measuring recycling) and the shares of secondary materials in the system's inputs and outputs. MFA tools are used for Mexico City to find the regular requirements of water, food, raw materials and fuel and also embark on its linearity, consuming more natural resources than it can regenerate. Thus, it is importing large quantities of raw materials (food and other materials from other regions), while generating waste, gases and wastewater that is having a negative impact on the city at the regional level. The footprint of Mexico City has exceeded beyond the carrying capacity of the region and exists as an unsustainable system.

5.1 The Energy Method

Odum (1973, 1995) emphasises the dependence of almost all the energy of the planet on the sun and coined the term "Emergy". By accounting for the solar energy used to create a product or deliver a service, the qualitative difference of mass and energy flows was accounted. This method also emphasises the use of a standard unit of measurement to calculate energy, nutrient and waste movement in the biophysical system; the unit chosen was "solar equivalent joules" (sej).

5.2 Emergy and Exergy (Qualitative aspects of energy)

Rooted in ecology and thermodynamics, Emergy is defined as the sum of all inputs of available energy directly or indirectly required in a system (or embodied energy). Exergy, on the other hand, is defined as the maximum usable energy of a material and can be computed for both combustible and non-combustible materials. Some researchers have suggested that Exergy could be a relevant metric to assess circularity.

5.3 BRIDGE Project

This project enumerates "Sustainable Urban Planning Decision Support and Accounting for Urban Metabolism" (Gonzalez et al., 2013) on GIS-based platforms and integrates it with Environment Impact Assessment (EIA). It helps to accurately quantify the potential effects of planning interventions. The project uses UM Tools for water, energy and pollutants like carbon and other nutrients in different forms.

i. Water – Water balance, risk of flooding, surface runoff, evo-transpiration.
ii. Air and Climate - Pollutants, Low Carbon emission.
iii. Material – Resource management, discharge values, waste management.

5.4 The Multi-scale Integrated Analysis of Societal and Ecosystem Metabolism

This trans-disciplinary approach interrelates economic, environmental and human time variables and material energy transformations. Though Material and Energy Flow Analysis (MEFA) is comparatively easy in comparison to MuSIASEM, which is more integrative and comprehensive, it is particularly useful to evaluate metabolism across the different strata of societies for Energy Use in different segments of the society, Input-Output Analysis (IOA) in production, Ecological Footprint of settlements, Consumer Approach and Simulation approach as well as hybrid approach (Sanchez et al., 2019). Andreoni (2020) utilised the approach to analyse the pattern of energy consumption after the financial crisis of 2008. The analysis is performed on three scales, viz. society, household and individual sectors like agricultural, industrial and services to see the relation of energy consumption with the increase or decrease of GDP in the Global Financial Crisis. As per the studies, Greece, Romania, Spain and the United Kingdom reduced energy consumption by up to 20% among the different strata of the society.

5.5 Integrated Urban Metabolism Analysis Tool (IUMAT)

This evaluates the urban economic drivers and their impacts on environmental sustainability with an integrated framework focusing on production and consumption (Mostafavi, 2018). Urban Efficiency Index (UEI) models local input and output flows for 904 municipalities of Milan (Caputo et al., 2016). Based on UEI and the input-output model, clustering is used which can be further utilised by planners and policymakers to relate the waste produced as raw material. The research presents an understanding of the metabolic profile at the regional scale and how the whole urban region shows interesting behaviour in terms of production and consumption of easy resources.

5.6 Life Cycle Analysis

LCA takes a cradle-to-cradle approach of systematic evaluation of the environmental impacts generated through the whole process from the extraction of raw materials, embodied energy and disposal to the recycling of the waste. Goldstein et al. (2013) conducted a life cycle analysis comparing Beijing, Cape Town, Hong Kong, Toronto and London showing the direct and embedded environmental stresses due to urban resource flows.

5.7 Sankey Diagrams

The Sankey diagram contains mainly Nodes and Links that cross intertwine and have different widths. These are named after Captain Sankey and have been in use since 1800. He first created these flow diagrams to visualise steam engine efficiency. These have been in use for mapping energy and water distribution. Li et al. (2017) developed a generic form of EVSM using Sankey diagrams' visualisation of complex energy and material flows at a time for economic and environmental perspectives. LCA and Input-output assessment (IOA) are used for depicting problems of artificial ecosystems such as cities and countries (Beloin-Saint-Pierre et al., 2017).

6. Applications in Urban Sector

These accounting applications have been under varied uses (refer to Tables 4 and 5) around the world for engaging sustainable practices with actual assessment models and material stocks and flows within the urban agglomerations brought under check. A summary of the varied urban applications implemented globally using the UM and CE concepts has been documented as below –

Table 4: Sustainability Assessment by Urban Metabolism
Source: Authors

Criterion	Sub criterion	indicator	units
Land Cover	Urban	Developed Areas	Hectare
	Landuse	Reconstructed urban areas	Hectare
	Built Environment, energy passive buildings	Area of constructed lands, green and passive energy for building operations	Percent of total area
	Open space, natural spaces	Green- blue spaces	Per capita
Water	Consumption pattern	Per capita by residential sector	Liter/number/day
	Wastewater production	Water consumption per capita	Liter/number/day
	Sewage Lines	Total Household units connected	Per capita
Air-pollution	Suspended particles up to 10 microns emissions per year	CO2 emissions	Per capita ton of CO2/ SO2/NiO2 per annum
Material	Organic and Plastic Waste	Per capita of solid waste collected	M3/person/ yr
	Waste materials	Share of buried solid wastes	Kg/person/yr
	Recycling	Per capita of waste production waste materials	Kg/person/yr Total ton
	Reuse of Construction & Demolition waste	Construction waste materials	% of total Vol.
Energy	Transportation	Access to the public transport, Parking lots availability	Optimal / average distant
	Renewable energy sources to total energy consumption	Energy consumption per capita, Energy consumption per constructed area, Green Fuel	KWh

Table 5: Linkages of Metabolic Concept to Urban sustainability
Source: Adapted from Lucertini and Musco (2020)

Dimension	Criterion	Urban Planning Interventions
Environmental Dimension	Resource Use	Renewable, Non Renewable, Reuse, Recycle, Recovery.
	Water resource	Water Harvesting Efficiency of use, Waste Management, Metering, Recycling.
	Waste disposal	Reuse, Waste reduction, Collection and Management, Green Infrastructure.
Social Dimension	Green Coverage rate	Creation of green areas, Restoration of Land.
	Open Space	Land Recycling, organised open spaces.
	Public Health	Access to health infrastructure, Healthy life years, Exposure to health risks like Indoor Air Quality (IAQ), Safe Drinking Water.
Economic Dimension	Energy Use Efficiency	Alternate Energy Sources, Green Fuel.
	Green Transportation and Mobility	Pedestrian and Cycle Track, Mixed Use, Transit oriented development, Mass Transport.
	Green Infrastructure	Green Investment, PPP Models, Flexibility of usage, Waste to energy, Sewage Treatment.

6.1 Waste to Energy Simulation

Waste Management has been a growing challenge in the purview of the climate crisis, metabolic concepts were used to analyse the nexus of waste to energy production and other environmental policies for the three Metro cities of Tokyo, New York and Taipei. He used Monte Carlo Simulations to stochastically analyse the feasibility of Waste to Energy facilities in urban regions over a lifetime and with cost-benefit Analysis.

6.2 Efficiency in Building Material and Resource Use

Urban Metabolism will help in understanding the impact of different projects and policies on the environment and to emphasise more resource-efficient strategies for urban development. The Smart Urban Metabolism (SUM) Model by Shahrokni and Solacolu (2015) provides real-time feedback on energy and material flow from the level of the household to the urban district through the case of Sweden and Stockholm Royal Seaport through Integrating ICT and smart city Technologies. These frameworks are used for the assessment of water systems, for the flow of key nutrients like phosphorous and nitrogen, the study of heat accumulation in pavements and rooftops and the deposition of nutrients in soils or waste sites.

Sankey diagrams were used in Rotterdam to visualise emissions through construction and demolition (C&D) material waste and highlighted potential intervention on reduction of dependency on fossil fuel in the construction sector, design of buildings for renovation or disassembly rather than demolition.

6.3 Web Traffic Analysis

Sankey diagrams are also recently being used to display web traffic for customers' reactions and actions through links, nodes, drop-off links and transactions; and may visualise the energy accounts on a regional or national level including cost breakdown.

6.4 Optimising Settlement Size based on Eco Footprint

Scholarly studies were also conducted to determine the threshold size of settlements in the context of their eco-footprint and dependence on the hinterland for resources. UM tool may highlight the unhealthy pattern of consumption and discharges for the development of an action plan, to enhance the level of sustainability and prioritise technologies to support the circular economy by identifying clusters of exchange which in turn will reduce the eco-footprint of cities. The relevance of the Carbon Footprint of products, processes and services to environment planning may appear unclear, but it forms the basis for an estimate of GHG emissions associated with major policy and planning areas such as energy and transport.

6.5 Environment Management

This identifies key processes that generate environmental burdens, explores alternative solutions at an early stage and deploys solutions. Management sets priorities for new processes, goods and systems for environmental benefits.

6.6 Risk to Resilience

UM has the power to earmark the causes of increasing vulnerability and inversely point to existing risks and directions, in order to enhance resilience. Kissinger and Stossel (2019) identify and confirm the correlation between metabolic functions and evolving vulnerability or building resilience by equity, efficiency, resource optimisation and the well-being of the community.

7. Discussion

Circular cities are the systems in which resources are looped in a way to regenerate ecosystem balance. It is high time to make urbanisation sustainable and to avoid over-extraction of resources and degradation of the environment, which is only possible through combined use of Circular Economy and Urban Metabolism. Urban Metabolism emphasises on goals of resource efficiency, generating opportunities for Circular Economy. For example, the consumption of construction materials has been growing exponentially with urbanisation, where construction materials contribute to 75% of the material which is mostly non-renewable in nature. In this respect, it is time to focus on an investment shift towards reductions in the consumption of raw materials.

GHG emissions and overloading landfill sites have induced a slow-onset climate crisis, polluting groundwater and degrading the environment. Though globally Municipalities and utilities are trying to adopt Best Practices or zero footprint, limited work is evident in India in this regard. Headquarters of the Ministry of Environment, Forest and Climate Change, New Delhi is the first Net Zero Building (NZB) in India and Kochi Municipal Corporation is the first city to develop a city-wide road map for the achievement of NZB for all building types. NZB are resilient against climate change-induced impacts through revisiting energy supply and demand. However, it is time to popularise and upscale UM tools for the assessment of Net Zero concepts at the urban level.

Urban metabolism can assess the eco-footprint of urban infrastructure projects. The flow of resources may be designed to be circular, fossil-free and climate-positive. Quantification of 'in-and-out' flow of resources at the product and material level may guide towards decoupling resources from the Economic/ GDP growth. Analysis of trends and material/energy flows can be better understood and intervened to connect the loose end in circularity instead of linear. Presently the concept of sustainability in urban planning and policymaking has been focusing on urban metabolism mainly through infrastructures for sewage, water, energy and waste management.

These tools for the assessment of urban sustainability are likely to set a new paradigm, conceptualising cities through their metabolic pattern and circularity. This calls for structural transformation to organise the flow of material, energy and people. Finally, the research embarks on the implementation of urban metabolism which may bring changes as follows -

i. Optimal energy usage, clean energy and enhanced energy efficiency.
ii. Optimal water usage and reuse, water harvesting and recharge of groundwater.
iii. Zero footprint - Practice of reuse and recycling of materials for consumption and energy production, with zero waste models.
iv. Greenfield and Brownfield development - Development of green spaces and optimal distribution in different areas, mixed-use zonings, revival and reuse of dilapidated structures.
v. Zero landfill model - Circular economy uses all waste as a resource, encouraging zero landfill and Net Zero Buildings (NZB). It will also create a livelihood for people while generating wealth from waste.

8. Conclusion

This paper presents a comprehensive review of the research and outlines commonly used tools for environmental sustainability assessment through Urban Metabolism based circular economy. Urban Metabolism is visible in input-output models available generally in the form of water or air pollution, as the incorporation of waste-to-energy concepts is comparatively new and lacks dependable data on actual performances at the city level. This also requires a focus on geographies beyond traditional city and district boundaries, linking rural-urban as well as global-local networks, involving different stakeholders at corresponding levels with idealised solutions to reduce raw inputs as well as emission outputs from the system.

Although urbanisation is usually seen as an economic or demographic phenomenon, this also represents a human ecological transformation. With the looming climate change crisis, sustainability and environmental concerns have gained more importance than before. The Urban Metabolism tool can assess levels of sustainability by understanding drivers of resource flow, including lifestyles-based consumption patterns, pollution levels and climate change impacts. Assessment of these impacts can help understand and emphasise the implications of the Circular economy (CE) in various urban sectors.

Circular systems are likely to replace existing linear solutions and reduce wasteful discharge in the form of air pollution, and soil and water pollution. Material recycling is an important aspect of sustainable development by connecting the loops of output to input. In this purview, UM is a strong analytical tool where the flow of materials can be visualised with volumes and weights. UM has the capacity to point out the causes of increasing vulnerability and inversely demarcate directions to enhance resilience.

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ARTICLE

The Golden Ratio and Modulor Scale

By Ar. S. L. Kolhatkar

"The intent of all theories of proportions is to create a sense of order and harmony among the elements in a visual construction. According to Euclid, a ratio refers to the quantitative comparison of two similar things, while proportion refers to the equality of ratios. Underlying any proportioning system, is a characteristic ratio, a permanent quality that is transmitted from one ratio to another, establishing a visual relationship between parts of the building and between part and the whole."

– Francis Ching

Principle and Practice

The golden ratio or golden section in geometry refers to the division of a line segment into two parts so that the greater part is the mean proportional between the smaller part and the whole segment. This means that the whole segment is to the greater part as the greater part is to the smaller part. In other words, if the greater part is 1 unit long, the smaller part shall be 0.618034 units long and the whole shall be 1.618034 long. As seen in figure 1, line AB is divided into two segments a and b such that b/a = AB/b = 1.618034.

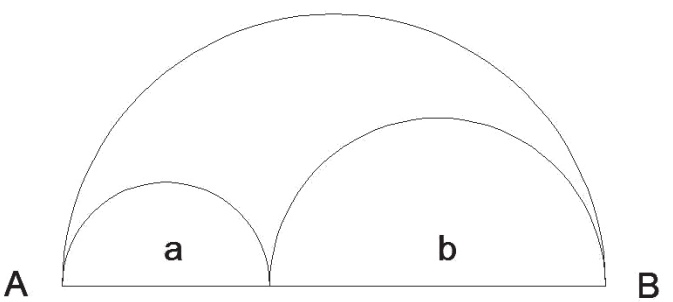

Figure 1: Golden Ratio
Source: Author

The ratio 1.618034 occurs in the ratios of the successive terms of the Fibonacci sequence. The terms of the series are 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233 and so on, in which each term after the second is the sum of the next two preceding terms, thus 3 + 5 = 8 and 5 + 8 = 13 and so on (Reichmann, 1967). Besides having peculiarities of its own, this sequence also appears to manifest itself in numbers associated directly with nature. It is associated with art through the medium of the golden section and approximates very closely to a natural rate of growth.

The sequence is named after the Italian mathematician Leonardo of Pisa, who was better known by his patronymic —Fibonacci. He presented the hypothetical breeding results of a colony of rabbits as an example. If a pair of rabbits is placed in an enclosure, how many pairs of rabbits will be produced on the assumption that starting in the second month after their birth, each pair of rabbits gave birth to a further pair in each subsequent month? The original pair will give birth to a new pair every month. Consequently, by the end of the first month, there will be *two* pairs. The original pair will again give birth in the second month, but the pair born in the second month will not.

Thus at the end of the second month, there will be *three* pairs. Of these, two pairs will each produce another pair in the third month making a total then of *five* pairs; in the next month there will be three birth pairs making a total of *eight* pairs. The numbers written in *italics* here are the same as in the Fibonacci sequence. At the same time, ratios of the successive terms approach more closely to the value of 1.618034 as the series progresses. The ratios are alternately less than and greater than 1.618034. This

is the equivalent of (1 + √5) / 2 and is a common ratio in this geometrical progression.

This value is only an approximate value. It is, of course, an irrational. This is an exponential function, the successive values of which represent a type of continuous growth. The Greeks recognised the dominant role the golden section played in the proportions of the human body which they showcased in their temples. The Renaissance architects also explored the golden section in their works. The properties of the golden section may be seen in the sculptures of the artist Phidias. Of a typical statue of a 34 unit height, other relative measurements would be: feet to navel 21 units, navel to crown of head 13 units, crown to breast line 8 units and breast line to navel 5 units.

Rectangles which have their respective sides in a golden section relationship have a built-in property which gives rise to an infinite process of exhaustion, as can be seen in figure 2. The intersection points carve out a logarithmic curve which grows very fast but never changes its shape.

