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# Sthala

#### A JOURNAL OF ARCHITECTURE, INTERIOR DESIGN, URBAN DESIGN AND PLANNING

By SJB School of Architecture and Planning, Bengaluru, India



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# STHALA

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#### CONTENTS

Sri Adichunchanagiri Shikshana Trust	1
From Dean's Desk	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
From Editorial Board	4
Call for Ideas	
SUB-THEMES: 1- Exploring the understandings and perceptions of research,	
teaching and practice in architecture academia.	
Multiple dimensions of Research, Practice and Education in Architectural	5
Academia.	
Janani Suresh and Goutham DM	15
Idealism vs Pragmatism: Integrating Design and Economics in Architecture	
Shwetha H. Pai	
An Investigational analysis of Rapid Transit corridors in Hyderabad and	20
Bengaluru- A Case to highlight planning process as a major tool.	
Jotirmay Chari, Dr.B Shankar	
SUB-THEMES: 2 - The teaching of Building construction technology in	
Architectural Education.	21
I eaching Building Structures as a subject in Architecture Studies	31
SUB THEMES: 3 Teaching Architectural History as a tool for the analysis and	
appreciation of Architecture	
Deliberating in the retrospect on Dichotomies in teaching History of	38
Architecture	50
Sindhu Jagannath	
Studying the Architectural past for a better future.	47
Kavitha Kamath,	
Knowledge management through architectural history as an efficient tool for	54
risk management of heritage tourism infrastructure development projects.	
Shubhra Pande	
SUB-THEMES: 4- Pandemic and disaster resilient urban and rural built	
environment	61
The Many Facets Of Waste Management: A Case Of Bengaluru Metropolitan	
Area	
Sumodhini V.	
Post Disaster Reconstruction: Urban Context	
A thought to include resource planning during post disaster reconstruction of	73
Urban neighbourhoods: an integral part of academics in an Urban design	
Inflyikram.N.B Ductob Construction System & Its Aid In Dandomic Fight	70
r reiad Construction System & Its Aid in Fandemic Fight Mitchell Deepa V	/0
SUB_THEMES: 5_ Advancement of technology Social Media and Architectural	
Education	<b>.</b>
Rethinking Architecture Pedagogy in the era of pandemics	84
Nasreen Kauser	

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#### Sri Adichunchanagiri Shikshana Trust ®

Sri Adichunchanagiri shikshana trust ® runs close to 500 Institutions in India under the divine guidance of Jagadguru Padbhabhushan Sri Sri Sri Dr. Balgangadharanatha Mahaswamiji. The Trust has earned its reputation of being pro-poor, pro-rural in its focus and a stickler for quality. SJB School of Architecture & Planning (SJB SAP) is the latest platform under the guidance of Sri Sri Dr. Nirmalanandanatha Mahaswamiji, an IITian himself and Sri Sri Dr. Prakashanatha Swamiji, where the Trust continues its tradition of excellence in the field of design and built environment.

#### From Dean's Desk

#### Architecture is a way of Life, expressed through built environment.....

SJB School of Architecture and Planning [SJBSAP], is approved by Council of Architecture (COA), India and affiliated to Visvesvaraya Technological University (VTU), Belagavi, India. The institution was established in 2013 under the auspices of Sri Adichunchanagiri Shikshana Trust, part of a thousand year old monastery running over 500 educational institutions.

In the first 5 years, it has evolved into a 3 program School with B.Arch, M. Arch (Construction Project Management) and University recognised Research Centre. SJB SAP is known to harbour global ambitions having successfully participated in several joint studios in countries ranging from USA, Australia, Spain, Canada and UK and tours of works of masters like Frank Lloyd Wright and Tadao Ando, earning peer respect and laurels for its various innovative approaches to teaching.

In continuation of its pursuit of excellence, SJB SAP is coming out with its first Annual Journal of Architecture, Interior Design, Urban Design and Planning-STHALA, meaning space/ place in Kannada. This journal aspires to provide a scholarly platform for practicing architects, academicians, researchers, students and scholars of architecture and related fields, to publish their research papers, projects, case studies and book reviews.

Architectural academia has been customarily linked to the scheme of cognitive research. To convey knowledge, a person needs to attain one. The process of attaining knowledge is continuous and provocative. Academic journals in architecture inspire active reading and provoke deep thinking. They provide a wealth of knowledge. Academic scholarly journals are one of the major tools to promote the most up-to-date academic trends and helps in seeking valuable primary sources for future reference.

Integrating knowledge generated through research and practice with teaching is an essential area that needs prompt attention focussing on student learning activities. There is a growing requirement on the prominence of dialogical and dialectical processes between student-teacher interactions. Meaningful insights can be gained by weaving research and practice into teaching as a knowledge transfer process. Thus, a key aspect is to explore the integration to augment interaction and interactive platform to create the crucial research-teaching practice linkage, through "STHALA".

I feel immensely proud to present the debut edition 'STHALA- A journal of Architecture, Interior design, Urban design and Planning', that is an endeavour to critically reflect the comprehensive approach towards addressing the concerns of built environment through the lens of architecture. I congratulate all authors for their immense involvement for writing their research papers for "STHALA". The journal is published in English. The journal provides free and open access to all its contents on our website. I congratulate the editorial board members for their endowment to publish the debut edition of "STHALA" - Journal of Architecture, Interior Design, Urban Design and Planning', of SJBSAP. I also take this opportunity to express our sincere gratitude to Management of Sri Adichunchanagiri Shikshana Trust for the encouragement and unstinted support as ever.

I would be failing in my duty if I fail to acknowledge the huge contribution by Prof. Smitha MB in this beautiful journey. As on the day of publication, she continues to be a well-wisher of the institution and the journal, while she continues with her new assignment with Indian Institute of Human Settlements, Bengaluru.

#### Prof. Dr. M N Chandrashekar

Dean SJB School of Architecture & Planning, Bengaluru. www.sjbsap.edu.in

#### **From Editorial Board**

"If I had to teach architecture....I would strive to inculcate in my pupils a keen sense of control--unbiased judgment and of the "how" and the "why." I would encourage them to cultivate this sense till their dying day. But I would want them to base it on an objective series of facts. Facts are fluid and changeable especially nowadays, so I would teach them to distrust formulas and impress on them that everything is relative."

#### - Le Corbusier

Architecture is a comprehensive intellectual practice of design and a liberal art requiring an eclectic range of proficiency to synthesise the complexities of practical world into a formal built environment.