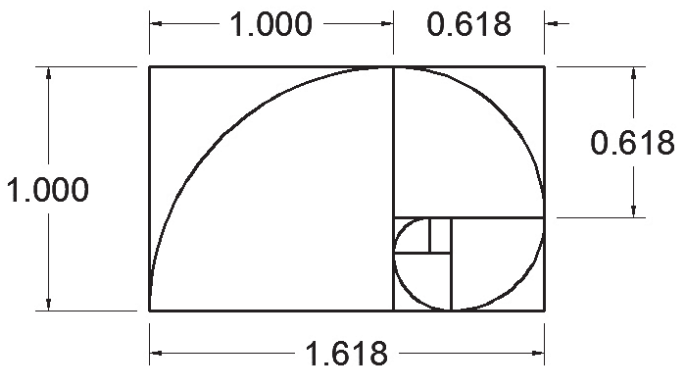

Figure 2: Golden Ratio
Source: Author

The property of the golden section occurs in many geometrical propositions. For example, if the side (a) of a regular decagon (polygon with ten equal sides) inscribed within a circle of radius (r) is laid off along this radius, the latter will be divided in a golden section. The length of any side of a regular polygon can be expressed trigonometrically in terms relative to the angle subtended at the centre (of the inscribed circle) by the side. For a polygon having *n* sides, this angle is $360^0 / 2n$, so that for a decagon the subtended angle is 18^0. It can then be shown that the length of the side is equal to $2r \sin 18^0$. The ratio of the radius to the side will therefore be $r / 2r \sin 18^0 = 1 / 2 \sin 18^0$. From tables, we obtain the value $\sin 18^0 = 0.309017$ and $2 \sin 18^0 = 0.618034$, the reciprocal of which is 1.618034 as has been previously noted. This example is of particular interest as it relates golden section to a specific trigonometric ratio.

It is usually also possible to introduce other trigonometric ratios into associated propositions because of the relationships which exist between these ratios themselves. It has been seen that $2 \sin 18^0 = 0.618034$; now also it can be noted from the tables that $2 \cos 36^0 = 1.618034$.

This equivalent is useful in a further example in which golden section almost excels itself. In figure 3, FGHJK is regular pentagon. If we produce the sides of this figure, we can form a star-shaped figure called a pentagram whose vertices are at A, B, C, D, and E. These vertices all lie on the same circle and also coincide with the vertices of another pentagon inscribed within that circle. The star construction may thus the regarded as consisting of the diagonals of this larger pentagon.

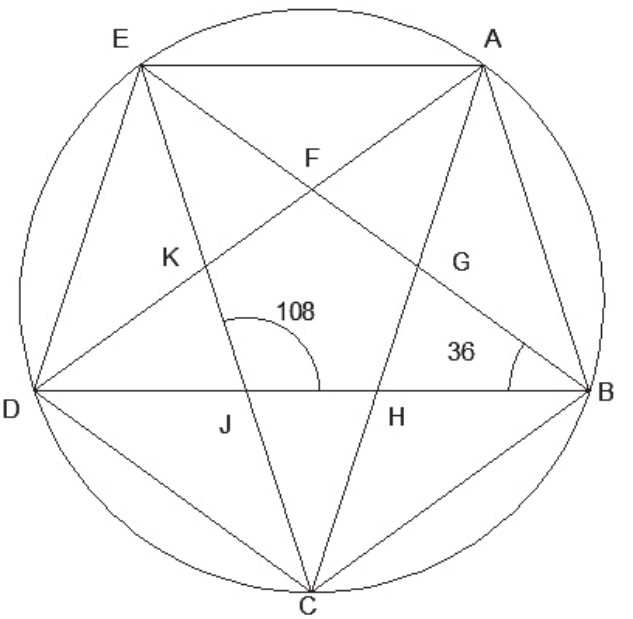

Figure 3: Pentagram
Source: Author

These properties display a symmetry of great aesthetic appeal but there are also further hidden qualities which make the pentagram a very remarkable figure indeed. A minor but nevertheless interesting property lies in the simplicity with which it may be drawn. The pentagram and, indeed, the whole above figure is unicursal i.e. it can be drawn in one continuous process without lifting the pencil from paper and without traversing any part of it more than once. A much more esotric attribute of the pentagram relates to its golden section properties. In triangle EBJ, we have angle $EJB = 108^0$ and angle $EBJ = 36^0$. Then by the sine law which holds that the sides of a triangle are proportional to the sines of the opposite angles, $EB / EJ = \sin 108^0 / \sin 36^0 = \sin 72^0 / \sin 36^0$. (This follows from the identity, $\sin \theta = \sin (180^0 - \theta)$; so $\sin 108^0 = \sin (180^0 – 108^0) = \sin 72^0$).

The values of sin 72^0 and sin 36^0 may be read from printed tables and the above ratio will be found to be equal to 1.618034. But it can also be shown that by a transformation of the trigonometric equivalent, sin 2A = 2 sin A. cos A and that sin 72^0 / sin 36^0 = 2 cos 36^0 so that the value of the above ratio may more easily be calculated by doubling the value of cos 36^0. The lines EB and EJ thus seem to be in golden section relationship. But EJ = EG; so EB and EG also have the same ratio. In fact, the diagonal EB is divided in such way that each of the segments FG, EF, EG and EB is 1.618034 times as great as the next preceding segment in the order shown. Furthermore, each of the other diagonals is divided in exactly the same way and is also 1.618034 times as great as each of the sides, such as EA, of the larger inscribed pentagon. And as if the properties of the pentagram were not sufficient in themselves, the figure was for long regarded to have mysterious powers.

The golden section occurs also in relationships between the metrical properties of regular solid figures which have plane faces and straight edges (see figure 4). An icosahedron (having 20 triangular faces) can be inscribed within an octohedron (have 8 triangular faces) of appropriate dimensions, so that each vertex of the former divides one of the edges of the latter in a golden section (Reichmann, 1967).

The Modulor

Le Corbusier developed his proportioning system, the Modulor, to order "the dimensions of that which contains and that which is contained" (Le Corbusier, 1950). He saw the measuring tools of the Greeks, Egyptians and other high civilizations as being "infinitely rich and subtle because they formed part of the mathematics of the human body, gracious, elegant and firm, the source of that harmony which moves us, beauty". The measuring system traditionally used in the construction of South Indian Hindu temples is the Vastu Shastra system, which is based on ancient Hindu architecture and design principles. This system is not based on the metric or imperial measurement systems used today but rather on a complex system of ratios and proportions that relate to the size and shape of the human body.

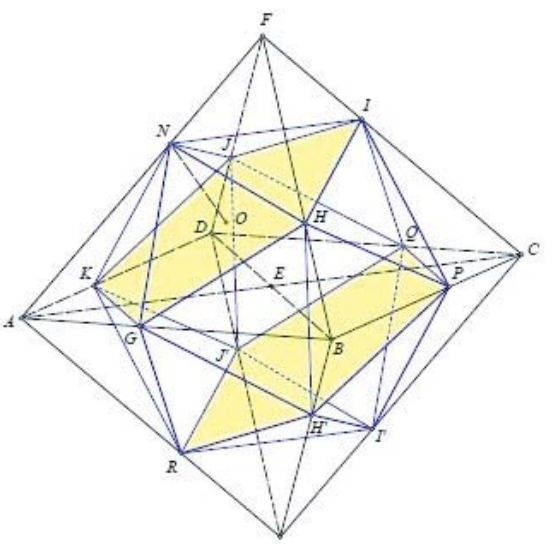

Figure 4: Icosahedron inscribed in an octahedron
Source: Author

For example, the measurements of the temple's various elements, such as its base, pillars, and walls, are based on the dimensions of the human body, such as the length of the arm, the height of the eye, or the width of the palm. The *Arthaśāstra* by Kauṭilya mentions various units of measurement for building palaces, temples, roads etc. So the standard table of measurement would be:

- 1 aṅgula = approx. 3/4 of an inch
- 4 aṅgula = dhanurgraha = 3 inch
- 8 aṅgula = 1 dhanurmuṣṭi = 6 inch
- 12 aṅgula = 1 vitasti = 9 inch
- 2 vitasti = 1 aratni or hásta = 18 inch
- 4 hásta = 1 daṇda or dhanuśa = 6 ft
- 108 aṅgula = 1 garhpatya dhanuśa = 1.81 mt
- 400 hásta = 1 nalva = 180 mt
- 10 daṇda or dhanuśa = 1 rajju = 60 ft
- 2 rajju = 1 parideśa = 120 ft
- 2000 daṇda (dhanuśa) = 1 kosa or goruta = 4000 yards or 2.25 miles = 3.66 km
- 4 kosa = 1 yojana = 9 miles = 15 km

However, kosa may also refer to roughly 1.8 km (1⅛ mile) or 3.2 km (2 miles). *Arthaśāstra* standard unit of kosa is equal to 3075 metres in SI units and 1.91 miles in imperial units.

Le Corbusier and his team worked very hard through the years of the second world war and discovered the interconnection and interrelationship between a numerical progression (the Fibonacci sequence), geometry of the golden section and the measurements of a human body. "A man with arm upraised provides, at the determining points of his occupation of space – foot, solar plexus, head, and tips of fingers of the upraised arm – three intervals which give rise to a series of golden sections, called the Fibonacci series" (Le Corbusier, 1950). On the other hand, mathematics offers the simplest and most powerful variation of a value: the single unit, the double unit and the three golden sections. 1130 mm, 1830 mm, and 2260 mm define the space occupied by the human figure. The basic grid consists of three measures:

1130, 700 and 430 mm, proportioned according to the golden section.

(430 + 700 = 1130, and 1130 + 700 = 1830 mm and 1130 + 700 + 430 = 2260 mm)

Blue series: 50, 110, 160, 270, 430, 700, **1130**, 1830, 2960, 4790, 7750……etc

Red series:100, 220, 320, 540, 860, 1400, **2260,** 3660, 5920, 9580, 15500……etc

The basic unit of 1.13 m, the double unit of 2.26 m and their golden sections added and subtracted give us infinity of measures and therefore, infinity of combinations of these measures.

Le Corbusier's method of formulating the modulor scale consisted of the following steps (see figure 5):

1. Take two contiguous squares of measures 1.13 m × 1.13 m each

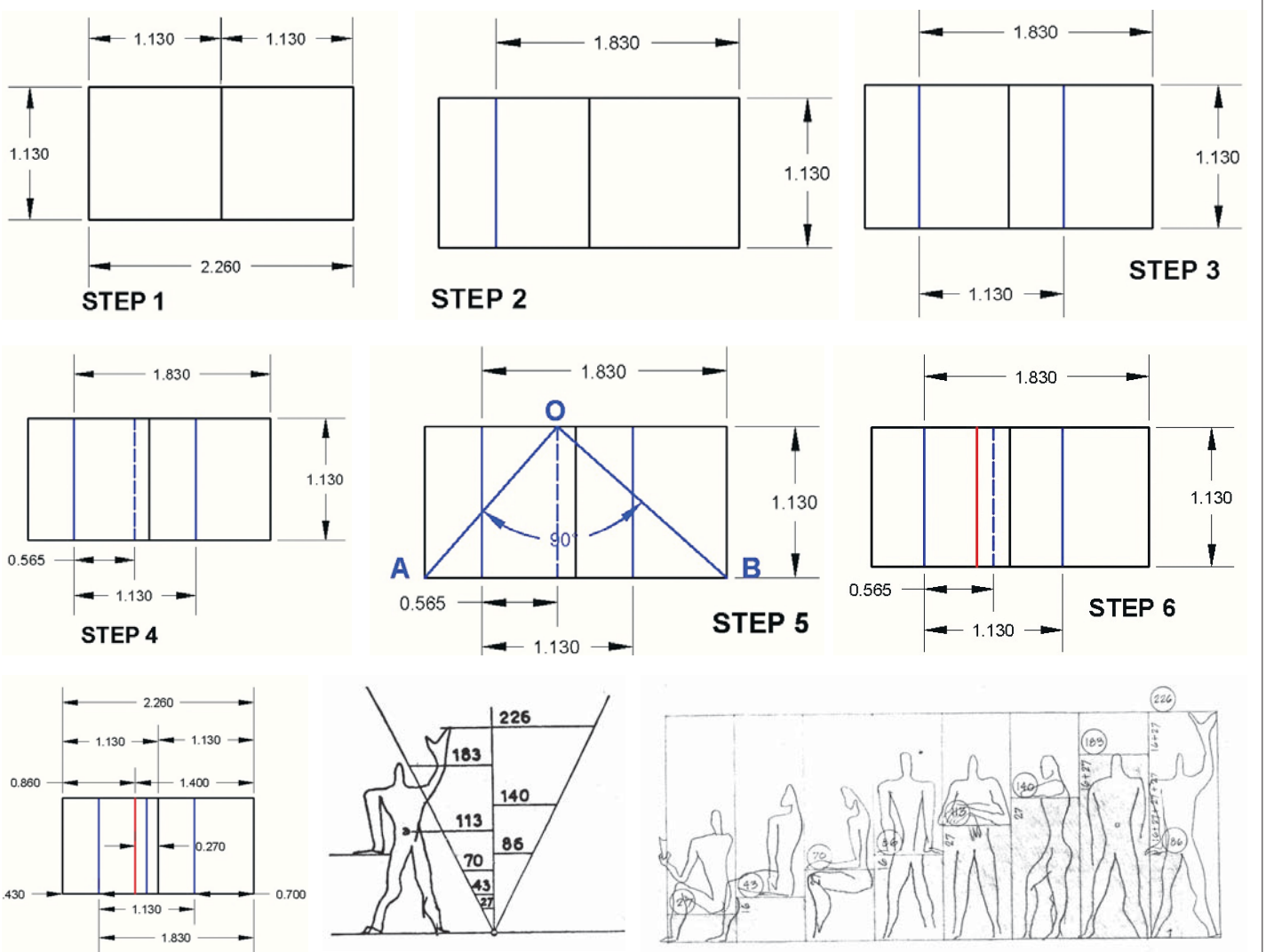

Figure 5: Steps to formulate Modulor Scale by Le Corbusier
Source: Le Modulor, 1950

2. Take golden section of measure 1.13 m (1.83 m) and mark it on the diagram
3. On this line place a third square of measures 1.13 m × 1.13 m; thus we have placed a third square in two contiguous squares at the place of golden section
4. Draw centre line of the third square.
5. Draw lines AO and BO and measure the angle AOB, which is 90^0. We have, therefore, succeeded in placing the third square at the place of golden section.
6. Take a mirror image of the line which joins two original contiguous squares, around the centre line of the third square.
7. Now if we make this figure erect and place a human figure inside it with the height of 1.83 m, we will observe that all the measures obtained so far in this procedure relate to human physique.

Mougeot, the founder of Committee of Economic Organization in Paris, calculated and told Le Corbusier

that between the smallest measure considered in practice – the fifteen thousandth of a millimeter – and the periphery of the earth, the Modulor counts only 270 intervals. Le Corbusier states that "a good composition requires the use of very few elements, but each of them should have a distinct personality and a very strong one at that. It takes only twenty six letters to write tens of thousands of words in fifty languages. The universe, at our present state of knowledge, is composed of 118 elements. All arithmetic is written with ten figures and music with seven notes".

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THE TRANSPOSED BRICKS DEPARTMENT

A Caveat Photo-Manuscript about Protecting 'Kahnian' Artefacts in Ahmedabad.

Ar. Mohesh Babu Radhakrishnan

Abstract

India has many timeless architectural wonders, ranging from the Taj Mahal in Delhi to the Stepwells in Ahmedabad. One such modern, timeless wonder is the IIA Campus in Ahmedabad (IIMA), designed by the renowned and celebrated architect Louis Isadore Kahn. He has created ground-breaking architectural endeavours, especially in his institutional design, such as Salk Institute, The Institute in Dhaka, Philips Exeter Academy, and IIA Ahmedabad. These visionary contributions do not just stand for their architectural greatness in textbooks, but are a continuous inspiration for modern-day architects up until now.

Architect Kahn has his grammar in his architectural manuscripts, i.e., the buildings that came to life from his thoughts. This 'Kahnian' Grammar includes various signature styles such as the play of geometry, monumentality, the skyline in buildings, vast open spaces, relationships to earth-water-sky and, more significantly, Materiality. One such famous material that made a head turn worldwide was the usage of bricks in IIMA. Albeit the architecture of IIMA is iconic and fascinating, it does not change the fact that it is one of the ageing buildings that needs care and attention as it was constructed in the 1960s. Over the past few years, IIMA has faced multiple architectural dilemmas. A few campus buildings started showing signs of structural weaknesses, and the campus demanded growth.

This essay does not intend to downsize or undermine any architect's professional decisions nor questions their intent. Also, the intent of the essay is not to make authoritative judgments but instead to engage the architectural audience in critical and debatable discussions about the built environment. The readers are encouraged to form their own opinions and to recognise that reasonable people may disagree on architectural matters. Ultimately, this essay gives a purview of the current situation of IIMA and theoretically explores the methodology of moving forward with similar architectural situations. This case-by-case thematic essay will explore the entire timeline of IIMA's noteworthy situations in four acts: The New Additions, The Demolition, The Outcry and the act of Coming Together.

The New Additions

Since 1961, after the establishment of IIM during Kahn's period, there have been many additions to the IIM-A. These reasons for such new additions were predominantly for service provisions, campus expansions addressing the influx of students. Twenty years later, in 1981, Anant Raje constructed the management design centre, the dining and kitchen hall celebrated in the architectural world. Time of India (TOI), 2021 states that Raje's design is a "gem" and can "host international congresses level catering" in the halls. TOI also reported that Raje had skilfully translated Kahn's concepts. Years later. In 1999, a competition was conducted for a new campus plan, where HCP Design won and carried out the construction. The new campus extensions look similar to Kahnian grammar, and HCP has stated that they did not intend to imitate the Kahnian Palette.

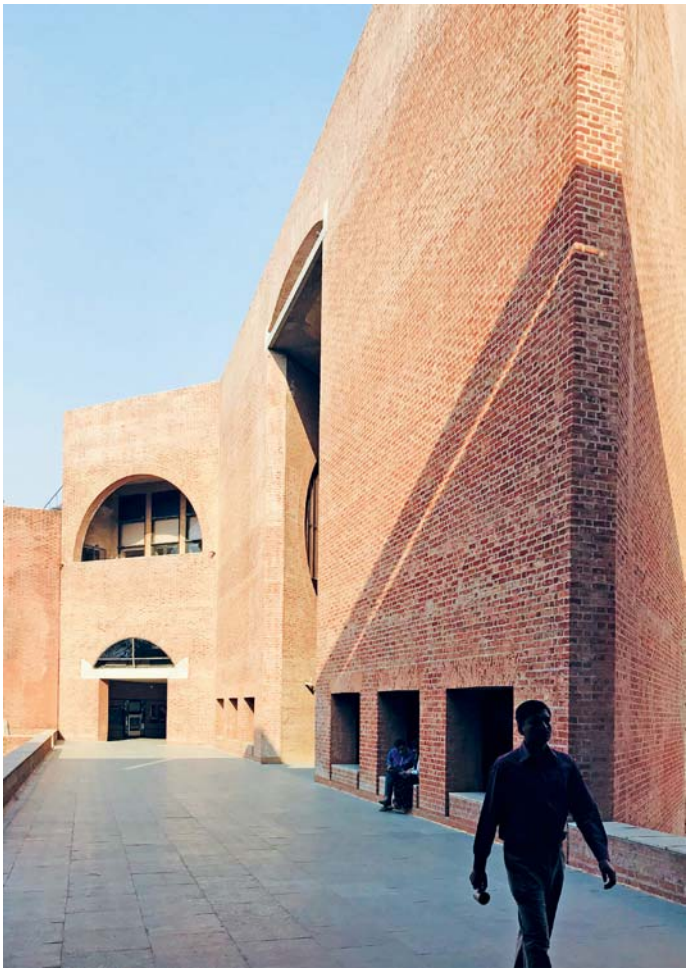

Figure 1: Long Span Corridors at IIMA
Source: Author

This design intent steered away from Kahnian Grammar on the new campus and stirred many debates. TOI (2021) mentions that these new additions were “soulless” and “bland”. Although HCP boldly moved with its landscape, concrete and steel, it still holds a few similarities to Kahn’s geometries in varying proportions. Cut to chase to 2014; there is another competition from IIM-A where the brief was to rethink the entire master plan for the next 20-25 years. Once again, HCP proposed their idea for the IIA Masterplan. TOI (2021) differs from this idea, stating that the proposal would be “inferior and hostile to Kahn’s idea”. However, HCP expresses that idea of the masterplan “sensitivities and appropriates change”. There is a dilemma between sentimentality to protect timelessness and the need for change and growth. While the “need for change” intentions for IIMA formed, new dilemmas arose regarding the demolition.

The Demolition

The stories of demolition started in 1982, but IIMA decided to take considerations more seriously and set a timeline for restoration. Damesh Singh (2022) stated

Figure 2: Circular Fenestration
Source: Author

Figure 3: Semi-circular passageway
Source: Author

that in 2014 a competition was held to restore Kahn’s campus, where Somaya and Kalappa Consultants (SNK) were shortlisted for such restoration. For the first two years, they did a condition mapping, and two years later, during 2016-2017, SNK successfully restored 85 cracked brick flat arches and upgraded reinforcements. Their work was appreciated as they restored the buildings to their default settings. SNK advised a detailed conservation plan.

Figure 4: Tall Brick Spires
Source: Author

Figure 5: Intricate balanced Asymmetrical Geometry
Source: Author

The episode of demolition started when IIMA's then-director drafted an 11-page open letter about why 14 out of 18 dormitories needed to be demolished. In explaining the demolition, this letter stirred many reactions, uncertainties, and questions. The outcry was loud and detailed in its concerns, not nationally but globally.

The Outcry

Over 14000 letters, responses and over 20,000 signatures in petitions against demolition were filled in as soon as the demolition decision was made. 11 such open letters were sampled and summarised the responses. The letters stated that IIMA is a "Beacon of Architectural history, an inspirational building in academic fields; national identity of cultural heritage". They also advised the administration to "consider the legacy" as demolishing it would cause "ethical implications". They also added that demolition would be a "destructive proposition" and "not a right choice". They suggested there could be "preservation and restoration" considerations instead of demolition.

One such letter from Wattas (2022) lays out a question:

"Could we possibly visualise the whimsical towers of Cambridge or Oxford being torn down to provide space for employing extra FAR or tidy up existing moss-bloomed stone façade for dazzling and garish modern wall coverings?"

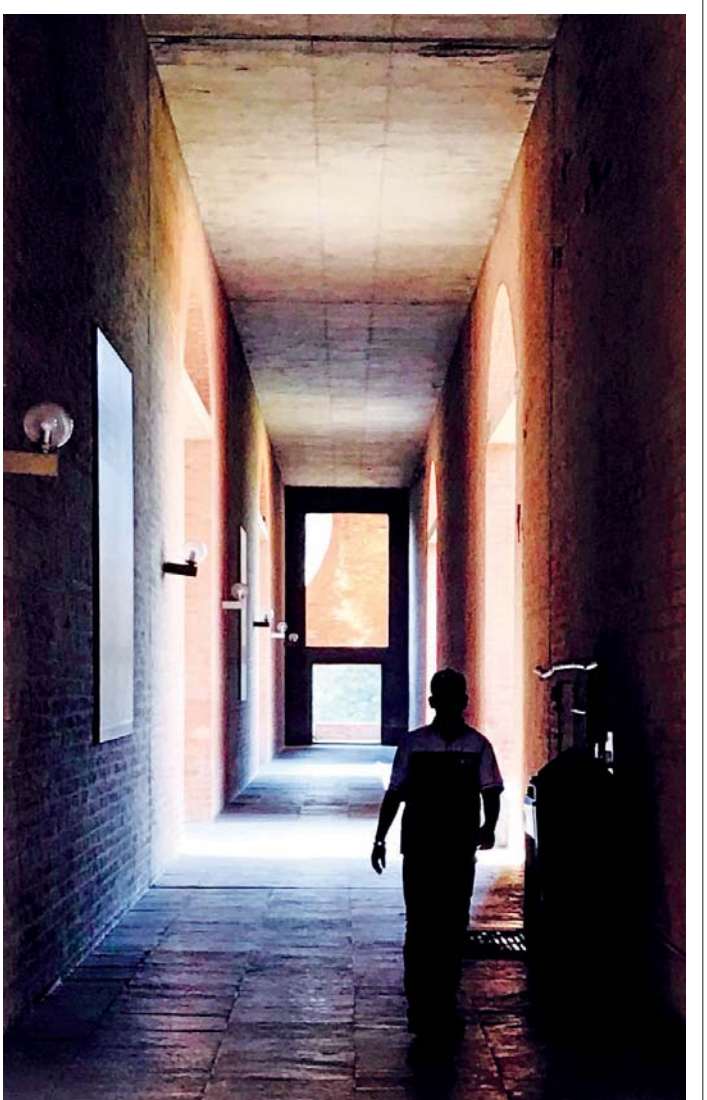

Figure 6: Varying Light and Shadow in IIMA Corridors
Source: Author

Figure 7: Edging of Landscape
Source: Author

The Coming Together

Somewhere down the lanes, we as a community try to "Break our Favourite Toys" consciously, subconsciously, or even unconsciously. Based on the manuscript above, it is clear that architects need to come together to solve this situation. The outcry and the letters above show the need to preserve the Kahnian Grammar in Ahmedabad, especially considering safeguarding heritage and this timeless work. This act of preservation would not be a mere architectural imperative but rather a diligent obligation to honour the past, Kahn and his works.

The shared attempt of architects from around the nation during these architectural emergencies would signify power and commitment to preserving the artefact of creativity and ingenuity. Collaborative advocacy and thoughtful actions moving forward can thwart the threat of demolitions.

With the knowledge that IIM Ahmedabad is one of the ageing campuses, there are specific approaches that could help us move forward:

1. Structural assessments are currently carried out, but they are also taking opportunities to reach out to the worldwide support system for architects in times of need.
2. Adaptive Reuse mended with Conservation Principles works well, especially considering successful preservation precedents such as Tate Modern, Kala Ghoda Arts Precinct, Neemrana Project and other such projects.
3. Community Engagements: Creating awareness among the architect public can foster ownership among stakeholders, which could also be an effective strategy.

Figure 8: Monumental Louis Kahn Plaza
Source: Author

4. Legal Policy Measures: As per the current demolition act, only buildings 100 years old can be outlined as "heritage", where these policies can be revisited and revised by petitions on allowing special permissions to consider certain buildings under the label of "heritage".

Conclusively, preserving Kahnian Grammar in the Ahmedabad campus will not only do the benefits above. Instead, it will set a solid precedent for future generations in a way that ageing buildings need to come together rather than facelifting or merely demolition. This issue should not be taken lightly as another controversy. Instead, it is an act for us all to work in one accord to find innovations in the new age era and pass down the architectural assets to the next generation.

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Designing for the Marginalised: Centre for Albinism Advocacy

By Nikita Thole and Dr. Vasudha A Gokhale

Abstract

Albinism is a rare, non-contagious, genetically inherited condition that occurs worldwide regardless of ethnicity or gender. Albinism causes vulnerability to sun exposure and visual impairment; in addition to purely medical consequences of white skin, profound social and medical misunderstanding of Albinism is the source of deeply engraved stigma and discrimination. Disability studies focus exclusively on visible disabilities, neglecting non-visible disabilities like Albinism. Besides, this marginalised cohort also struggles in public, educational and work environments as their spatial needs remain unnoticed. This work includes research to explore PWA's concerns about architectural and planning aspects that affect their mobility and participation in the urban realm. Based on discussion sessions and questionnaire surveys, PWA's problems and issues in accessing architectural facilities are identified. The analysis is supposed to help architects and planners design spaces and structures for inclusion and equitable use. The research outcome culminated in a design project aimed at providing a platform facilitating these marginalised people, which is altogether missing worldwide. It is to provide the required facilities for capacity building and promote research and awareness about this equally intelligent and accomplished but neglected population.

Keywords: Albino, hypopigmentation, melanin, discrimination, stigma.

1. Introduction

Albinism is a genetically inherited condition that affects the pigmentation of the retina, hair and skin. This disorder occurs due to the lack of skin pigment called melanin which provides colour to the skin, eyes and hair (King, 1987). The earliest description appears in the ancient pseudepigrapha, written around 200 BC. In the first century AD, a Roman author and natural philosopher, Plinius Secundus, mentioned men in Albania having sea-green eyes, white hair since childhood and having difficulty seeing in the daylight (Kromberg & Kerr, 2022). The first scientific description of Albinism was made by the English physician Sir Archibald Edward Garrod in 1908. Since Garrod's initial discovery, scientists have made significant progress in understanding the genetic and molecular basis of Albinism. Despite these advances, negative cultural beliefs, myths and superstitions about Albinism persist in the world, leading to discrimination and exclusion from society (Nebre, 2018).

One in 1.7 million people are born with Albinism worldwide and their population in India is approximately 20 million. In India, social stigma is associated with any pigmentary disorder. Thus people having Albinism access medical facilities only at the later stage, which increases the incidence of advanced malignancy (Vanarase & Gadekar, 2018). India, as the United Nations Convention on Rights of Persons with Disabilities signatory, enacted and implemented the Rights of Persons with Disabilities

Act, 2016. However, this statute does not include any specific provisions concerning the rights of PWA - people with Albinism (Basu & Raha, 2023). This aspect is alarming for families having more members with Albinism as PWA often inherit an albinism gene from their parents (Figure 1).

Figure 1: Indian Family with Albinism
Source: https://realhistoryww.com

2. Problem and issues associated with Albinism

Lack of melanin in PWA causes sensitivity to the sun, making them highly vulnerable to the risk of developing skin cancer (Marçon & Maia, 2019; Santos et al, 2013). Albinism is associated with visual impairment; in extreme cases, a PWA may experience vision loss over time. This marginalised cohort suffers from psychological, educational, occupational and social problems due to lack of resources and social stigma (Brocco, 2016). The United Nations Human Rights Council adopted a resolution in 2013 to prevent PWA from discrimination and satisfy their specific needs (Mhando, 2016). They suffer from physiological impairment associated with numerous interrelated vision and eye-related issues. They have deficient stereovision due to a disrupted anatomical substrate for binocularity that disturbs the visual space in the cortical organisation of the visual fields. PWA has uncontrollable rapid eye movement as their underdeveloped fovea, a part of the retina, causes congenital misrouting of optic nerves connecting the brain to the eyes (Olagunju, 2019). In tropical regions, the skin is exposed to the sun, where hypopigmentation and the absence of melanin cannot check the penetration of ultraviolet rays (Madubuko & Onunu, 2021).

PWA has a natural visual impairment and aberrant eye behaviors that include crossed eyes (strabismus) and involuntary, rapid and repetitive movement of the eyes (nystagmus). Their eyes send signals to the brain in an unusual manner, preventing eyes from working together and decreasing depth perception. The depth perception process is also known as stereopsis (Creel et al, 1990). It refers to the eyes' ability to judge the distance between objects. The severe visual impairment impedes their eyes' ability to focus and accommodate vision. Besides, they have photophobia, which is the sensitivity to light (Williams, 2018). Albino students have to struggle with school assignments because of their visual impairment. Restriction on full learning participation creates inequalities in accessing learning opportunities (Machingambi, 2023). In many instances, they are placed at the back of the classroom to avoid the teacher being in closer contact. In such cases, the student cannot see the blackboard correctly which leads to a lag in learning. This treatment causes lower self-esteem and social and psychological marginalisation (Chetty, 2021; Masanja, 2020). The various aspect related to visual functionality are shown in Figure 2.

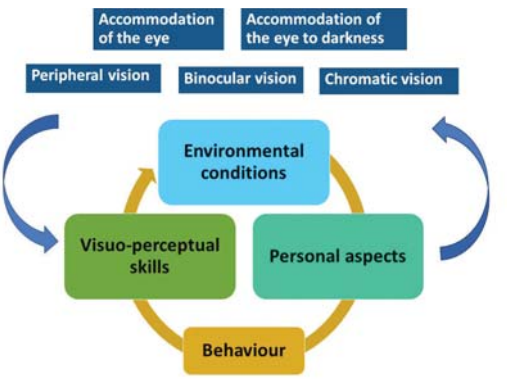

Figure 2: Visual Functionality
Source:https://albinismo.es/wp-content/uploads/Guide-ENVIRONMENT.pdf

3. The research design

A questionnaire survey was conducted to explore PWA's problems, issues and spatial needs. As the target audience for the survey is niche, it took time to approach them. Snowball sampling technique was used to achieve the required number of respondents. The questionnaire survey was conducted using Google Forms sent through email and social media like WhatsApp, while a few were contacted in person. It was followed by a telephonic communication to the maximum number of possible respondents to get authentic and rich data. The final sample size included 38 respondents of which 48% were male and 52% were female.

It is noted that 80% (20 respondents) are albinos; some of the respondents' siblings and the rest of

the family members, like the father, suffer due to albinism. Facing discrimination in society is a common phenomenon that is observed. In the telephonic and in-person conversations, it is revealed that discrimination consists of name-calling, derogative remarks and persistent teasing and bullying. Discrimination faced by persons with albinism manifests in the responses as 28% of respondents face discrimination frequently while more than 50% face it sometimes. However, 11% rarely face it and 8% do not have such experience.

Reduced melanin can cause eye problems like blurred vision, double vision, or poor eyesight. This makes navigating the outdoor environment difficult for albinos as too much light enters the eyes of PWA, who are sensitive to bright light and glare. The environment may appear all white or lack contrast. Such environment also causes strain and discomfort. Analysis indicated that blurriness and double vision are experienced by 24% of respondents while 50% experienced it sometimes. About 26% have rarely faced or never had such experience. The problem of glare and contrast was more acute, as 55% and 68% of respondents were significantly affected by glare and contrast, respectively. In addition to having difficulty with outdoor reading street and store signs, they need help navigating in the bright sunlight when glare is present. The majority (74%) of respondents have problems reading signboards. However, a mixed response was obtained for navigation problems in public spaces, as 45% have this problem significantly sometimes, 10% did not consider it a problem. PWA have poor binocular vision that causes impaired depth perception, creating difficulty transitioning from one type of surface to another and using stairs, which is expressed by more than 55% of respondents. The data analysis outcome is presented in Figure 3.

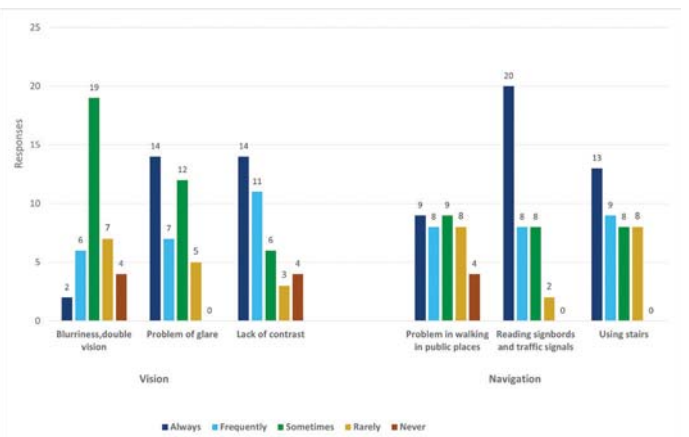

Figure 3: Vision related problems in using public spaces
Source: Author, 2024

Based on the analysis, the spatial implications for PWA are identified as follows:

- In tropical climates, the skin becomes highly vulnerable to skin disorders due to hypopigmentation. PWA is prone to sunburn as sun-exposed skin undergoes sunlight-induced malignant transformation, whereas damages to skin largely depend on the intensity and duration of exposure to sunlight.
- The medical condition makes the words wiggle on the page and makes it hard to focus on small, narrow print. Due to low vision, students with Albinism (SWA) cannot read from the blackboard and needs to sit in the classroom's front row and in a place not exposed to direct sunlight.
- SWA prefers to play in the covered corridors or shaded courtyard areas.
- PWA experiences difficulties looking at distant objects and crossing a road alone.
- Detecting obstacles depends on three functions: visual-field status, contrast sensitivity and acuity, which help avoid contact with obstacles in the space. Obstacles on the ground or discontinuities in the ground plane, such as steps, pose hazards for PWA with low vision.