"STHALA" is an annual ' Journal of architecture, Interior design, Urban design and Planning', creating an academic and practice exchange platform for practicing architects, academicians, researchers, students and scholars of architecture and related fields. Scholarly Journals are extremely important to create a knowledge forum for critical writings for young as well as established academicians, scholars and practitioners from all the areas of architectural research, including research-by-design, urbanism, practice-related research, sustainability, technology, pedagogy, visual culture and artistic practices. STHALA acts like a catalyst to ignite the thinking process and provides a think-tank stage for architectural professionals.

We feel a great sense of pride to present the debut edition of "STHALA", a journal publication of SJB School of Architecture and Planning, Bengaluru. This voices the architectural design influences via textual matter strongly conveyed through appealing visuals and illustrations. The journal also seeks views from scholars in other fields of humanities as valuable indicators towards its contextual understandings.

We wholeheartedly congratulate and acknowledge the tremendous efforts rendered by each and every author, for actively taking part in writing research and scholarly papers for our debut edition of "STHALA".

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**S U B M I S S I O N F O R M A T** Authors are required to prepare full length paper as per the prescribed manuscript template. Full length paper should be restricted to FIVE pages only including references It is indeed a moment of pride to introduce "STHALA ", a journal publication of SJB School of Architecture and Planning, Bengaluru. We invite you to submit your manuscript for its debut issue. This journal is theme based, with the upcoming debut issue dedicated to "INTEGRATING RESEARCH, TEACHING AND PRACTICE IN THE PERSPECTIVE OF ARCHITECTURAL EDUCATION".

Seven sub-themes correlating to the main theme of the issue support in focused writing of the manuscript. Manuscripts can include unpublished research papers and other technical writings. We look forward to receiving your valuable contribution.

### THEME: INTEGRATING RESEARCH, TEACHING AND PRACTICE IN THE PERSPECTIVE OF ARCHITECTURAL EDUCATION

Academic disciplines and professional practice by convention have their own traditions, resulting in varying research approaches, methodologies and cultures, which ultimately determine the ways in which research-teaching-practice linkages are shaped. Fundamental to the integration of research-teaching-practice linkages and implicit in these issues are the perceptions of faculty of such linkages. If cultivated, these integrated links have the potential to be a key characteristic and distinguishing feature of architectural education. Faculty show a preference for integrating research, teaching and practice as opposed to focusing exclusively on one or the other. However, there is a lack of opportunities to explore the nature of this integrated relationship. As such, there is a need to identify and explore faculty perceptions of such integrated research-teaching-practice linkages.

#### SUB-THEMES

**1)** Exploring the understandings and perceptions of research, teaching and practice in architecture academia

**2)** The teaching of building construction technology in architectural education

**3)** Teaching architectural history as a tool for the analysis and appreciation of architecture

- 4) Pandemic and disaster resilient urban and rural built environment
- 5) Advancement of technology, social media and architectural education

#### NOTE TO AUTHORS

Submission of a manuscript is considered subject to the understanding that the manuscript is original and has not been published before in any form and is not being considered for publication elsewhere. Author/s is/are solely responsible for originality of content and views expressed in the paper. Author/s should submit full length paper by stated submission date.

FOR FURTHER DETAILS CONTACT MEMBERS OF EDITORIAL BOARD

#### 1) EXPLORING THE UNDERSTANDINGS AND PERCEPTIONS OF RESEARCH, TEACHING AND PRACTICE IN ARCHITECTURE ACADEMIA

Integrating new knowledge created through research and practice with teaching is an important area that needs prompt attention with the growing emphasis on student learning activities, quality assurance procedures and research funding mechanisms in architecture academia. There is a growing significant emphasis on the prominence of dialogical and dialectical processes between studentteacher interaction, improving interactive settings such as projects, tutorials and seminars to create the integrated association. Meaningful insights can be gained by weaving research and practice into teaching as a knowledge transfer process. Research, teaching and practice are seen as activities where individuals and groups negotiate meanings and build knowledge within a social context. Thus, a key aspect is to explore the integration to augment interaction and interactive settings in creating the crucial researchteaching-practice linkage.

#### 2) THE TEACHING OF BUILDING CONSTRUCTION TECHNOLOGY IN ARCHITECTURALEDUCATION

Most of the architecture schools have and have been reconsidering and reforming the structure of their curricula influencing the educational strategies. In this context, one of the major components which have been instigating diverse deliberations and questions is the teaching of building construction technology subject in architectural education. Every deliberation on architectural education subliminally and obviously concerns and questions the effectiveness of the pedagogical position of the building construction technology. There are several dimensions to this concern. However, the predominant ones are contemporary content of the subject, proficient teachinglearning methods and qualitative as well as quantitative locus of the subject in the curricula. There is a need to promote integration of building construction technology and architectural design to regard them as a whole is beyond doubt. The current teaching-learning practices pertaining to building construction technology are being widely questioned as there is an increasing demand for a radical reconsideration of these practices so that teaching-learning could be more compatible with the contemporary trends of architectural education and practice.

# Sthala

A JOURNAL OF ARCHITECTURE, INTERIOR DESIGN, URBAN DESIGN AND PLANNING

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#### 3) TEACHING ARCHITECTURAL HISTORY AS A TOOL FOR THE ANALYSIS AND APPRECIATION OF ARCHITECTURE

History of Architecture has been taught to highlight the significant events, styles, materials and building construction techniques. This gives an opportunity for students to analyse buildings and the built environment as the product of culture, climate and context. Furthermore, when teaching History of Architecture, moving from a knowledge-teaching to a studentoriented learning approach needs a careful strategy. A switch to a "learn to learn" process where students are expected to do more than just "know" should help prepare them to adapt to evolving and demanding situations through transversal skills such as "know how" and "know how to be. Hence, this topic focuses on the various ways of applications derived from History of Architecture as a critical to

#### 4) PANDEMIC AND DISASTER RESILIENT URBAN AND RURAL LIVING ENVIRONMENTS

Pandemic outbreaks and disasters (both natural and manmade) have huge impact on the life of people and their physical spaces. The coming years would fundamentally change the way living environments (both rural and urban) are conceived, built and experienced. Every outbreak of pandemic and disaster in the history of mankind reveals a bitter truth about our choices which are triggers for such massive crisis. However, on the other hand pandemics and disasters are causes of several innovations in most of the fields including architecture, design and planning of both rural and urban areas influencing design of the built environment. Not only during such crisis but otherwise, architecture professionals being the inventors of built environment of living have a greater responsibility of responding with a significant speed to contain the crisis. This also means that there is a crucial requirement for more curricular time and more hands-on-training for architecture students and professionals. We will require extraordinary measures to keep the profession relevant in the times to come. To realise this, we need deeper introspection necessitating pausing and re-orienting to reconnect with our humanistic instincts.