The above aspects are addressed in the proposed project with appropriate design interventions.

4. Project argument: Need and relevance

The spatial needs of PWA has to be recognised as they are left far behind in development measures and access to various physical, social, spatial and human rights interventions (Reimer-Kirkham et al, 2019). Their exclusion from equal access to the built environment is attributed to disempowering and disadvantageous spatial and social environments. The National Organisation for Albinism and Hypopigmentation (NOAH) is an international body that provides many programs for PWA virtually and through social media with no physical space. Although the PWAs are connected through social media; there needs to be more facilities where they can come together and share their experiences. In the medical discipline, Albinism is a neglected part of skin-related disorders where more research is needed. PWA are required to use skin ointment, cover their body and take medication. These pose problems as they have scarce financial resources. In India, this community needs a place for capacity building, organising awareness programs and research and training facilities for mainstreaming this marginalised cohort.

This project, 'The Center for Albinism Advocacy', aims for spatial and social inclusion of PWA. It demonstrates the role of architectural interventions in creating a friendly built environment with the following aims:

- Providing a well-equipped space as a platform for PWA to come together, create awareness and share knowledge and experience.
- Provide space for research in Albinism.
- Facilitate PWA for their health and well-being with the medical care unit.
- Capacity building with provision of space for assistive learning.
- A space for entertainment, relaxation and enjoyment which will enhance the quality of life.

5. The site

The proposed site is located in Bengaluru in the South Indian state of Karnataka. It is the third most populated city in India. The city is well known for its IT sector research and development activities. The site is in the heart of Bengaluru city, close to the National Institute of Mental Health and Neurosciences (NIMHANS), the apex center for mental health and neuroscience education in the country. Bengaluru is classified as having tropical wet climate with seasonally dry spells. It has slight temperature variance between seasons due to its latitudinal location and its location on the mainland. Bengaluru was selected due to its moderate climate, which can be advantageous for individuals with Albinism. The relatively milder temperatures and lower sun intensity can reduce the risk of sunburn and skin damage. Another reason is its connectivity with other Indian and foreign cities. It also has good transportation facilities for the city dwellers. The site is on a relatively flat terrain and falls under the "institutional" land-use category, per the Bengaluru Master Plan. The site analysis is presented in Figure 4.

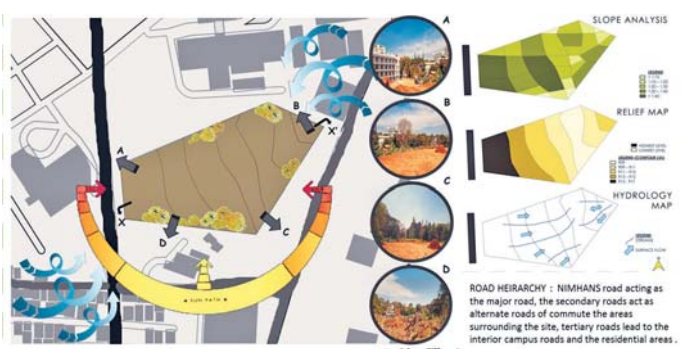

Figure 4: Site Analysis
Source: Author, 2024

The design programme is aligned with the aim and vision of NOAH that include:

- Space for interaction and counselling: Provision of a place where people with albinism and their families can find acceptance and support. It includes spaces for organising short-term programs for parents, grandparents and other family members.
- Facilitation Centre: PWA library and book club houses, literary and audio-visual resources, a reading room and an audio-video presentation facility; the medical support facility is designed to provide required medicines and sun-screens at reasonable cost, which are not available frequently in the market.
- Especially designed remedial classrooms assist students needing to catch up on their school or college curriculum due to physical limitations.
- Covered/semi-covered sports facilities.
- Training Centre: Offers a well-equipped space to train parent liaison volunteers for each newly diagnosed family. It also houses the one-year Mentorship Program affiliated with NOAH.
- The Research Centre includes required clinical research facilities, laboratories and ancillary spaces.
- Conference and seminar rooms are designed to host international and national level conferences, seminars, awareness programs and presentations by top scientists in albinism research.

The detailed plan, elevations and sections of cluster 1 providing clinical and research facilities is presented in Figure 5, 6 and 7.

6. Design interventions

- PWA needs a health-promoting physical environment where buildings are designed for minimal exposure to direct sunlight. Therefore, it is critical to balance sun exposure and sun protection. The outdoor spaces in this project are designed to provide desirable sun protection while still maintaining a feeling of being in nature outdoors.
- The most significant challenge is designing for gradual exposure from inside to outdoors, as sudden change is difficult to grasp. A smooth transition from indoors to semi-covered spaces is designed and vice-versa to provide visual comfort while navigating.
- Obstacles on the ground or discontinuities in the ground plane, such as steps, pose hazards

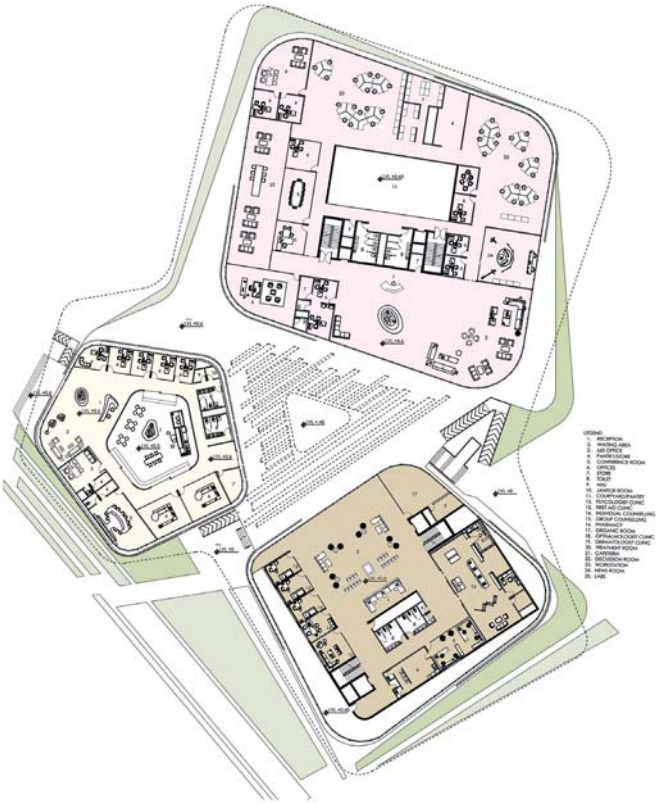

Figure 5: Ground Floor Plan
Source: Author, 2024

for PWA with low vision. Hence, the sudden change in levels and discontinuity are avoided. The steps and ramps are provided with colour contrast to facilitate ease of movement.

- PWA experiences difficulties looking at distant objects and reading signboards. Specially designed signage with desirable colour and required font size is adopted for legibility.
- Interactive transitional spaces between buildings are provided with soothing landscaping features and hardscapes which avoid sudden changes in texture.
- The sharp turns and corners, which make Albinos uncomfortable, are avoided. Instead organic form of buildings and connecting passages are used.
- It is noticed that exposure to direct sunlight is acute for SWA during leisure activities.
- Research revealed that SWA prefers to play in the covered corridors or shaded courtyard areas or avoid physical activities, preferring to watch television leisurely.

The design interventions are presented in Figure 8. It provides a place where people with albinism and their families can find acceptance and support, where they will have a conducive and refreshing environment, as presented in Figure 9 and 10.

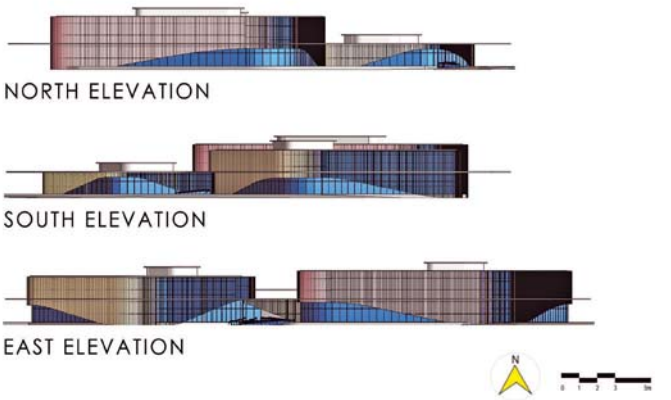

Figure 6: Elevations
Source: Author, 2024

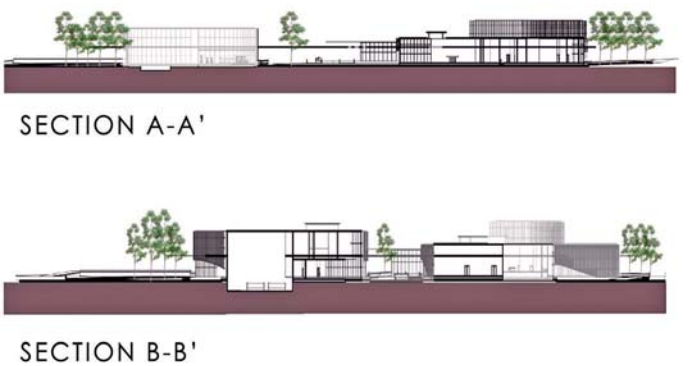

Figure 7: Sections
Source: Author, 2024

7. Conclusion

The physical appearance of persons with albinism is often the object of erroneous beliefs and myths influenced by superstition, which foster their marginalisation and social exclusion. Albinism is still profoundly misunderstood socially, medically and spatially due to negligence and lack of awareness about the intricacy of this disability amongst architects and planners. Besides, no specific provisions relating to the rights of PWA render them vulnerable to living a dignified life. These people with equal intellect need to struggle in public and private environments, compromising the quality of their life. It is recognised that accessibility to the physical, social and economic environment is crucial for redressing the profound socio-spatial exclusion of persons with albinism. In light of the aspects mentioned above, this work contributes to exploring and demonstrating the role of various architectural and planning interventions required to include the unique needs of PWA in architectural and planning endeavours. This project aimed to facilitate PWA with various learning and entertainment facilities and provide a platform for interaction and capacity building. It included a state-of-the-art research facility for doctors, scientists and

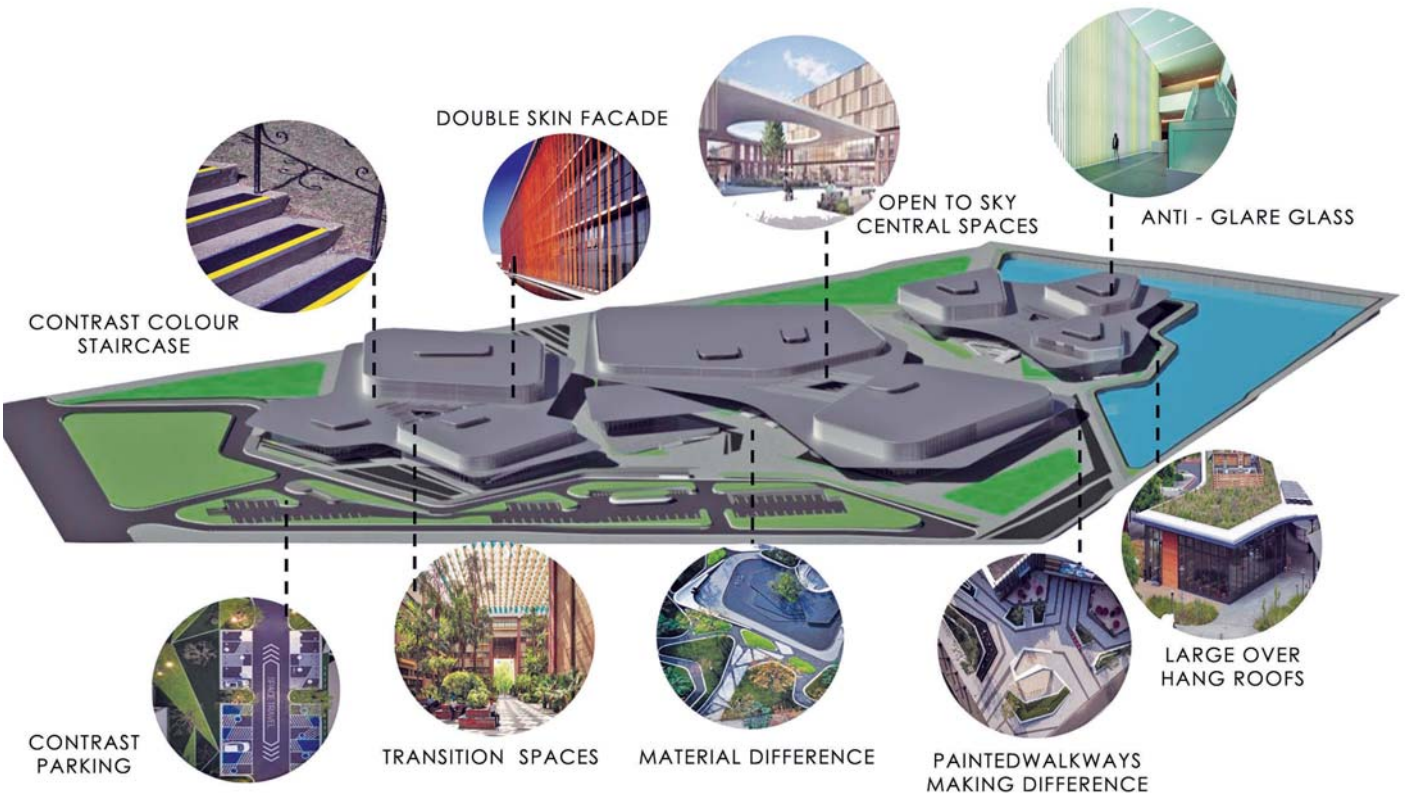

Figure 8: Design Features
Source: Author, 2024

Figure 9: Administrative Block
Source: Author, 2024

Figure 10: Facilitation Centre
Source: Author, 2024

researchers from all over the world. The proposed design aims to cater to the physical and socio-spatial aspirations of PWA. It is the need of the day to provide this marginalised cohort with equal opportunity to get equitable education, a good work environment and assistance in accessing and using public spaces.

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STUDENT WORK

AUGMENTED REALITY FOR ENHANCED USER EXPERIENCE

By Kshruti Shukla and Ar. Archana Singh Rathore

1. INTRODUCTION

'Augmented Reality' (AR) is a technology that blends virtual objects with the real world, enabling them to communicate with each other. Augmented reality provides a three-dimensional understanding, and this study is crucial in helping the reader comprehend and discover new insights into the world. Visitors' characteristics and interactions appear to influence fatigue levels. As a result, this study highlights the importance of visitors' interactions with the information and how much they retain the information and experience. Currently the rich data used to guide decisions and actions, is confined to two-dimensional pages and displays.

This article aims to quantify the enhanced learning outcomes for users exposed to augmented reality displays compared to traditional methods. It also seeks to provide a brief understanding of visual comfort and spatial design in this context. The objectives of the study are as follows:

1. To understand the concept of augmented reality, past development, and present capabilities.
2. To study installation methods and applications of augmented reality through literature study and experiment.
3. To compare augmented reality and conventional methods to analyse the effects on user experience.
4. To develop guidelines and recommendations for augmented reality installation in spatial design.

1.1 AUGMENTED REALITY

The technology known as augmented reality blends virtual objects with the real world and allows them to interact with each other. Despite the widespread use of augmented reality applications, the field of education stands out as the most significant. The goal is to examine how AR technology provides a more effective approach to supporting learning and to explore how technological advancements can improve educational methods.

Using augmented reality, users can receive more information or have natural environments aesthetically altered in some way. The main advantage of augmented reality is that it successfully combines digital and three-dimensional (3D) elements with how people perceive the real world. AR has several applications, from entertainment to aiding in decision-making.

Through a device like a smart phone or glasses, augmented reality provides the user with visual elements, sound, and other sensory information. The device layers digital information onto itself to create a seamless experience that modifies the user's view of the actual environment. The superimposed information may conceal or enhance a portion of the natural world.

1.2 DIFFERENCE BETWEEN AUGMENTED REALITY / VIRTUAL REALITY / MIXED REALITY

- *Virtual reality (VR)* offers complete immersion, blocking out the physical world using devices like the HTC Vive or Oculus Rift. VR transports

users to real or imagined environments, allowing them to experience scenarios such as a penguin colony or riding on a dragon.

- *Mixed Reality (MR)* combines elements of both AR and VR, allowing interaction between real-world and digital objects. Emerging technologies like Microsoft's Holo Lens showcase early examples of mixed reality experiences.
- *Extended Reality (XR)* encompasses technologies enhancing senses, including virtual reality, augmented reality, and mixed reality. Extended reality creates both realistic and simulated worlds for users.
- *Augmented reality (AR)* integrates digital elements into a live view, often through smartphone cameras. Examples include Snapchat lenses and Pokémon Go. AR enhances various fields, with a significant impact on education, by combining real and virtual information to boost student interaction and facilitate learning. For instance, digital tours to distant museums, led by a teacher, provide immersive learning experiences.

1.3 EQUIPMENT OF AUGMENTED REALITY

- *Head-mounted displays:* Wearing a head-mounted device (HMD) on the head or helmet allows for remote experiences and image enhancement. Video-see-through devices with small displays in front of the eyes overlay computer-generated scenes on the real world using a slanted, semi-transparent mirror.
- *Pinch Gloves:* Using a pinching motion to grab a virtual object provides an accurate and cost-effective method of identifying natural gestures.
- *Handheld Displays:* Devices that use video-see-through methods to overlay visuals on the actual surroundings. These are portable computers that the user may hold in their hands and have a display, as shown in Figure 1.