#### 5) ADVANCEMENT OF TECHNOLOGY, SOCIAL MEDIA AND ARCHITECTURAL EDUCATION

Advancement of technology, artificial intelligence, virtual reality have given an access to information and enabled for more frequent interactions with students and teachers in all the different domains of education, including in architectural education. With the ever-rising tide of social media interactions with students for sharing information, references and conducting online classes now are seeping into the sacred precincts of the Indian universities too. Though many academicians find themselves struggling to adjust to the newly fluid landscape of higher technology in architecture education, still it has influenced a lot to achieve mass and quick communication and enabled architecture students towards better prospects for acquiring knowledge and confidence.





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### MULTIPLE DIMENSIONS OF RESEARCH, PRACTICE AND EDUCATION IN ARCHITECTURAL ACADEMIA

#### Abstract

Architectural education, research and practice have a tripartite relationship, wherein all the spheres are mutually dependent on each other. The paper explores the multiple dimensions of this dynamic relationship and the benefits arising out of closer interaction amongst the spheres.

The paper studies a spectrum of approaches which may be adopted in this direction. It discusses the shifts required in architectural pedagogy to enable holistic learning, approaches to thinking, alternatives in design communication and the inculcation of research culture at academic level. The paper stresses on the need to identify research as an important subject in education and as the tool for innovation and meaningful design.

The exploration of practice sphere in reaching out to the other spheres is elaborated by means of a case study of a design practice wherein practice sphere merges with its neighbouring spheres by adopting 'Research through Practice' as well as involving and educating the student community.

#### Keywords

Architecture; Research; Practice; Architectural pedagogy; Research through Practice

#### 1 Introduction

Beyond the physical environment it creates, architecture has a wider role in the world around us. The arrangement of spaces and their integration with natural light, air, landscape, materials and textures have the ability to impact individuals at a psychological level. Users can feel a connection to the spaces and their emotions can be evoked. Architecture is a representation of the culture and values of society at a given

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time. It is a reflection of society, but also has the potential to shape society itself. Mindful designs can resolve pertinent social and ecological problems of the current times.

"Design is not just a building, an interior or a preserved landscape; it is a means of acting in and transforming the world" said Michael Speaks.

In this light, architects have to recognize the abovementioned roles of architecture and begin to design with a set of values to achieve them. The complete ecosystem of education, research and practice, herein referred to as the three spheres, will have to work in tandem to collectively create the desired po'sitive impact. Architectural education is the place where a shift in thinking can be seeded into the young minds. Research is an important tool to understand, introspect and innovate. Practice can convert research insights into tangible products to benefit the individual users and society. Architectural discipline demands a closer interaction between the three spheres for its advancement. A systemic shift is possible by integrating small changes in every sphere, which can eventually strengthen the entire architectural ecosystem.

#### 2 A web of interaction: Architectural academia Practice- Research

This web of interactions is represented in Fig. 1. The three spheres are inseparable and work in a mutually beneficial manner, one contributing to the growth of the other.

Architectural research supports education both directly, through research training of future architects, and indirectly, by providing for the continual advancement of  $\geq$  the discipline (Milan, 2011).

Professional practice, backed by the insights and findings from research, delivers value added design products. Quality in the profession is directly related to a strong academic ecosystem.





Researchers receive feedback by observing the real time products created on the basis of their research, which acts as a reality check to Researchers and practitioners contribute to education by sharing their expertise with the student community. The proximity of education, research and practice is essential to mutual growth of the spheres.

The current system: Challenges in the research sphere.

understand any gaps between theory and practice.

#### 3.1 Need for research in architecture

Research is the fundamental tool to increase the knowledge base of any discipline. Excellence in Research for Australia ERA defines research as the creation of new knowledge and/or use of existing knowledge in a new and creative way so as to generate

MULTIPLE DIMENSIONS OF RESEARCH, PRACTICE AND EDUCATION IN ARCHITECTURAL ACADEMIA

new concepts, methodologies and understandings. (Frayser, 2013). Research allows us to re examine existing knowledge, thereby modifying our understanding of the world in the light of new findings.

The Royal Institute of British Architects (RIBA) recognizes "the intimate relationship between research and design innovation." Architects must understand the value of research in their design. Research provides a meaningful path or direction to take the process of design forward.

# **3.2 Ambiguity in 'Research through Practice'**

Currently, two broad categories of architectural research are recognized. One is the traditional 'scientific' approach or academic research. The second is the 'Research through practice', a body of knowledge evolving through the experiences and experiments of individual architectural practices. Research driven by practice is largely undocumented and many times, architects do not even categorize their creative processes as research.

There is an ambiguity on what processes and knowledge qualify as 'Research through architectural practice'. Some interesting reformulations have been done by Lawson concerning how we should assess research when we no longer can rely on a 'scientific method'. The central question is then: "How has the work contributed to what is considered good and useful knowledge by those working in the field?" (Frayser, 2013). Mapping the contributions to knowledge made by practice-based research remains a challenge today.

#### 3.3 Lack of research work

At the academic level, the quantity and quality of research work produced in the field of architecture is only a small fraction of recorded research in other disciplines. There is a general lack of emphasis to conduct architectural research. Attitudes to research and knowledge exchange appear to be rooted in architectural education, learning styles and preferred communication methods, which are primarily visual and peer-to-peer.(Buday, 2017)

# 4. The current system: Challenges in the education sphere

#### 4.1 Model of architectural education

Historically, architectural education began as an apprenticeship based model where young architects were trained under practicing architects. Currently, architectural education follows the university based model, with emphasis on the design studio. Students are exposed to real time practice through internship with architectural practices as part of the curriculum. A studio is a workspace where students explore a set of skills with or without the presence of an instructor. The design studio is a physical environment where students are primarily taught various aspects of design education. (Lueth, 2008)

There has been much debate on what model of education is suitable for the discipline. One group criticize the studio based system of education for its inability to prepare students for the real world of practice. The students are incapable of drawing or understanding the realities as they have been designing in the closed constraints of a fantasylike studio atmosphere that does not mimic real-life settings. (Stevens, 2014) Others argue that the role of a formal university education cannot be undermined as it is the place of orientation, enquiry, and understanding of the subject without the pressures and limitations of practicality. The current system integrates both practical training and theoritical learning, but there is a lack of research training in its model.

#### 4.2 Pedagogical organisation

Architectural education, in general, focuses on the design product rather than the process of design. In many cases, evaluation and inputs tend to be based on the subjective viewpoints of the mentors due to the nature of the subject which is viewed differently by different people through the lens of the their own experiences and standpoints.There is a common tendency to neglect students' experience and process of learning during assessments. Furthermore, assessment criteria of the studio instructors may not be explicitly stated.( Cikis & Cil, 2009).



#### Figure 2 :Scope of overlap of the spheres Source:Author 5. Scope of overlap and outreach

For a holistic and all rounded advancement of the discipline, it is necessary to create a better knit network of academicians, researchers and practitioners. Refer Fig. 2. The possibilities of outreach of each sphere into the adjacent spheres is discussed below.

	Academicians conducting research
А	at universities.
	Research as a primary subject in
	education
	Practical training through
В	internships for architecture students.
	Professionals teach at colleges as
	Visiting Faculty.
	Research positions at professional
С	practice.
	Research through practice, its
	documentation and dissemination.

#### Confluence of the three creates architecture of highest potential

#### 5.1 Education sphere

Academic education plays a vital role in orienting the students with the required values and culture, apart from the subject knowledge. In this context, one needs to enquire on: "What are the approaches to provide a well rounded holistic learning experience to the students?". "What are the tangible measures one can adopt at the studio level to balance out on the subjective nature of architectural pedagogy?"

### *Inculcating the attitude of research through university culture*

Education must kindle in students a curiosity and the urge to explore, or in other words, research. A faculty led research environment is critical for students to imbibe the culture of research culture. Students learn effectively by assisting the faculty, who themselves are producers of research work. Architectural schools should explore the introduction of formal classic research methodology as part of the curriculum. Methods of conducting research, analysis and interpretation of the research conducted by peers, writing and communication of research work, should become a part of the syllabus.

Students will have to conduct research work relevant to their design coursework which will assist in developing the design. Research can form a useful tool for decision making at different stages of the project, providing direction to the designer. Modes of communicating designs can shift from graphic-only representation to a hybrid form including writing. Students may learn to represent their research, reasoning in design, impact assessment of proposed design in addition to graphical representation. Such paradigm shifts in method of learning can ensure integration of research and design in the formative years of a student's life.

Inculcating the approach to thinking and exploring alternatives

An important skillset of an architect is to be able to think of creative, fresh and alternative solutions for the old problem.

"You cannot dig a different hole by digging the same hole deeper"(Bono, 1960)

By thinking extensively in the same method, one may not be able to arrive at better design solutions. Lateral thinking is concerned with the creation of new ideas, methods, processes and products. Vertical thinking is a sequential thinking process that helps develop the chosen concept. The two forms of thinking are complementary and need to co-exist for sensible progress. Fortunately, thinking skills can be shaped and developed by consistent practice. Schools may focus on sharpening lateral thinking capabilities the of students, which can have far reaching effect on innovation in architectural practice sphere.

Discussion at the studio can move away from personal preferences and lean towards design intents to overcome the problem of subjective discussions. The 'Why factor' of design must assume importance, where students explain why they have designed something rather than what they have designed. The emphasis should be given to the process of design and not the mere product. Students of architecture must be encouraged to explore different design alternatives and conducting a detailed analysis of the options in terms of the pros and cons, expected experience, building performance, environment impact, social impact etc. before taking a decision on the design path. Such an education will be a better foundation for nurturing the future architects who may adopt similar approaches in their design practice or research at a later stage.

#### 5.2 Research sphere

A vast ocean of research is continually conducted by various architectural practices. There is a need for architectural practices to associate with research specialists to document, map, analyse their practice based research. A method can be developed for sharing the insights thus developed for use in further products within the organisation and such tested knowledge can then be shared in external platforms for benefit of the larger community. A set of definitions of standards need to be framed in such a way that they are sufficiently rigorous to secure the quality of research, but sufficiently inclusive to allow all expression subjects to find within them.( Nilsson & Woyseth, 2008). Another measure to strengthen the research sphere can be framed by incentivising the practices conducting extensive research. Medium and large size practices may report their expenditure on Research and Development to the Council of Architecture annually. The Council may provide credits and recognition to reporting practices on its platform. Potential clients, seeking architectural services, will be able to use this information to make an informed choice.

Researchers need to actively participate in education sphere to inculcate the need for research and methods to conduct it. Published research work must be discussed and debated on relevant forums to increase its exposure to a number of architects and thereby put its findings to use through architectural practice.

#### **5.3 Practice sphere**

Practical training modules introduce students of architecture to real time challenges and expose them to various aspects of professional practice. Practicing architects also contribute to formal education by teaching as Visiting faculty in architectural schools, thereby mentoring students through the filter of practical expertise. Practicing architects may employ creative methods of exposing students, such as conducting workshops on various aspects of professional practices, arranging site visits, organising 'open days' where students are invited to experience the office environment.

There is much to gain from architectural knowledge, but it requires a cultural shift in collaborations, not just between academia, practices and clients but also between disciplines and organisations beyond architectures traditional concerns.(Samuel & Dye, 2015). Collaborations and idea exchanges within the three spheres and also across disciplines can broaden the perspectives of designers and fuel design innovations.

# 6. Case study: Outreach of an architectural design practice

Objective of study: To understand the scope of outreach to other spheres beginning from the Practice sphere

Name of architectural design practice: Mud Hands, Bangalore, Karnataka

Method of study: A design project conducted by the practice was studied and its impact on education and research sphere was analysed.

The architectural design practice employed the method 'Research through Practice' as a tool for designing. This process involved ideation, exploration, research and development as a back and forth before implementation of design in real time. Once new conclusions were reached, the knowledge was shared with beneficiaries by means of workshops, internships, publications and other educational tools. Student interns and young architects conducted research under the guidance of the design firm.

#### Project : An exploration in flat roofing system

The primary objective of the research was to explore alternatives in flat roofing systems. Reducing the use of steel and cement in the roof component was the key criteria to be fulfilled by the alternative methods. After studying the existing practices as well as traditional roofing techniques, the use of high compression bricks to create flat roofs called as funicular roof was explored.

The flat funicular brick roof was first implemented in a school project at Mysore to



Figure 3: Funicular brick roof at project site, Mysore. First: Construction detail; Second: View of entrance canopy; Third: View of structural system, Source: Author

cover a semi open area of 158 square meters. The roof was sub-divided into 13 roof bays, each containing a brick funicular roof. The bricks are laid at an angle in concentric circles starting with the outer most layer. In comparison to a flat RCC slab of the same area with 150 mm thickness, the reduction in steel consumption achieved was 60% and the reduction in concrete was 50%. The maintainance of the roof was reduced as there is no requirement for further surface treatment such as plastering and painting.