Figure 1: Early stages of head mounted display, Pinch glove for gesture control and Handheld displays
Source: Researchgate

1.4 APPLICATION OF AUGMENTED REALITY

- Health: AR can assist medical professionals in their capabilities to diagnose, in the treatment, and performing surgery on their critical patients more precisely.
- Marketing: AR marketing enables advertisers to add a personal touch to mobile apps and other materials content.
- Education: AR technology, teachers can materialize abstract concepts to help students visualizeand understand challenging subjects.
- Automotive: Driver can receive visual information about the environment, traffic conditions, and navigation through the windscreen.
- Tourism: A regular tourist map can come alive with AR technology allowing guests to see places of interest, restaurants, bars and more.
- Art and museums: The most straightforward way is to use it to add explanations of pieces. This means visitors get more information when they view exhibitions using AR.
- Cinema: AR is still in its early stages in cinema, but its potential to revolutionize storytelling and audience engagement is vast.

2. EXPERIMENT

The experiment explored AR's potential to enhance conventional methods by introducing an innovative and interactive approach to exhibit presentation. This study seeks to provide valuable insights into the integration of AR technology for enriched educational and immersive experiences, appealing to both architecture enthusiasts and the public. To understand the effect of augmented reality following framework was adopted as shown in Figure 2.

Figure 2: Frame work for data collection and analysis of user experience
Source: Author

2.1 SAMPLING FOR EXPERIMENT

A sample frame of 25 individuals was selected, encompassing age groups of 5–19 years, 20–40 years, and over 41 years, to mitigate potential biases related to technical knowledge. Participants were drawn from diverse age groups and professional backgrounds to ensure a comprehensive analysis. All participants were confirmed to be in good health, with no physical or mental impairments.

2.2 FRAMEWORK OF EXPERIMENT

The study selected a diverse cohort of architecture students and individuals from various backgrounds to investigate the impact of augmented reality (AR) on

enhancing the user experience. Initially, participants engaged with traditional displays adhering to conventional layouts. Subsequently, the group transitioned to an augmented reality environment, wherein basic AR technology transformed the exhibit presentation. This sequential exposure aimed to evaluate participant reactions and engagement levels in both traditional and AR-enhanced settings where equipment used and participation of crowd is shown in Figure 3.

Figure 3: Documentation of experiment setup, equipment used and user participation
Source: Author

2.2.1 Experiment Procedure: Evaluating the Effect of Augmented Reality on User Experience

The purpose is to investigate the impact of augmented reality on user experience compared to conventional display methods across different categories: science, history, and automobiles.

The experiment was structured into two distinct experiential zones: Part A, which focused on traditional display methods, and Part B, which involved augmented reality integrated methods. Each part of the experiment was further divided into four stages, allowing for a comprehensive comparison between the conventional and AR-enhanced learning approaches.

Stage 1: Entrance Interface

- *Setup A:* A large board display with lights that read 'Welcome to the display.'
- *Purpose A:* To create an initial impression and introduce the content.
- *Setup B:* An interactive moving figure that explains the content people will experience inside.
- *Purpose B:* To create an engaging initial impression and introduce the content interactively.

Stage 2: Science Observation

- *Setup A:* A text board accompanied by a model of a bird.
- *Purpose A:* To observe the bird and its colours using conventional methods.
- *Setup B:* A holographic display with supporting audio, presenting a three-dimensional image of the bird.
- *Purpose B:* To observe the bird and its colours with a more immersive and detailed representation.

Stage 3: Historical Exploration

- *Setup A:* Basic audio narration accompanied by text describing historical content.
- *Purpose A:* To understand historical events and contexts through traditional means.
- *Setup B:* An augmented reality app that provides fully immersive and interactive 3D spaces, accessible via headsets and mobile displays.
- *Purpose B:* To understand the size, context, and details of historical events in a more interactive manner.

Stage 4: Automobile Exploration

- *Setup A:* A car advertisement brochure.
- *Purpose A:* To explore and understand automobile features and advertisements.
- *Setup B:* A phonic live-sized model of a car, allowing users to move and inspect the vehicle interactively.
- *Purpose B:* To explore and understand automobile features in a more dynamic and realistic setting.

2.2.2 Observations and Results:

- Participants were observed for their engagement, retention of details, and overall experience.
- It was noted that they remembered more details and had a more favourable overall experience with augmented reality (AR) integration.
- The AR methods resulted in more specific knowledge and a deeper understanding of the displayed content compared to traditional methods.

3. DETAILED ANALYSIS BAISED ON KRIKPATRICK'S MODEL

The Kirkpatrick Model is a widely recognized framework for evaluating training and learning programs, is a level 4 of evaluation. It assesses both formal and informal training methods using four criteria: reaction, learning, behavior, and results. This model provides a comprehensive approach to measuring the effectiveness of educational interventions.

3.1 REACTION LEVEL 1

Reaction, the first level of criteria, measures how interesting, favorable, and applicable the technology is to learners.

An emphasis on the user as opposed to the technology is a key element of Level 1 analysis. Although it would seem natural for a facilitator to focus on the learning outcome (such as the course material or learning environment), the Kirkpatrick Model supports survey questions that are more concerned with the learner's takeaways.

3.1.1 Task completion rate

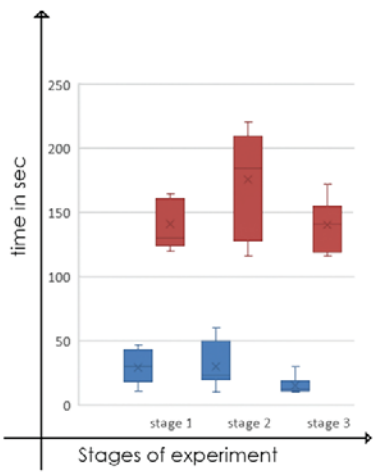
Also known as "task success rate," It is easiest to measure the completion rate for defined tasks that have a clear start and end. The subject was required to finish a task u with and without AR display and time was noted down as shown in Figure 4.

Condition	Time	Ease of task	Accuracy
Freehand	4:30 ± 30 sec	45%	55-65%
AR app	2:30 +_30 sec	55%	60-80%

Figure 4: Showing readings of task completion rate, level-1 assessment of Kirkpatrick's model
Source: Author

3.1.2 Average time on task

The box and whisker plots, representing comparative data across three stages for all users in two different experiential zones, reveal how long a user takes to complete a specific task. In this article, spending more time on a task is indicative of more engaging and interesting content, as shown in Figure 5.



Stages	Conventional	AR Integrated
Stage 1	15	120
Stage 1	21	130
Stage 1	30	125
Stage 1	47	127
Stage 1	11	123
Stage 1	25	157
Stage 1	30	160
Stage 1	40	162
Stage 1	47	165
Stage 2	20	116
Stage 2	60	128
Stage 2	23	173
Stage 2	26	210
Stage 2	10	197
Stage 2	21	185
Stage 2	50	221
Stage 3	10	120
Stage 3	11	150
Stage 3	30	116
Stage 3	15	148
Stage 3	12	135
Stage 3	13	172

Figure 5: Showing readings of Average time on task, level-1 assessment of Kirkpatrick's model using box and whisker plot
Source: Author

3.2 LEARNING LEVEL 2

Level 2 evaluates each participant's learning by assessing whether they develop the desired attitudes, knowledge, abilities, and commitment to the content. Pre- and post-assessments should be used to determine accuracy and comprehension, which can be evaluated both formally and informally. The retention value and recall value was recorded, as shown in Figure 6, provides further insights.

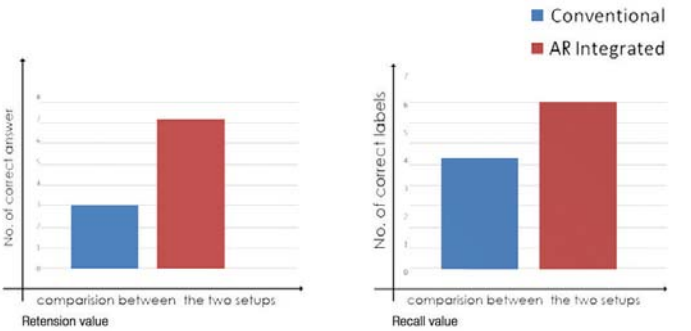


Figure 6: Showing readings of retention value and recall value, level-2 assessment of Kirkpatrick's model using bar graph
Source: Author

3.3 BEHAVIORAL LEVEL 3

The Kirkpatrick Model's Level 3 assesses whether the learning had an impact on the participants and whether they are applying what they have learned. It is one of the most important processes. By evaluating behavioral changes, it is feasible to determine the understanding of skills and their practical application in the job.Evaluating conduct frequently reveals problems in the workplace. Lack of behavioral change may not indicate inadequate training, but rather that the organization's current procedures and cultural contexts do not support the best conditions for learning the intended change.

3.3.1 Adoption Rate

This provides insight into how quickly your product is growing or how many customers are trying out a new feature. Experts predict that AR/VR will achieve mass adoption in the next five years, despite numerous challenges still to overcome. These technologies have the potential to revolutionize new markets and provide impressive applications in enterprise settings. AR/VR will be developed for personal, consumer, and enterprise use. The increased demand of AR equipment's is depicted in Figure 7. This study does not analyse the adoption rate of AR/VR equipment because the experiment lasted only one day.

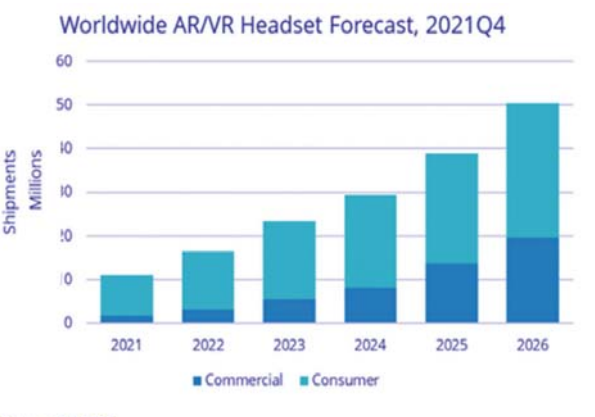


Figure 7: Bar graph showing adoption rate of expected increase in AR equipment, level-3 assessment of Kirkpatrick's mode
Source: IDC 2022

3.3.2 Net Promoter Score (NPS)

The Net Promoter Score (NPS) measures user experience on a scale of one to ten, ranging from "not at all likely" to "extremely likely." This score indicates not only whether a user intends to continue using the product but also if they are satisfied enough to promote it on their own which was measured by using Likert scale. The findings of the survey are shown in Figure 8.

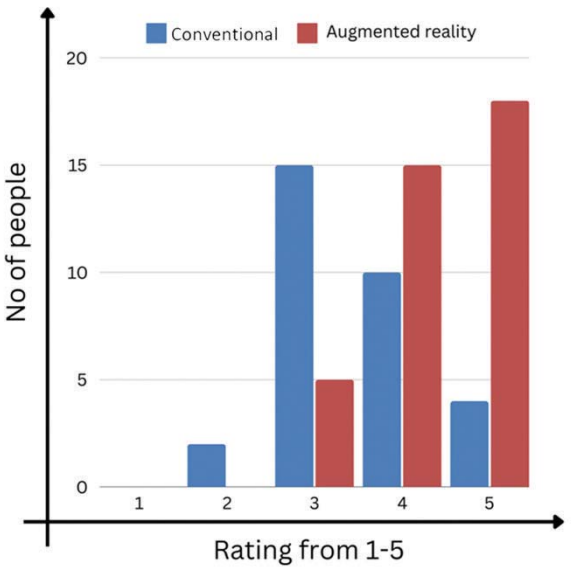


Figure 8: Bar graph showing Net Promoter Score, level-3 assessment of Kirkpatrick's model using Likert scale
Source: Author

3.4 RESULT LEVEL 4

The fourth and final level, Level 4, focuses on measuring direct results. This level compares the learning outcomes to the organization's business results, known as Key Performance Indicators (KPIs), which were defined before the learning began. The analysis of the KPIs used in the survey is shown in Figure 9.

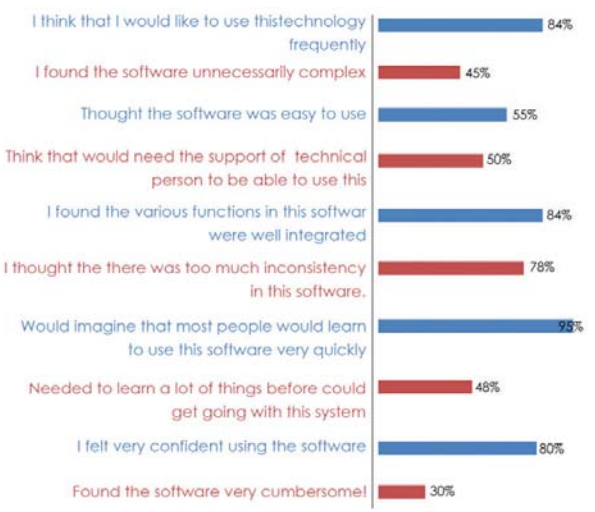


Figure 9: Bar graphs showing agree and disagree statement as result, level-4 assessment of Kirkpatrick's model
Source: Author

1. It reveals that while 82% of people use augmented reality, less than 90% are aware of it. (source -primary data)
2. Task completion accuracy improves with AR.
3. The study shows that time spent on AR content is 2-3 times longer compared to traditional learning.
4. Some educational programs, such as Biju's, make extensive use of AR to facilitate learning.
5. Age groups ranging from 6 to 25 years old and 45 years and above show higher receptiveness to this technology.
6. Based on the survey sample, experts predict that this technology will be integrated into our daily lives in 4-5 years.
7. 60% of people strongly support AR technology, finding its interface user-friendly and engaging.

4. CONCLUSIONS

The experiment concluded that augmented reality significantly enhances user experience by providing more interactive, immersive, and detailed representations of content, leading to improved retention, and understanding.

AR significantly increases user engagement by creating interactive and immersive environments. Participants exposed to AR displays demonstrated better retention and recall of details, facilitating a deeper understanding of complex subjects. The positive effects of AR were consistent across different categories, including science, history, and automobiles, demonstrating AR's versatility and potential to enhance user experience in a wide range of fields. As a result, AR represents a valuable tool for enhancing educational and informational displays, making it a superior alternative to conventional methods in many contexts.

5. RECOMMENDATIONS

To optimize the user experience with augmented reality, a comparative analysis of AR-integrated architectural practices versus conventional methods has identified critical factors that require attention, as shown in Figure 10.

1. Managing visual fatigue
2. Optimizing Viewing Distance
3. Adjusting the degree of visual angle
4. Controlling Depth of Field and Blur
5. Managing Illumination

By implementing these recommendations, the overall user experience with augmented reality can be significantly enhanced, leading to more effective and enjoyable interactions.

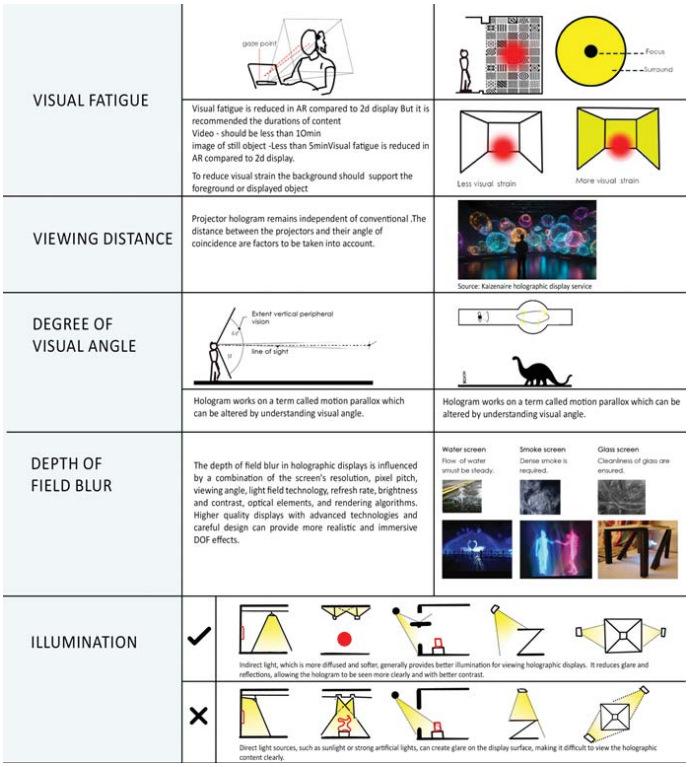


Figure 10: Graphic showing factors to optimize the user experience with augmented reality
Source: Author