#### **Exploring** alternatives

- I. Shapes: Variations in the basic shape of the funicular roof was explored, where basic circular shape was replaced with triangular, semicircular, hexagonal and Such experiments square. were developed and tested by preparation of miniature scale models. The load carrying capacity of the roof and its stability were analysed in the various shapes and spans.
- Binding: The binding material between II. bricks was also varied from wet mortar using cement to dry mortar using high compressive strength course and fine aggregate.
- III. Design: Design explorations evolved around supporting framework for the roof and subtracting the inner layers of bricks

to create central skylit openings within the funicular roof. Methods of supporting the roof was varied based on context. The funicular roof has been suspended from a central support pole in one case and embedded within the concrete slab in another case as seen in the Fig 3.

The Outreach to education sphere: experiments were published online on blogs and shared with students and architects across the country by conducting several hands-on workshops. The school project site was kept open for site walks and observation by students. The entire knowledge on the roofing system has been kept open source. Seminar on the roof form and its exploration was given at different architecture colleges in India.

Findings from study:

- Hands on experimentation and research can open up new possibilities which can improvise the existing system. Practice sphere is an ideal platform to begin research where the results can be implemented and experienced in the projects of the firm itself.
- Building awareness amongst clients is an ഗ important role of a design practice through ALA which society becomes better informed about the roles and importance of the profession. The client was explained the pros and cons of the alternative roofing

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Figure 4: Design and structural explorations in the flat funicular roof system using scaled models; Introducing students and architects through hands on workshops. Source: Author

system and was able to make an informed choice.

There need not be exclusivity in roles but instead multiple roles are possible, that is, a design practice can also be an education and research platform at the same time. Thus, a continual cycle from research to practice to education is established.

#### 8. Conclusion

Strengthening the links of education, research and practice by blurring the traditional boundaries maintained by the spheres can enable architecture to make valuable contributions to society. Efforts of reaching out to other spheres can be explored by all three groups. Knowledge sharing between spheres is important to fuel perpetual innovation.

Grass root level shifts in architectural pedagogy is essential to initiate far reaching effects on the entire architectural discipline. Research must be introduced as a primary subject of study within architectural education. Architects must be skilled to represent their design research, intents, critical analysis and impact assessment for their design proposals and must use a similar approach in their design practice. Research is a necessary tool for better design and its integration with both academia and practice is crucial. The results from 'Research through practice' should not be kept as a closed information but readily shared with the architecture community. This approach is required to bringing the ideas from niche to mainstream.

The roles of architecture can be best realized by the close interaction amongst the spheres working with the same ideology towards a collective goal.

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### IDEALISM VS PRAGMATISM: INTEGRATING DESIGN AND ECONOMICS IN ARCHITECTURE

#### Abstract

This article/ essay looks at the reasons for the conflict between the architect and real estate developers, the former representing 'design' and the latter representing 'economics'. It looks at an architect's need for understanding market forces not just for a successful practice, but also establishes the need for integrating profit maximization as a pre-requisite in his/her design approach. It looks at how integrating design and economics is necessary to address global challenges such as sustainability, affordable housing and urban land use policies.

#### Keywords

Design, economics, commodity, finance, profitability, sustainability

#### 1. Introduction

The term 'Real estate' has a negative connotation in most architect's cognizance. While an architect is trained to be idealistic and is entrusted with upholding the moral and ethical standards of building design (Van der Kuil, Wellner 2017), the real estate sector (including developers and investors) is the one that converts these designs into real property, albeit with a profit motive. However, in a globalized world driven by the pursuit of financial interests, architects are faced with the dilemma of choosing between design and economics very early on in their careers. This essay is an attempt to establish the inter-dependence of design and economics and to emphasise the need for their co-existence to develop a sustainable built environment.

A key reason for the conflict between architects and real estate developers is their perception of a building – while architects are trained to treat it as 'shelter', a place which houses a certain function, the real estate industry perceives it

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as a 'commodity' that is influenced by market forces and due to the concept of ownership and the huge capital investments made in constructing these buildings, they are considered as an 'investment vehicle'. As a result, the architect's focus is more on the aesthetic, functional, structural and symbolic dimensions of the building, whereas the real estate industry focuses on the financial returns of an investment or profits made by selling a product.

While architectural education focuses more on theory and design, in practice, an architect has to play a larger role in the entire development process. Development process of a building involves, aside from design, various activities such as acquisition of land, financing, development, management and adaptive reuse (more relevant in the postcovid era) involving multiple stakeholders. The role of an architect is to balance the conflicting needs of various stakeholders to ensure that the design addresses the client's requirements in terms of use, budget, time and economic returns. Also, the building industry today faces a number of challenges such as high cost of land, labour shortages, volatile material market, rising construction cost, all of which are driven by market forces. An understanding of the market forces is therefore of paramount importance to establish a successful practice for an architect.

Creative differences, cost overruns, delays and a complete absence of the understanding of the consumer's need are some of key reasons of conflict between architects and the real estate industry. In most cases developers are blamed for not giving any importance to the value add that is brought about by design; on the contrary, they consider architect's contribution as expensive, unnecessary and time-consuming (Budds, 2018). Architects on the other hand blame real estate developers for commoditization of the built environment. According to them free flow of capital in the globalised world has resulted in homogeneity, repetition and lack of context (ibid) in the built environment. Buildings all over the world today look identical with no connection whatsoever to its natural, historical and socio-cultural settings.

#### 2. Integrating Design and Economics

The Vitruvian triad defines good architecture as commodity, firmness and delight. The term 'commodity' refers to the 'function' of the building and there are several layers to the term function. Function may refer to user function, technical function, environmental function, economic function and symbolic function (Omrania, referred 2020). It is therefore the architect's responsibility to fulfil the economic function of a building by integrating design and economics.

Built-environment requires substantial financial resources. Both individual households and businesses spend considerable amounts of their income/revenue in creating these assets, which in turn account for significant portions of their wealth. Hence, owners wish not only to lower costs but also to increase profits. The owner/investor employs various ways to increase profits such as

- select locations that enhance revenue opportunity
- maximise usable floor space
- ensuring the development is demand driven
- ensuring the land is put to its highest and best use

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The role of architect is to treat this requirement of profit maximization as a 'must-have' or indispensable in their design approach rather than it being an after-thought. Take for instance, maximising floor space achieving the full Floor Area Ratio (FAR) permissible for a given site is a pre-requisite especially for high-value land in city centres; failing which, market forces will ensure its redevelopment for the highest and best use in the long run. The next section elaborates on how some of the major challenges faced by the built environment can be addressed by integrating design and economics.