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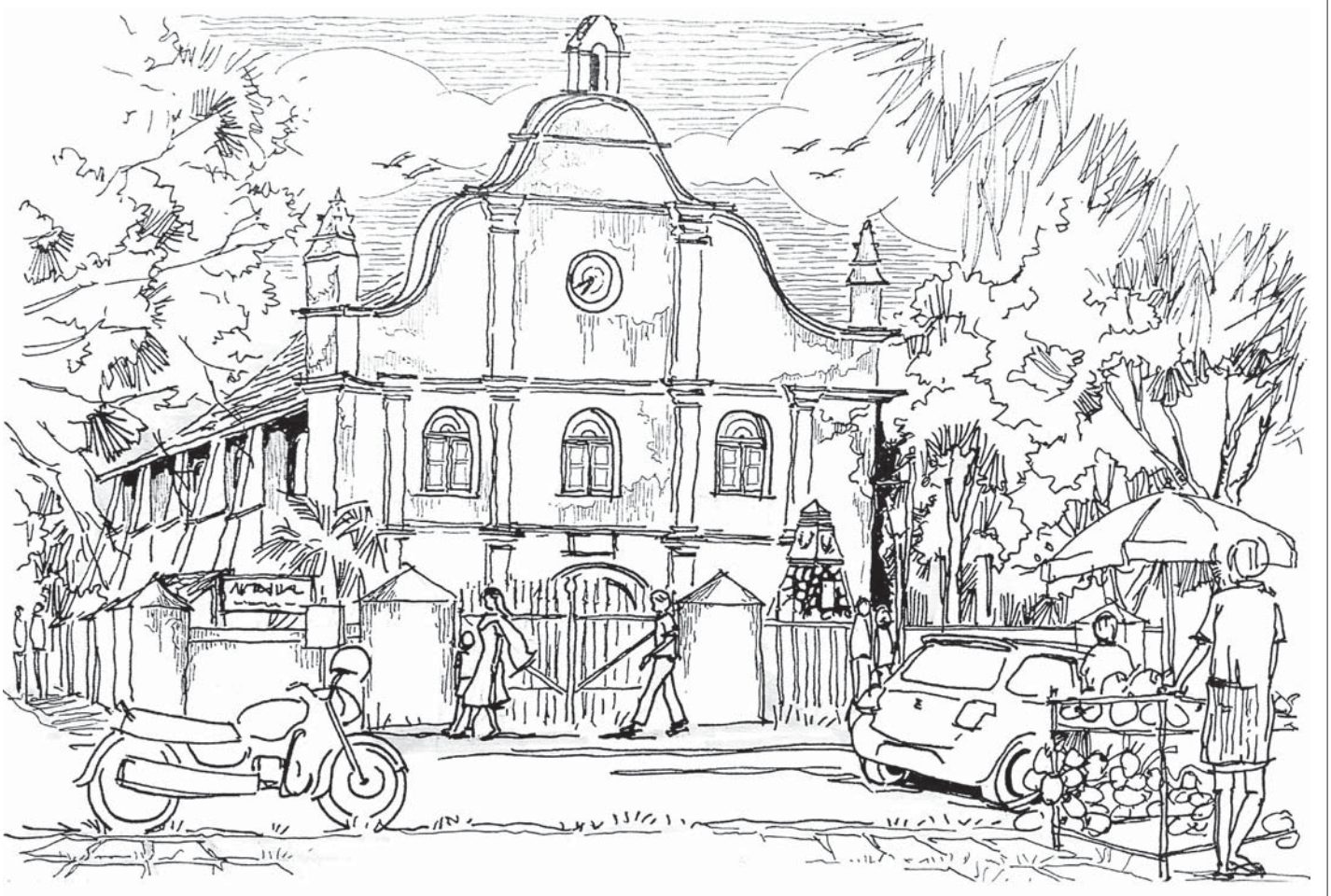
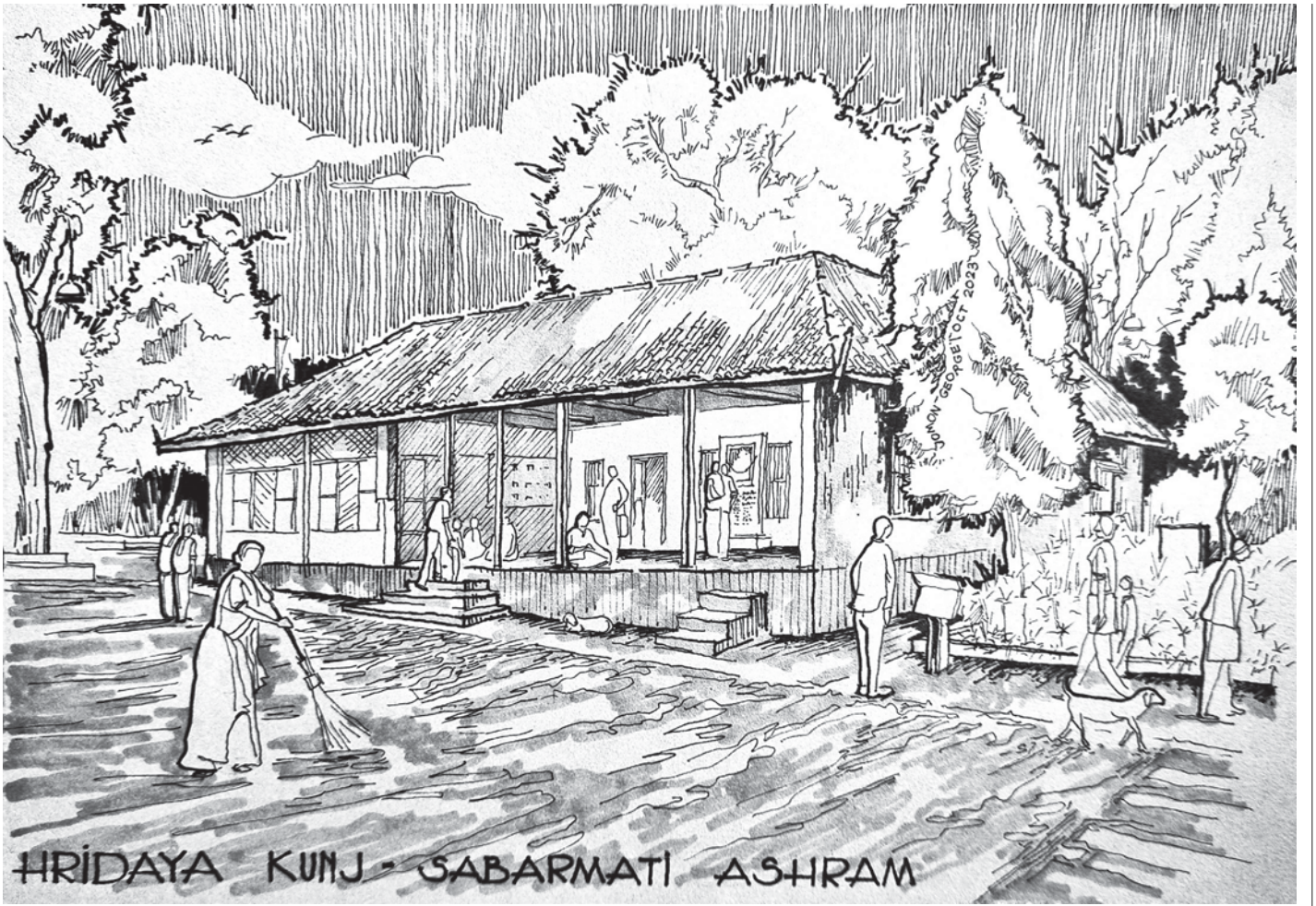
Sketching
A Journey of Continuous Evolution

By Ar. Jomon George

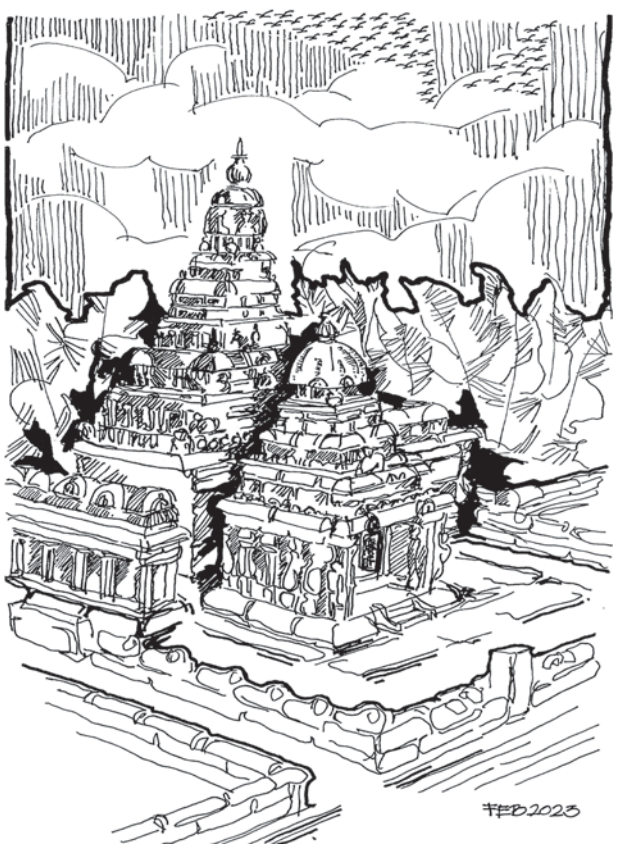
Sketching has been my passion since early school days. This creative pursuit has consistently driven me to observe my surroundings more closely, reminding me to continually refine my observational and cognitive skills. I am dedicated to enhancing these abilities and I believe that this journey of improvement is a lifelong process. During my school days, I began my artistic journey with pencil drawings, watercolours and cartoons. As I progressed, I found myself increasingly drawn to the pen and ink medium. These skills not only allowed me to depict what I observed in nature and from my imagination but also enabled me to create and interpret various forms.



Saint Francis Church, Fort Kochi



Hridaya Kunj in Sabarmati Ashram, Ahmedabad



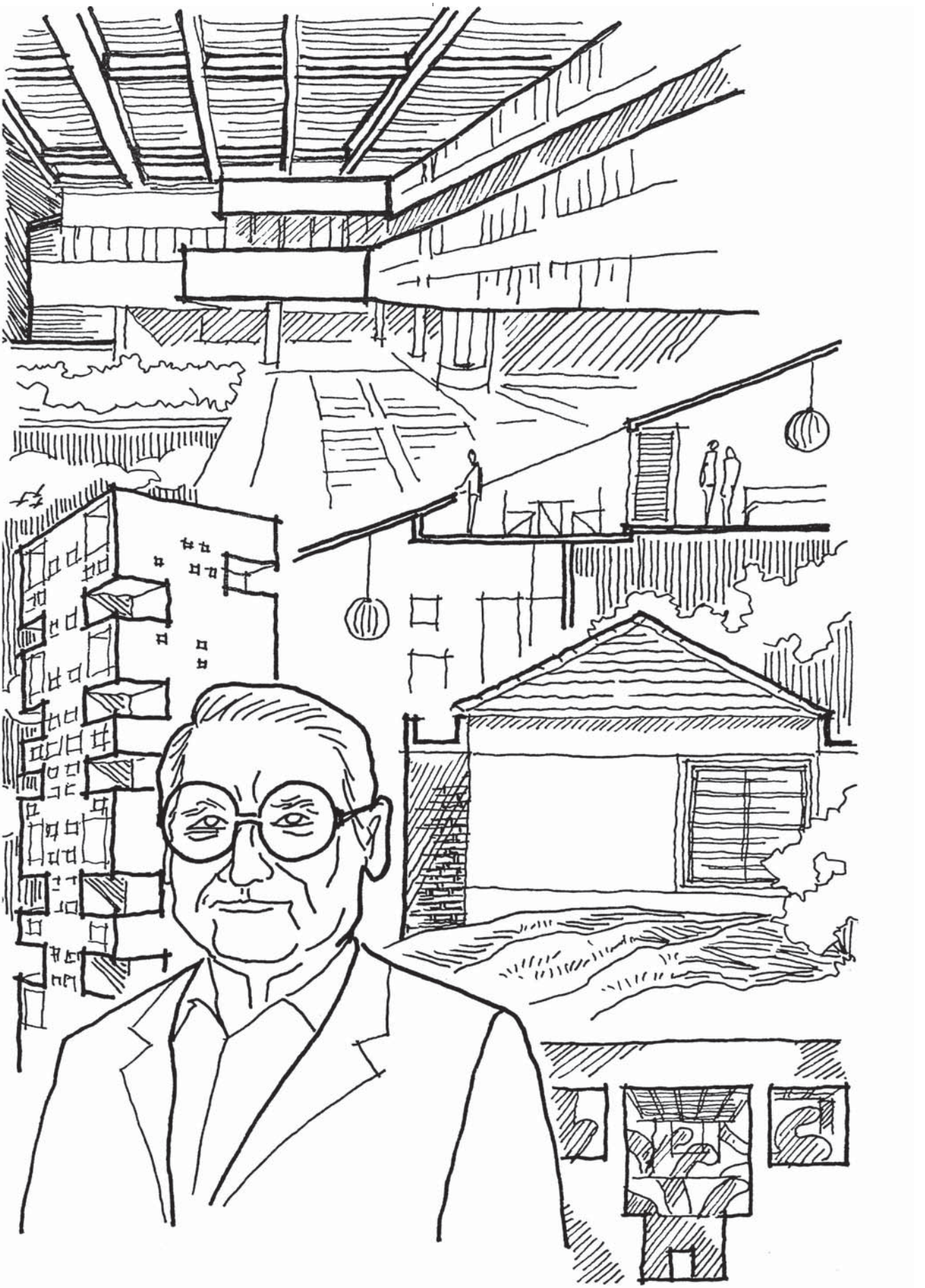
Shore Temple, Mahabalipuram

Sacred Heart Basilica, Pondicherry

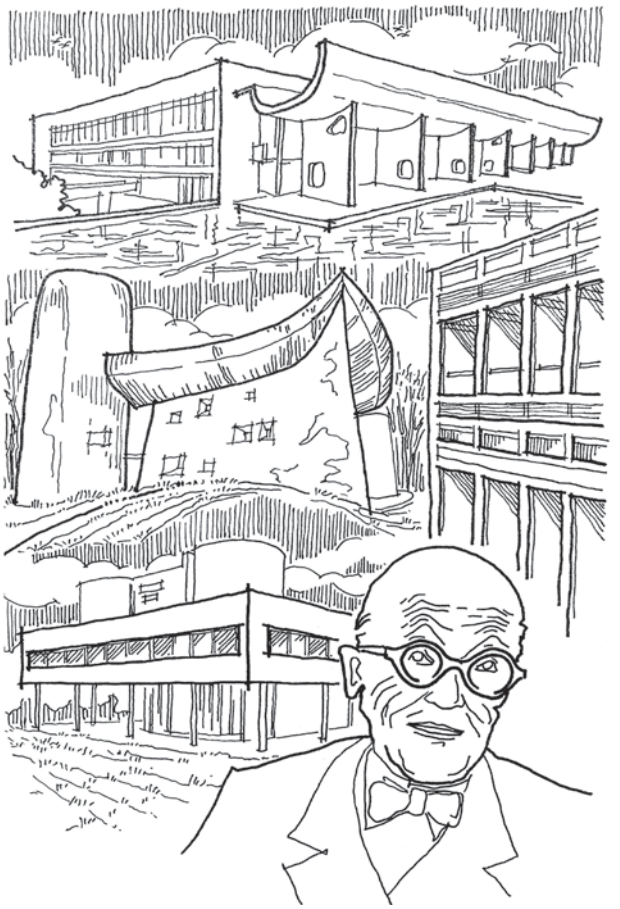
Doors and windows of French Colony, Pondicherry

A street in Fort Kochi

Manek Chowk, Ahmedabad



Works of Charles Correa



Works of Le Corbusier

As my journey evolved, my thoughts and interests began to shift towards human habitats, guiding me towards a career in architecture. My education and practice in architecture further honed my skills and I continued sketching with a renewed focus on architectural and urban subjects. Today, I concentrate primarily on the pen and ink medium, capturing my observations of buildings, architectural elements, streets and urban spaces. The sketches presented here represent my ongoing journey to improve my skills and deepen my understanding of the built environment.

All Images Courtesy: Author

Ar. Jomon George (A19983), a practicing architect and educator with over a decade of experience, holds a B.Arch. degree from the College of Engineering, Trivandrum, and a Masters in Project Management from Alagappa University, Karaikudi. He has contributed to diverse projects in Kerala and currently teaches at the CEPT Foundation Program, CEPT University.
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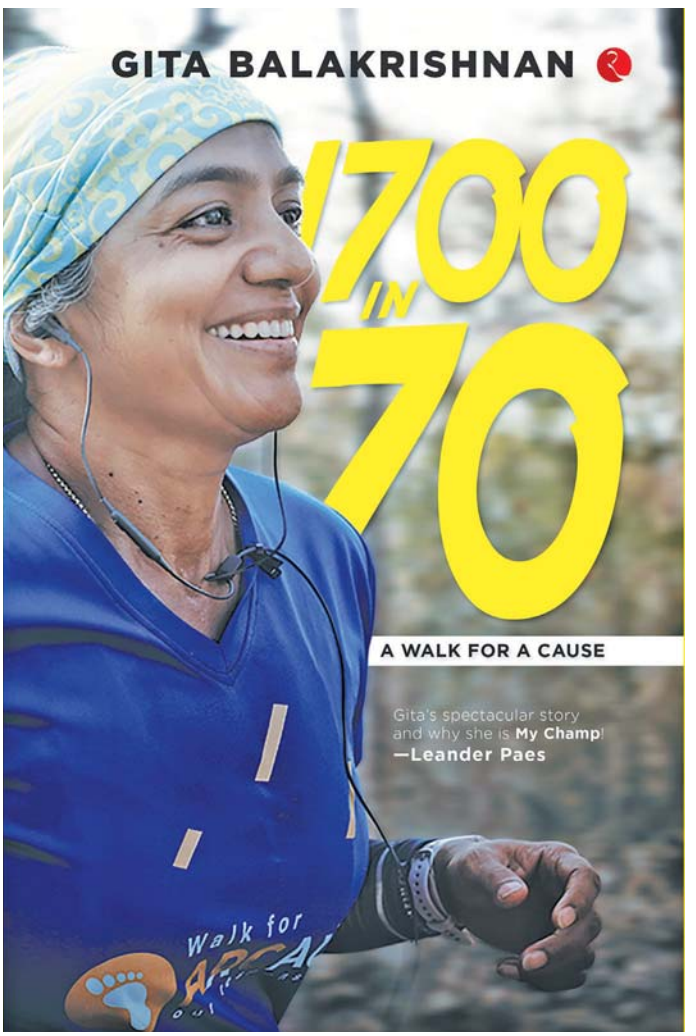
BOOK REVIEW

1700 in 70: A Walk for a Cause

Wandering many steps, weaving many conversations

Author: Ar. Gita Balakrishnan
Reviewer: Ar. Vijay Narnapatti



1700 in 70: A Walk for a Cause: book cover

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Language: English
Publisher: Rupa Publication India Pvt. Ltd
No of pages: 204
Year of publication: 2024

A little bird told me that her journeys are quests for the soul. So is Gita's Walk across 1700 kms. She writes a touching travelogue of her soulful journey. It is a deeply inspiring account of a voyage shaped by a quest for discovery along with a zest to bring design to the masses. A fabric of many colours and threads has been woven along the length of this journey. Gita makes this passage from her city, Kolkata to Delhi, winding through West Bengal, Jharkhand, Madhya Pradesh, Uttar Pradesh, Rajasthan and Haryana, through the many landscapes of culture, terrain, people and territories. She chooses to walk and run the distance so that the slow pace of the journey allows her to meet, see and share things intimately and immediately. She writes lyrically - *Walk, and you shall see. Walk, and you shall hear. Walk, and you shall smell. Walk, and you shall feel. Walk, and you shall do.*

She has written with a gait that shifts gently between prose and poetry, making sense of each part of the journey. While it had to be well planned, carefully organised with an immensely collaborative effort, it was shaped to meet people who she never knew or may never meet again and experience things that were uniquely of that time and place. This idea resonates through the book. She was able to meet all those 'show stoppers' like Sunita Devi, a social worker, a crusader and a woman mason who builds toilets that so many women lack and need in rural India; the Mahua tree, that is a veritable medicine repository, locally known for cures for various diseases from diabetes to dental problems, as well as a cure for sobriety in its locally home-brewed form; the children with a sparkle in their eyes at the local ASHA (Association for Social and Human Awareness), an NGO in Namkum, Ranchi which works with the

wards of brick kiln workers. Each of these stories makes the planned or accidental meetings deeply resonant. They capture the spirit of adventure of this journey - making this a search for humanity, sharing and learning.