#### 2.1 Sustainability

Buildings are enormous consumers of energy and resources; it accounts for 36% of the global energy use and is responsible for 39% of the global carbon di-oxide emissions (International Energy Agency, 2017). The building industry is heading towards more performance-based and outcome-based compliance in order achieve to its sustainability goals. The most economic building is one that provides the highest value at the lowest cost by economising the use of scarce resources throughout the life cycle of a building (Mulligan, 1993). 'Cost' here not just refers to the initial cost of construction, but also operations, maintenance and repair costs. While developers are motivated by the cost savings, architects have a significant role to play in ensuring that energy and resource performance of the project is integrated into the overall design.

#### 2.2 Housing affordability

The second aspect that is addressed by a combination of design and economics is that of 'affordability' particularly in the case of low-income housing. Affordable housing is

defined as housing that is affordable to that section of the society whose income is less than the median income of that region. According to a study by Indian Institute for Human Settlements (IIHS), 95% of the urban households in India cannot afford a house that costs more than Inr10 lakhs (IIHS, 2014). This shows the massive housing shortage and also the need to bring down the cost of construction. Adopting modular construction that includes design optimization, adequately supported by the economic principles of scale and the integration of automation technology can help bring down the initial cost of Modularisation construction. has the capability to disrupt construction and real estate ecosystems; some of the recent projects using modular technology have proven that project timelines can be accelerated by 20%-50% and costs reduced by 20% (Mckinsey, 2019).

Some economists argue that international finance in housing markets respond to the preferences of global investors forcing markets to build not for end-users but for investors who are fixated upon the product's future/ resale value rather than the need of communities (Farahani, Clark, 2016). Reports suggest that this has resulted in spatial segregation and inequality in cities. However, countries such as Singapore have tailored government policies by leveraging market forces to achieve their social goals (Centre for Livable Cities, 2017). This has also given birth to the concept of 'demand Ζ driven design' where a thorough market due diligence and consumer preference surveys are conducted to provide a clear design direction to the architects. Some architects are using this method of demand driven design to inverse the relationship between demand and

supply in real estate from supply driven to demand driven (Delaux, 2018).

#### 2.3 Urban policies

According to urban researchers, great cities are a result of the alignment of their spatial and economic growth (Patel, 2015). Urban planning has undergone a paradign shift from the design driven approach during the industrial era to a market driven approach today. Planners argue that design driven planning is static and urban planning based on land-use regulations has negative impacts on housing affordability, business locations and labour markets. They observe that urban policies driven by markets are dynamic and are more responsive to the exogenous factors in a globalised world. Alain Bertaud in his book "Order without Design" highlights the relationship between market forces and urban spatial structure. According to him market forces help in increasing urban land supply, transforming land use, setting the quantity of land and floor space used as well as heights of buildings (Bertaud, 2014). At the same time Bertaud emphasises the need for design intervention where markets have failed, especially in providing public goods such as parks, open spaces, streets and road networks.

#### 3. Conclusion

Ensuring that a building satisfies its economic function is more relevant in today's world than ever before. Increasing population and urbanization are two reasons causing immense pressure on land resources. More than 60% of the urban population is expected to live in cities by the year 2030 with more than 43 megacities (cities with more than 10 million inhabitants) (UNDESA, 2018). Majority of these megacities and fastest growing urban centres are expected to be concentrated in the emerging economies of Asia and Africa. Catering to the growing demand of this urban population in terms of affordable housing, transportation, energy efficiency and infrastructure are major challenges that will require the participation of building professionals and the real estate sector to ensure the best use of the limited resources.

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### AN INVESTIGATIONAL ANALYSIS OF RAPID TRANSIT CORRIDORS IN HYDERABAD AND BENGALURU- A CASE TO HIGHLIGHT PLANNING PROCESS AS A MAJOR TOOL

#### Abstract

Roads are an integral part of any city. A well-planned road helps in the economic growth of a city abreast of delivering social benefits. Along with other things, a strategically planned road facilitates access to education, health services, and employment and has proven to be significant for poverty alleviation. The growth of a city with respect to the area and population poses an additional challenge for planning the intercity roads. To cater to a burgeoning city, Rapid Transit Corridors have been traditionally planned in many cities. A strategically planned road helps layered and incremental planning for future growth and ensures a city's seamless growth. A strategically planned expressway is a facilitator to the growth of a city. The adequacy of roads in a city is defined by the relationship between the road's length and the population. The Bengaluru populace was 84.3 Lakhs (2011), and the population of another major south Indian city of Hyderabad was 68.1 Lakhs (2011). The construction of Rapid Transit Corridor (RTC) named as Nehru Outer ring road in Hyderabad and Secunderabad commenced in 2008 and culminated in 2016. The construction of RTC named as Outer Ring Road in Bengaluru commenced in 1992, and the last phase culminated in 2002. This paper attempts to compare the effect of growth of the population in both cities. It further compares and analyses the features of Transit Corridors of Hyderabad and Bengaluru towards their adequacy. Strategic recommendations are based on the analysis.

#### Keywords

Rapid Transit Corridors, Ring Road; Outer Ring Road; Inner Ring Road; Road Traffic, Congestion



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#### 1. Introduction

As India has been progressively getting urbanized over the last few years, metro cities started getting crowded with more populace than non-metro cities (Kundu 2006). Owing to the inclease in urban population, there is an increased demand for additional Infrastructure in urban areas to support the rise in pupolation. In a large city, the accessibility to an efficient and effective transportation framework is basic for economic activity, movement of population and the associated development. This requires making a framework that delivers this capacity, and offices run on it (MGI 2010). Good infrastructure encourages exchange and different linkages the city with the area and promotes its development. A significant phenomenon related to urbanization in metro communities is that the rural and peri-metropolitan zones are developing more than urban communities (Sivaramakrishnan and Kundu 2005). Metropolitan planning addresses how individuals will live, and work in a given territory, and as a consequent, regulates and guides the development of metropolitan, rural, or suburban territories. Efficient urban planning would ensure roads facilitating, distribution and transportation of populace, waste, water and other esentials. Road would at times even help in bypassing the centre of city.

Architecture cannot be restricted to mere designs of building but has a larger role and responsibility in the society. The subject cannot work in silo but need integration with other domains as the need of the hour by the creation of physical settings that are conducive to general movement and physical activities. The research and teaching have to be modelled accordingly to the students. Over the years, government and planning legislations involving urban renewal have encouraged research for the continued development and inclusive adaptation of our towns and cities. (Sports Confederation of Denmark, ഗ 2009). The trend is projects where architecture and town planning converge towards more researched and inclusive  $\underline{\circ}$ living spaces. This necessitates integrated teaching and research in the field of architecture.

These paradigm shift in the concpts of road planning, are continually reflected in planning methodologies, zonal.

AN INVESTIGATIONAL ANALYSIS OF RAPID TRANSIT CORRIDORS IN HYDERABAD AND **BENGALURU** 



codes, and strategies, making it a profoundly specialized, political, social, monetary and environmental field. If the design which is optimal and aspects concerning the service of a trasit system balances the need of both customers as well as operators, then the probability of success of sustainebale urban transportation increases system (S.C.Wirasinghe et all, 2013). Planning for roads and its development should take in account the uses of transportation; future as well as present. A Road is stragegically planned to support the growth of a city with least monetary and environmental expense. The main objective in planning a road is mandatory as the guiding mission of the project.

The objective could be decongest the traffic from other areas, development of the area in the neighbourhood of the road or connect to places, to name a few. Distinctive monetary and trade between the metropolitan and periphery zones lead to the interest for transportation among them and over/close by the periphery zones. Ring roads as Rapid Transit Corridor, supports the movement of populace and facilititates economic activies intra region in a city in an organised pattern. Expressways are circumferential interstates that are found in many urban communities. The roads were developed to disperse the congestion from downtown areas to the city's peripheral areas (Mill, 1981).

A "ring road," freeway, circumferential roadway, or circle expressway is a road that encompasses a city to smooth out the downtown traffic course through better dissemination and connectivity between different hubs just as by filling in as a bypass for roadway traffic (Road Traffic Technology, 2013). It is a significant method for accomplishing transport network and higher traffic speeds, decreasing natural effects on

	Table 1:	Cities	with	a ring	road	system
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State/ Region	Ring Road
Ahmedabad (India)	Sardar Patel Ring Road
Ankara (Turkey)	Otoyol 20
Bangkok	Kanchanaphisek and
(Thailand)	Ratchadaphisek
Beijing (China)	Total of six ring roads
	around the city
Bengaluru (India)	Outer Ring Road
Delhi (India)	Outer and Inner Ring
	roads
George Town	Middle Ring
(Malaysia)	Road(Penanag) and Inner
	Ring Road (George
	Town)
Hong Kong (Hong	New Territories Circular
Kong)	Road (Route 9)
Hyderabad (India)	Nehru Outer Ring Road
Jakarta (Indonesia)	Inner, outer and Outer
	Ring road number 2 in
	Jakarta
Kathmandu	Kathmandu Ring Road
(Nepal)	
Kuala Lumpur	Kuala Lumpur inner,
(Malaysia)	Middle ring road number
	1, Middle Ring Road
	number 2 and Outer Ring
	Road.
Lahore (Pakistan)	Lahore Ring Road

Source:Collated from City Development Authority web sites

environmental, air, noise pollution and congestion, and better traffic dissemination (Pharande 2015). Given the numerous advantages of such roads, urban communities must create them to decongest and regulate traffic as objectives instead of land development of adjoining/ neighbourhood areas. Most expressways are significant reason assembled parkways around a town or city, normally without signs or road or S

AN INVESTIGATIONAL ANALYSIS OF RAPID TRANSIT CORRIDORS IN HYDERABAD AND BENGALURU railroad intersections. In the United States, freeways are basic shares of the Interstate Highway System. In the United Kingdom, it is called "orbital motorways". In India, they are called "Ring Roads".

#### 2. Methodology

Existing literature on road planning, traffic management, and features of a ring road as Rapid Transit Corridor were studied. The secondary data on traffic, population, and traffic density was analyzed to assess the reuirement od Rapid Transit Corridor. All data associated with both the ring roads collected were analyzed. Empirically, Hyderabad, and Bengaluru's existing outer ring roads were studied by traveling on them at different times to relate the theory and the secondary data. The recommendations were ideated based on analytical comparisons. The scope is restricted to comparing both the ring roads in terms of meeting the objective of decongesting the city it serves.

#### 3. The ORR in Bengaluru

Bengaluru is situated in southern India, popularly known as "Silicon Valley" because of the many global tech firms. It has acquired the sobriquet "Asia's quickest developing City." While the whole foundation infrastructural frameworks are under gigantic pressure in Bengaluru, the transportation infrastucture is severely hit. The city has an Rapid Transit Corridor in the name of Outer Ring Road. As per the design, all interstates and district roads are radially meeting into the center zone. The road network in Bengaluru has grown by 11% in the previous six years, which is a moderately little development

compared to the spatial development of the city. Although Bengaluru has three-ring roads, five significant outspread roads, and five auxiliary spiral roads, it is not able to meet with the city's exponential development. Bengaluru is the third most crowded city in India with an expected populace of around 84.3 lakhs spread more than 821 sq Km. The Bengaluru "ORR is a two-directional road" with two lanes accommodating the traffic to move in either way. The path widths for the whole part of the road were kept up at 4 meters with channels on one or the other side with depth of 1.5 meters. Bengaluru has a spiral road network with five essential roads (National Highways) and five optional roads (State Highways) uniting/veering from the existing Outer Ring Road. Generally, the development of the ORR in Bengaluru was very advantageous, leading to the development of more network of roads and flyovers, which indirectly helped in the growth of software industry. The ORR was planned to go around the ourskirts of the the city of Bengaluru, at its borders. The Bengaluru Development Authority created this 62-kilometer-long (37 mi) road, and various segments were opened between 1996 and 2002. The ORR was planned to be road interfaces all significant parkways around the city - Magadi Road, NH 948/ Bannerghatta Road, Kanakapura Road, NH75/ Old Madras Road, NH44/ Hosur Road, NH 48/ Tumakuru Road, NH 44/ Airport Road and NH 275/ Mysuru Road . It goes through significant areas and rural areas.