Gita begins by telling us her story, of who she is and what the path of life has given her. She narrates her close call with death and assault, that shook her faith. This gave her a deep determination to do things her way, to push herself and societal boundaries to carve her own path. Overcoming early traumatic experiences, Gita gets her architecture degree and goes onto chart an unusual practice in the field with student centred engagements outside academia, more so through her organisation, Ethos - a learning and student engagement platform in the field of architecture and design. This made her realise that the field tended to be more inward looking, with a very small percentage of the people knowing of and benefitting from design. Extending her past experience in rural and slum development projects and her yearning for outreach in design, Gita designed this walk to "throw light upon the power of design - something grossly undervalued by the common people, the government and the society at large." Walking the 1700 kms seems to have reinvigorated her zest and shaped many new ideas, possibilities and collaborations.

The extraordinary is hiding in plain sight behind the veil of the ordinary. We just need to find it. Gita's more convinced that if architects and designers allow for engagement with the larger, rural and small-town India, away from the buzz of mega cities, they will find new spirit and collaborations with those who most need design thinking help but have large hearts and larger canvases. It is a two-way street when we engage with them - a lot to learn from the local knowledge about ecology, craft and culture while they need assistance to nudge and evolve their dwellings and habitat into better modern places to live in their contexts. This is a powerful idea that can change the world.

Gita narrates her journey in 33 short chapters and adds a wonderful 34th chapter, with yet another walk. This time, it is from Kolkata to Dhaka, a walk across the border that separates the land of the Bangla. There will be more walks and stories she will want to tell. But this first one, from Kolkata to Delhi, will always be the first in a new stage, a solo performance that is affectionately supported by a close production team with a deeply supportive family and many many collaborators. We all live many lives in one and Gita makes her life joyful yet meaningful with a hop skip and jump because of who she is and how she chooses to live her life.

Author

Ar. Gita Balakrishnan (F8633), a graduate of the School of Planning and Architecture, New Delhi, completed practical training at the Centre for Building Performance and Diagnostics at Carnegie Mellon University, Pittsburgh, USA. She is the founder of Ethos and has recently completed her fourth journey on foot from Chennai to Bengaluru to build empathy for the cause of Universal Design and Accessibility. She has won several awards for her outstanding contribution to the field of Architecture.
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Reviewer

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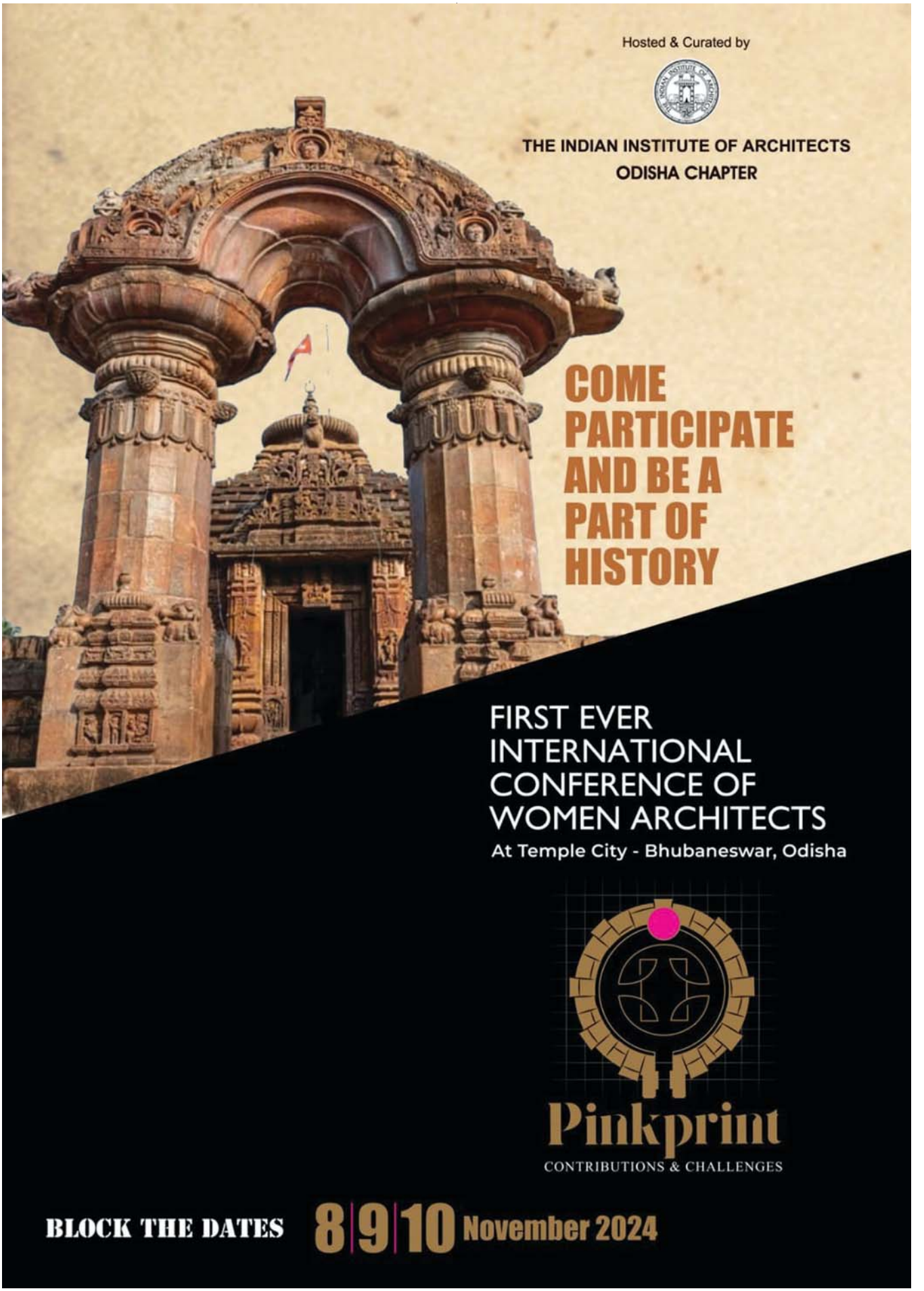
Contributions and Challenges

Welcome to the International Women's Architects Conference, proudly organized by the IIA Odisha Chapter. This year, our conference is dedicated to celebrating and exploring the multifaceted contributions and unique challenges faced by women in the field of architecture. This Conference will provide a platform for thought-provoking discussions, insightful presentations, and inspiring stories from women who are redefining the architectural landscape.

The IIA Odisha Chapter invites you to join us in this enlightening journey, where we aim to empower women architects, celebrate their contributions, and address the challenges they face. Together, we will pave the way for a future where architecture is enriched by the diversity and innovation brought forth by women in the field.

We look forward to your participation and the vibrant discussions that will undoubtedly shape the future of architecture.

Track 1: Back to Roots	**Track 4: The Frontline**
This track focuses on exploring the cultural identity of various geographical regions and the contemporary impacts on these identities. It delves into the amalgamation of new construction techniques with culture, tradition, and religious beliefs, aiming to create a unique blend of cultural heritage and contemporary architecture. The discussion will centre on how architects can respect and incorporate cultural diversity while innovating within the field. *Subtrack 1: Cultural Identity of Various Geographical Regions* *Subtrack 2: Contemporary Impacts on Cultural Identity* *Subtrack 3: Amalgamation of New Construction Techniques with Culture, Tradition, and Religious Beliefs* *Subtrack4: Creating a Unique Blend of Culture and Contemporary Architecture*	Focusing on women who are entrepreneurs, businesswomen, and startup founders, this track discusses the challenges faced by women entrepreneurs in the frontline. It explores whether the field is an equal playground in present times, the way forward, and shares stories of women entrepreneurs who have significantly impacted the field. *Subtrack 1: Women Entrepreneurs in Architecture* *Subtrack 2: Challenges Faced by Women Entrepreneurs* Subtrack 3: Is the Field an Equal Playground? Subtrack 4: The Way Forward for Women in the Frontline Subtrack 5: Impactful Stories of Women Entrepreneurs
Track 2: Her Identity	**Track 5: Beyond Architecture**
This track highlights the role of women in architecture, showcasing the challenges and success stories of iconic women in the field. It examines the balancing act played by women between their social and professional lives and discusses the way forward for female architects. *Subtrack 1: The Role of Women in Architecture* *Subtrack 2: Challenges and Success Stories of Iconic Women* *Subtrack 3: Balancing Social and Professional Lives* *Subtrack 4: The Way Forward for Female Architects*	This track opens the discussion on the diverse opportunities available to architects beyond traditional architectural practice, such as product design, interior design, and project management. It examines the challenges of thinking beyond architecture and how these opportunities can broaden the scope for architects. *Subtrack 1: Diverse Opportunities for Architects* *Subtrack 2: Challenges of Expanding Beyond Traditional Practice* *Subtrack 3: Product Design, Interior Design, and Project Management* *Subtrack 4: Broadened Scope for Architects*
Track 3: Think Tanks - Redefining Pedagogy	**Track 6: Transitioning to Future**
As the field of architecture evolves with the advent of AI, parametric design, and smart technologies, this track addresses the preparedness of upcoming architects for these changes. It questions whether architectural pedagogy is obsolete and explores the necessary changes to make it progressive and unique. The importance of research and the introduction of fresh thought processes are emphasized. *Subtrack 1: Impact of AI and Smart Technologies in Architecture* *Subtrack 2: Preparedness of Upcoming Architects for Technological Changes* *Subtrack 3: Is Architectural Pedagogy Obsolete?* *Subtrack 4: Necessary Changes in Architectural Education* *Subtrack 5: Importance of Research and Fresh Thought Processes*	In our final track, we explore how architects are adopting new technologies and whether they are stuck in obsolete methodologies. Discussions focus on the role of digitization in improving practice, the potential limitations of creativity due to technology, and whether architecture might become a subset of IT in the future. Topics like AI, the multiverse, and automation are also addressed. *Subtrack 1: Adoption of New Technologies in Architecture* *Subtrack 2: Obsolete Methodologies vs. Digitization* *Subtrack 3: Creativity and Technology: A Balance* *Subtrack 4: Future of Architecture and IT Integration* *Subtrack 5: Discussions on AI, Multiverse, and Automation*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Restoration of Sports Complex Reservation IIA Navi Mumbai Centre

Information on Restoration of Sports Complex Reservation for Development of International Standard Integrated State of Art Sports Complex on 78 acres plot reserved for Konkan Division Sports Complex at Ghansoli, Navi Mumbai. PIL 28 of 2019 was filed by Indian Institute of Architect, Navi Mumbai Centre (IIA, NM) for restoration of Sports Complex Reservation at Sector 12 and 12A, Ghansoli, Navi Mumbai and The High Court Order dt.01/07/2024 in restoration of Sports Complex Reservation at Ghansoli, Navi Mumbai.

[Note: This news is in continuation of the PIL News on p.82 of JIIA June 2024]

1. With the Economic Development of the Nation, Sports Infrastructure Development is very essential for Healthy Growth of the Society as whole. This will make young generation healthy physically and mentally, dynamic and protected from addiction. This will also reduce budgetary burden on Health Care Infrastructure.

2. As per Government Order dt.29/07/2008 under Maharashtra Regional and Town Planning Act, (MRTP Act) 1966, Navi Mumbai Municipal Corporation is authorised to act as Local Planning Authority for Ghansoli Node and CIDCO was ceased of powers of Planning Authority from that date. As per Maharashtra Sports Infrastructure Development Plan Policy, 2001 and G.R. dt.26/03/2003 and as per CIDCO internal noting in 2003 and NMMC General Body Resolution in September, 2013 with 37(1) modification procedure completed by Navi Mumbai Municipal Corporation as Local Planning Authority and forwarded the proposal to U.D. Government of Maharashtra for approval in June 2014 and accordingly, 78 acres plot is reserved for Sports Complex. NMMC appointed Architect M/s. Shivaji Patil and Associates in April 2012 for Planning and Development of NMMC Sports Complex at Ghansoli, Navi Mumbai. Out of 78 acres reserved for Sports Complex 36 acres plot is allotted to Navi Mumbai Municipal Corporation in September 2013 and 42 acres plot is reserved for extension of Government of Maharashtra Sports Complex remain un-allotted due to cost issue created by CIDCO even though as per GR dated 24/02/2003 Public Sports Complex Plot is to be allotted free of cost. .

3. In July 2012, regarding development of Sports Facilities in Navi Mumbai, NMMC had given presentation to Then Guardian Minister Shri Ganesh Naik in presence of then Mayor, then M.P., and then MLA along with then Municipal Commissioner and then City Engineer. For development of Sports Complex at Ghansoli, Navi Mumbai. Shri Ganesh Naik stated that 36 acres plot reserved for NMMC Sports Complex is very inadequate in comparisons with Balewadi Sports Complex at Pune on 128 acres and Indira Gandhi Sports Complex at New Delhi on 102 acres and further directed the Municipal Commissioner, Navi Mumbai Municipal Corporation to submit application to CIDCO and Urban Development Department for allotment of entire 78 acres plot to NMMC for Development of International Standard Integrated Sports Complex and also directed the Municipal Commissioner to prepare Integrated Project Plan for setting up State of Art Sports Complex on entire 78 acres plot at Ghansoli and by letter dt.31/07/2012 NMMC requested CIDCO and Urban Development Department Government of Maharashtra for allotment of 78 acres plot at Sector 12, 12A and 13, Ghansoli, Navi Mumbai reserved for Sports Complex. Accordingly Master Plan and detail plans of various stadiums and sports facilities of Sate of Art Sports Complex was prepared by appointed Architect M/s. Shivaji Patil and Associates. Out of which only 36 acres was allotted to Navi Mumbai Municipal Corporation in 2013 and Indoor Sports Complex building plans are approved in 2013 by Town Planning Department of NMMC. 86% NMMC Sports Complex Plot was affected by CRZ Notification 2011 and High Tide Line thereof. After presentation of Google Earth Images of 2003 showing manmade fishing ponds created in NMMC Sport Complex Plot and with presentation to Institute of Remote Sensing at ANNA University, Chennai, and presentation to Maharashtra Coastal Zone Management Authority (MCZMA) High Tide Line as per 2011 CRZ Notification was dropped

and High Tide Line as per 1991 CRZ Notification was considered and CRZ clearance was obtained in February 2015 but further development could not take place because of politics and non supportive role of CIDCO, Creator of New City.

4. As per Maharashtra Sports Infrastructure Development Plan Policy, 2001 and G. R. dt. 24/02/2003 State Government has directed to allot plots for public purpose Sports Complex at free of cost and also permitted 1/3 portion of Sports Complex plot to be utilized for Commercial use along with Club membership to generate funds to meet capital investment and maintenance cost of International Standard Integrated Sports Complex, without any monitory burden to Tax payers. In State Government approval letter dt.05/09/2007 approving CIDCO's New Land Pricing and Disposal Policy for Social Facility plots, it is clearly stated that policy regarding allotment and pricing of Social Facility plots to Government Department and Local Authority shall be decided by State Government whereas by G.R. dt.24/02/2003 Govt. has issued directions to allot Sports Complex Plot at Free of Cost and further permitted to utilize 1/3rd of the plot for Commercial exploitation to generate funds to meet capital expenditure and maintenance cost. This policy is not acceptable to CIDCO and wanted to charge exorbitant price for Public Sports Complex plot and that too only 0.10 FSI and no Commercial as envisaged in Sports Policy GR dated 24/02/2024. Due to which Sports Complex project is not developed for last 21 years.

5. As per Maharashtra Sports Infrastructure Development Plan Policy, 2001 by letter dt.29/08/2003 State Government has directed not to change playground reservation without prior approval of State Cabinet. Accordingly for Development of Dr. B. R. Ambedkar Memorial at Airoli, Navi Mumbai, CIDCO by letter dt. 21/09/2007 informed NMMC that, playground reservation cannot be change without prior approval of State Cabinet.

6. On Plot reserved for Government of Maharashtra Sports Complex, at Sector 12 and 12A Ghansoli, CIDCO illegally invited tender on dt.12.08.2016 to 30.08.2016 and on the day of opening the tender on dt. 01.09.2016, without approval of State Cabinet and NMMC-Local Planning Authority, CIDCO without authority in NMMC jurisdiction, had changed sports complex reservation on 42 acres plot in sector-12 and 12A to future development use without following any provision and procedure laid down in Section 37(1) of Maharashtra Regional andTown Planning Act 1966 (MRTP Act 1966) and Govt. also did not take objection. CIDCO illegally handed over 2.5 acres plot for residential use to the private builder at totally different location than tender lication, without inviting fresh tender, bang in middle of Sports Complex plot reserved for Government of Maharashtra Sports Complex shown in Tender Plan itself.

7. NMMC had declared intention on dt.14.12.2017 to prepare a Draft Development Plan as per provisions of MRTP Act 1966, for its jurisdiction and till 09.01.2019 the entire sector 12 and 12A about 42 acres was reserved for Sports Complex. But on dt.18/01/2019,15:58:47 CIDCO illegally and without any authority created New Ghansoli Node Land use Plan and without State Cabinet approval, Sports Complex reservation of sector 12 and 12A was change to future development use and inserted Residential plot bang in middle of Sports Complex plot. There after NMMC also illegally inserted Residential use plot (allotted to private builder) bang in middle of Sports Complex plot in Draft Development Plan and submitted the Draft Development Plan for General Body approval on dt. 11.02.2019.

8. To protect and Restore the International Level Integrated Sports Facility in Navi Mumbai, Indian Institute of Architect, Navi Mumbai Centre, (IIA NM), under the Chairmanship of Architect Shekhar Bagool and Secretary Architect Kaushal Jadia, decided to submit a Representation to CIDCO, Urban Development Department and Chief Minister, Government of Maharashtra and also Prime Minister of India in July - September 2018 but no action was taken by Government and CIDCO for Restoration of Sports Complex Reservation.

9. Thereafter, IIA NM took the help of IIA Fellow Member Senior Architect P.S. Govindrajan and IIA Fellow Member Senior Architect Shivaji Patil and Advocate Indrajeet Kulkarni and drafted the Public Interest Litigation and filed the same in Bombay High Court in January 2019 with PIL No. 28 of 2019. Since Architect Shivaji Patil and Associates was appointed in April 2012 for Development of NMMC Sports Complex at Ghansoli, as per Maharashtra Sports Infrastructure Development Plan Policies 2001 and 2012 and various sports G.R. issued there under, CIDCO record reserving Sports Complex Plot as per Sports Policy at Ghansoli, CIDCO's New Land Disposal and Pricing Policy for social facility plots, were readily available with Ar. Shivaji Patil and Associates which have strongly supported the PIL and various Rejoinders prepared by Architect Govindrajan and Architect Shivaji Patil and submitted in reply with CIDCO's and Government's false Affidavits against restoration of Sports Complex at Ghansoli, Navi Mumbai. Unfortunately CIDCO and Govt. were not supportive of Sports Facilities but auction the plots to builders and collect revenue and not bothered about meeting the requirement of Sports Facilities as per Maharashtra Sports Infrastructure Development Plan Policy 2001 and 2012.

10. Mr. Pradip Indulkar, then Sports Jt. Secretary, Sports Department, Government of Maharashtra, who formulated Maharashtra Sports Infrastructure Development Plan Policy 2001 and issued various Sports G.R. dt.24/02/2003 and G.R. dt. 26/03/2003

under his signature, after coming to know about PIL filed in restoration of Sports Complex at Navi Mumbai, he filed Intervention Application through his Advocate Nilima Sangalikar, in support of PIL 28 of 2019 and the Bombay High Court allowed him to file affidavit in January 2021.

11. After filing of PIL in Bombay High Court, for regularising illegal, malafide and pro private builder policy of CIDCO, State Government by G.R. dt. 26.03.2021 exactly after 18 years from dt. 26.03.2003, has shifted Konkan Devision Sports Complex from Ghansoli, Navi Mumbai, Dist.- Thane to remote village-Nanore, Taluka – Mangaon, Dist.- Raigad, 120 k.m. south of Navi Mumbai without any public notice and following procedure laid down under MRTP Act, 1966 for change of Social Facility Sports Complex reservation. Taking in to consideration exponential growth in Population of Mumbai Metropolitan Region and for public interest, the State Government G. R. needs to be set aside and restore the Sports Complex reservation at Ghansoli which is at the centre of entire Mumbai Metropolitan Region (MMR). G.R. for shifting of Sports Complex was challenged in Bombay High Court by the IIA, NM. Thereafter on dt.10/10/2022 the Bombay High Court granted stay order for any development on plot reserved for Govt. of Maharashtra Sports Complex and stay continued.

12. To support the illegal allotment and possession of social facility reserved plots to private builders by CIDCO, State Government has issued another illegal order dt.14.06.2021 to NMMC to grant building development permission to plots allotted by CIDCO even if it is shown under Social Facility Reservation in Draft Development Plan of NMMC. Which was challenged in Bombay High Court by IIA, NM.

13. To benefit CIDCO and private builders State Government issued another illegal order on dt.06.09.2021 to NMMC to delete all social facility reservation from Draft Development Plan of NMMC, having area more than 500 sq.mt. on land owned by CIDCO. As per Unified Development Control and Promotion Regulation-2020 the permissible built up area will be increased 3 times, due to which the population density will also be increased by 3 times and accordingly more social facilities plot should be reserved. Hence said Government Order dt. 06.09.2021 was challenged in Bombay High Court by the IIA, NM.

14. In November 2022, The Commissioner of Sports Submitted representation to the M.D. CIDCO for allotment of 42 acres of Govt. of Maharashtra Sports Complex Plot and accordingly Affidavit was filed in Bombay High Court by Deputy Director Sports, Mumbai, requesting allotment of 42 acres Sports Complex Plot.

15. The CIDCO and U.D. Government of Maharashtra made market valuation of Sports Complex plot at Rs. 2500 cores and argued that Sports Department or NMMC can purchase the Sports Complex Plot at Rs. 2500 crores. and accordingly filed various affidavits in the Bombay High Court for utilization of 42 acres Sports Complex Reserved Plot for Residential and Commercial purpose and shifting of Government Sports Complex at village- Nanore, Taluka- Mangoan, District- Raigad, 120 km away from Ghansoli, Navi Mumbai. Thereafter, Bombay High Court, by interim order issued in June -2023, directed the Government, CIDCO, Builder, NMMC and Petitioner IIA, NM to have amicable settlement in restoration/ shifting of Government of Maharashtra Sports Complex, Ghansoli, Navi Mumbai.

16. Thereafter two meetings were held in August-September 2023 for amicable settlement of PIL issue at Sachivalaya along with the Principal Secretary, Urban Development Department, Principal Secretary Sports Department, Commissioner of Sports, Pune, Municipal Commissioner NMMC, M.D. CIDCO, Builder and representative of IIA, NM. Government and CIDCO kept on insisting de-reservation and shifting of Sports Complex Plot and utilization of Sports Complex plot for Commercial and Residential purpose and to protect the private builder who was allotted Residential plot bang in the middle of Sports Complex plot for mear Rs. 63 crores whereas market price was around Rs. 300 crores i.e. Rs. Rs. 3.00 lakhs per sq.mts. For the same purpose another meeting was conducted in the cabin of Deputy Chief Minister Mr. Ajit Pawar and decision was taken by the Government to shift Government of Maharashtra Sports Complex at Village- Nanore, Taluka- Mangoan, District- Raigad. Accordingly, in September 2023 the fresh affidavit was filed in the Bombay High Court by the Government of Maharashtra against the Restoration of Sports Complex Reservation.

17. In 2022, Airoli MLA Shri. Ganesh Naik requested the Municipal Commissioner NMMC to send a letter to CIDCO for allotment of Government of Maharashtra Sports Complex Plot to NMMC for Development of International Standard Integrated Sports Complex at Ghansoli, Navi Mumbai. Accordingly, the Municipal Commissioner forwarded letter to CIDCO in January 2023. On further reminder by Shri. Ganesh Naik Saheb, for allotment of Government of Maharashtra Sports Complex Plot and accordingly after the Bombay High Court Order in PIL 28 of 2019, the Municipal Commissioner NMMC again forwarded letter to CIDCO for allotment of Government of Maharashtra Sports Complex Plot admeasuring 42 acres at sector 12 and 12A, Ghansoli to NMMC.

18. To protect larger public interest in development of Sports Facility, Indian Institute of Architects, Navi Mumbai Centre's Present Chairperson Architect Sheetal Nemane, Secretary Architect Minkshi Srivastav and Treasurer Architect Arif Punjabi supported the PIL in restoring Sports Complex. The IIA President Architect

Vilas Awachat and Maharashatra Chairman Architect Sandeep Prabhu always supported the noble cause. Past Chairman of IIA NM Architect Kaushal Jadia signed all Rejoinder Affidavits and attended High Court Hearing and constantly active in support of PIL. Fellow Member and Senior Architect P.S. Govindrajan and Fellow Member and Senior Architect Shivaji S. Patil prepared detail Rejoinder affidavits against Builders Affidavits, NMMC Affidavits, Government and CIDCO's affidavit favouring Builder in PIL No.28/2019. Total PIL no. of paper count is 972 pages. Architect interpretations of MRTP Act 1966, Maharashtra Sports Infrastructure Development Plan Policy 2001 and 2012 and various G.R. issued thereafter, CIDCO's Land Disposal Policy 2007 and 2008 is much clearer and specific due to practical exposure of same. Following reliefs were requested by IIA NM from the Hon'ble Bombay High Court.

i. In the Draft Development Plan of NMMC entire about 42 acres sector- 12 and 12A Ghansoli, Navi Mumbai to be reserved for Sports Complex.

ii. Illegal allotment and possession of Residential plot bang in the middle of Sports Complex should be cancelled and set aside and plot to be rested back to CIDCO and then to be allotted to NMMC at free of cost as per Maharashtra Sports Policy 2001, G.R. dt. 24.02.2003.

iii. State Government illegal G.R. dt. 26.03.2021 shifting Konkan Division Sports Complex should be set aside in the larger Public Interest of exponential growing population of Mumbai Metropolitan Region.

iv. Directives to be issued to the State Government for speedy development (pending for last 20 years) of International Standard Integrated Sports Complex through NMMC at Sector-12, 12A and 13 Ghansoli, Navi Mumbai as per Master Plan of NMMC in accordance with Maharashtra Sports Infrastructure Development Plan Policy 2001, G.R. dt. 24.02.2003 and in coordination with Navi Mumbai Municipal Corporation (Local Body and Planning Authority), CIDCO (Lessor of Govt. land) and Sports Department (Govt. of Maharashtra).

19. After two meetings in Sachivalaya, we, at IIA NM was not confident about Justice. But after prolong arguments by CIDCO's/ Govt.'s/ Builde's various Senior Councils, Advocates, NMMC Advocate, IIA, NM's single Advocate Indrajit Kulkarni and Intervener Mr. Pradip Indulkar's Advocate Nilima Sangalikar in the Bombay High Court, the Bombay High Court adjourned the hearing on 26th October 2023 for final judgment and continued the stay order for any development on plot reserved for Government of Maharashtra Sports Complex till the final judgment.

20. Final Judgment – on 1st July, 2024, 134 pages Judgment was pronounced by the Bombay High Court and it is worthwhile for every Architect to read this entire order in PIL 28 of 2019 to understand High Courts Judicial Interpretations regarding protection and restoration of Social Facility, MRTP Act. 1966 and fundamental rights of Citizens as per Constitution of India. The abstract details of the Order are as given below:

ORDER

i. The impugned decision of the State Government as contained in Government Resolution dated 26 March, 2021, in shifting the Government sports complex from Sector 12 and 12A, Ghansoli to Village Nanore, Taluka Mangaon, District Raigad is arbitrary, illegal and unconstitutional. It is accordingly quashed and set aside.

ii. CIDCO is directed to hand over the entire land in Sector 12 and 12A, Ghansoli, as earmarked for the Government Sports Complex to the Sports Department of State Government, to be utilized for the purpose of "Government Sports Complex", free of cost or at a specified price in terms of Regulation 4 of the 2008 Regulations or on similar terms as received by CIDCO from the Navi Mumbai Municipal Corporation, for the adjoining land allotted for its sports complex.

iii. The allotment of plot no. 4, Sector 12 in favour of respondent no. 5 (Builder) as made by CIDCO vide allotment letter dated 27 January, 2017 is quashed and set aside. CIDCO is directed to refund respondent no. 5 the amounts as paid by respondent no. 5 for allotment of said plot, along with interest @ 9% p.a. till the date of actual payment.

iv. It is clarified that the State Government, if so desires, may develop the sports complex at Village Nanore, Taluka Mangaon as a District Sports Complex or an additional sports complex.

21. After Judgement we at IIA NM realised that *Der hai, andher nahi hai* and *Truth prevails but you need to act for it.* Summer Olympic of 2036 will be held in India. This is the Great Public Service by Indian Institute of Architect, Navi Mumbai centre in restoring vital Sports Complex Reservation on total 78 acres plot for development of International Standard Integrated State of Art Sports Complex for entire Mumbai Metropolitan Region i.e. Mumbai City and Suburbs, Thane, Mira-Bhaindar, Vasai-Virar, Kalyan-Dombivali, Bhiwandi, Ambernath, Panvel Alibag and particularly for Navi Mumbai. Navi Mumbai International Airport will begin its commercial operation within short time and Navi Mumbai will have direct access from all over the world and some of Olympic 2036 competition will be also held at NMMC Sports Complex at Ghansoli, Navi Mumbai.

NEWSLETTER JULY

IIA CHHATTISGARH CHAPTER

IIA Chhattisgarh Chapter has had a productive month of planning and strategizing for upcoming events. Significant discussions and decisions were made during the meetings held throughout July.

Indian Institute of Architects Premier League (IIAPL)

The IIA Chhattisgarh Chapter is preparing for the highly anticipated IIAPL through thorough planning sessions designed to ensure the event's success. The primary topics addressed are as follows: strategy, responsibility and status of fund generation and sponsorship. The team assessed the current status of sponsorship commitments and fund generation. Specific responsibilities were assigned to members to ensure expedient follow-up and engagement with potential sponsors. Additionally, strategies were developed to attract more sponsors.

Initiative to attract IIA Members from Centres other than Raipur: strategies were devised to involve IIA members from various Centres across Chhattisgarh to increase participation. Outreach initiatives and incentives were assessed to foster a more extensive level of participation.

Roles and Responsibilities for Successful Management: the teams were allocated specific duties and responsibilities to ensure the successful execution of the IIAPL. These responsibilities included accommodation arrangements, cuisine, photography, transportation logistics, theme decisions and preliminary release. Each team was assigned specific objectives and deadlines to guarantee the timely completion of their assignments.

The new application process for the creation has been finalised to establish a unified platform for the general public, vendors, and architects. The primary topics addressed are as following the steps to register as an architect, vendor or layperson. The registration process within the app was outlined, ensuring it is user-friendly and accessible for all stakeholders. Detailed instructions and support mechanisms are in place to assist users in registering on the platform. The strategy for generating funds through the app involves vendors paying for their registration. This approach is expected to create a sustainable revenue stream to support the app's maintenance and future development.

The IIA Raipur Chapter Meeting on 9 July 2024 will serve as a crucial follow-up to the General Body Meeting held at Hotel Mayura on 11 May. This meeting will focus on reviewing the progress made in developing and launching the application and finalising preparations for the IIAPL.

IIA CG Chapter members strategise and collaborate for upcoming events, ensuring a successful and impactful future for the architectural community in Chhattisgarh.

IIA ODISHA CHAPTER

Second General Body Meeting and Rajo Festival Celebration

On 17 June 2024, IIA Odisha Chapter, held its second General Body Meeting in conjunction with a vibrant Rajo Festival celebration at Hotel Swosti Premium, Bhubaneswar. The event showcased the organization's commitment to professional development and cultural preservation.

The proceedings began with the General Body Meeting, presided over by Vice Chairperson Ar. Mousumi Nanda. Chairperson Ar. Swopnadutta Mohanty welcomed the attendees, setting a tone of congeniality for the gathering. Honorary Secretary Ar. Bibhudatta Sahoo presented a comprehensive overview of the institute's accomplishments over the past year, highlighting significant milestones and developments. Treasurer Ar. Laxminarayan Singh followed with a detailed financial report, offering insights into the institute's fiscal health and progress.

Following the formal meeting, the event transitioned into a lively celebration of the Rajo Festival, a traditional Odia festival honouring womanhood. The festivities featured an array of cultural elements, including *mehendi* and *raja paan* stalls, a *pitha* (traditional Odia sweets) booth, and a *doli* (swing) installation. These offerings provided attendees with an immersive experience of local traditions.

The organizers curated a diverse program of activities to engage participants throughout the day. Competitions such as saree-draping, karaoke singing, tug-of-war, musical chairs, hand wrestling and card games fostered a spirit of friendly competition among the architects and their families. Additionally, music and dance competitions for children ensured that the younger generation was actively involved in the celebrations.

The event's success was evident in the enthusiastic participation of IIA members and their families, creating an atmosphere of joy and camaraderie. As the festivities concluded, attendees departed with renewed connections and cherished memories.

The IIA Odisha Chapter's leadership, including Honorary Secretary Ar. Rudra Sabitru Nayak, expressed their commitment to continuing this tradition of combining professional development with cultural celebration, aiming to strengthen the architectural community in the region.

This event underscores the IIA Odisha Chapter's dedication to fostering both professional growth and cultural appreciation among its members, setting a precedent for future gatherings that blend business with pleasure in the architectural community.

Women Architects of the chapter putting their steps into the traditional BEAT.

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