#### JANUARY 2021



Figure 1: Outer Ring Road Bengaluru with proposed Peripheral Ring Road Source: BDA, GoK

#### 4. The Outer Ring Road in Hyderabad

The notion of the outer ring road was first conceived by N. Chandrababu Naidu, the chief minister of Andhra Pradesh, in 2001. One fifty-eight kilometer-long expressway encompassing Secunderabad and Hyderabad's urban communities was proposed to counter the metropolitan district's gridlock issues. The goal was to give orbital linkage to arterial roads and admittance to the airport region and other metropolitan regions. The underlying overview on the current NH44 and NH65 showed a necessity of 4/6 lane road. The decision was to build up a road for every crossing roadway. The first road construction Phase required 750 acres of land, out of which the private land gained was acquired was 500 acres of land. The land needed for Second Phase is around 5,500 acres of land, of which the Govt. land is around 1,000 acres of land. The assessed Cost of Acquisition is ₹250 Crores. The undertaking was finished in two phases and is assessed to cost ₹3000 Crores. The Rapid Transit Corridor or the Nehru ORR in Hyderabad is an eight-path ring road interstate with 158 kilometers enclosing Hyderabad city. A huge portion of the zone covers metropolitan hubs, including

AN INVESTIGATIONAL ANALYSIS OF RAPID TRANSIT CORRIDORS IN HYDERABAD AND BENGALURU





JANUARY 2021

Hyderabad International Airport. There are 20 trade intersections on the external ring road. It gives a network between, NH 161, NH 163, NH 765, NH 65 and NH 44 from Warangal to Vijayawada and Hyderabad just as public interstates prompting Vikarabad Nagarjunasagar and Karimnagar/Mancherial areas. The external ring roads diminishes the movement time from the air terminal to urban areas like Nizamabad and Adilabad as it interfaces with NH44. The freeway associates with the internal ring roads and the impending territorial Ring Road.



#### Figure 2. Hyderabad and its outer ring road. Source: HUDA (GoAP & Telengana)

AN INVESTIGATIONAL ANALYSIS OF RAPID TRANSIT CORRIDORS IN HYDERABAD AND BENGALURU 25

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Phase II	Construction of 83.7 mi (134.7 km)
14. 09. 08	Shamshabad –Narsingi –Gachibowli (22 km) (access to Hyderabad
	International Airport)
07. 07 10	Pedda Amberpet - Shamshabad(38 km)
14. 08. 11	Patancheru - Narsingi(23.7 km)
03. 12. 12	Gowdavalli - Patancheru, and Shamirpet - Kandlakoya (38 km) (part
	completed in 27. 04. 18)
04 .03.15	Ghatkesar - Pedda Amberpet (14 km)
15.07.16	Shameerpet – Ghatkesar (23 km)

 Table 2. Construction of Roads.

Source: Indian Journal of Transport Management, Volume 38 (April – June 2014), HUDA and GoAP project reports]

#### 5. Analysis

The growth of Bengaluru city has been exceptional in the last couple of decades. As per Department of economic and social affairs, (UNO), the populace in Bengaluru Municipalities and Urban Region would expanded from 30 lakh to 143.95 Lakhs by 2025. The same department predicts that the population of Hyderaabd would be 113.38 lakhs by 2025. The explosive population growth in Bengaluru has resulted in the transportation infrastructure being severely affected due to excessive traffic movements in the city and the ring radial road pattern. BDA had executed and implemented the outer ring road and inner ring road traffic managegement plan as a part of the Comprehensive Development Plan(CDP). The ring road helps in reducing the core traffic in the city. Bengaluru has two ring roads. The inner ring road connects Indiranagar and Koramangala area, the outer ring road connects "all the major highways around the city." The traffic movements to and from all majot highways, resulted in immense growth in intra-city traffic movements. The urban congestion ranking

worldwide shows that Bengaluru ranks number one amongst 28 countries with eight million (Datacorp, 2019). The outer ring road was constructed as a bypass to the city for vehicles commercial and personalized vehicles (Reject et all 2017). However, due to increased traffic on the outer ring road and interconnected roads, volumous traffic at all major intersections has led to traffic congestion. The shift in the International airport from HAL, Domlur to Devanahalli has also resulted in traffic congestions. The most noteworthy gridlock is found in the Hebbal and Silk Board intersection because of the number of tech and other major firms working in the region and its connectivity to the airport. The outer ring road has not relieved traffic congestion between junctions; hence, a second ring road is needed at a radius of about 17 to 25 km from the core of the city. A Rapid Transit Corridor call the peripheral Z

ring road is planned to improve the  $\sigma$  connectivity of areas beyond the outer ring  $\sigma$  road and ease traffic congestion.

#### 6. Comparison Analysis

The BATF (Bangalore Action Task Force), <sup>◀</sup> <sup>⊥</sup> which functioned from 1999 till 2004, <sup>⊢</sup>



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demonstrated some promise to relieve some congestion issues; however, no authentic exertion has been made to implement any tangible plan. Also, so far no effort has been seen to include the general population in planning A few issues. answers for decongesting the traffic on ORR Bengaluru have been resident-driven yet formally they never joined in the the official planning process to decongest the ORR (Bengaluru) or The Hyderabad ORR has been the city. strategically planned and methodically It takes executed. into account the development of the city and the related traffic. The development of the zones around the external ring road is arranged to control the road congestion. Contrasted with ORR Bengaluru, in Hyderabad, the settlements of any sort, be it business or private, are far from the ORR limit. ORR in Bengaluru can be accessed at any place without any regulated entry or exit compared to ORR at Hyderabad. The process and the land use plan of the ORR Hyderabad ensures a de facto buffer to the eight-lane expressway and the associated service lane. There are no at-grade intersections and the provision of suitable interchanges like for National and State Highways and other important urban roads exists at convenient points. This provision to regulate the traffic is not there in Bengaluru Outer Ring Road. Unlike Hyderabad Outer Ring Road, the development and construction at many places have been incremental and continue to be in installments based on the new requirements.

Except for in cases of emergencies, on Nehru ORR, there is no arrangement of parking. There are committed paths for vehicles like trucks and transports with heavy ladedn weights only on the left two lanes. No vehicles like bikes and autorikshaws are permitted. This arrangement and system

separates it from the Bengaluru ORR.There are no settlements close to the Nehru ORR, Hyderabad which requires parking near the ring road. The road is additionally not utilized for travelling short distances. There are 19 exchanges where the vehicle can join the ORR or can exit. Each exchange is at a normal separation of 8.4 km. It understands that it is practical to utilize the ORR if the normal distance to be travelled is in excess of 10 Km.

In ORR Bengaluru, there is no ban or embargo of any kind on any vehicle to utilize the ring road for travelling short distances. Unregulated and unplanned growth along ORR lead to uncontrolled development of the Unregulated area. and spontaneous development along ORR has prompted and pamperred the uncontrolled development of the zone. Notwithstanding the workplaces and business foundations, neighborhoods have sprung up to oblige those working at the workplaces and ORR, adding to more population, vehicles and chaos in the neighbourhood. The cost of construction or the land acquisition factored are not compared because, they are plausible based on the strategic plan made.

#### 7. Conclusion

The integration at all levels have become imperative for an inclusive and collective strategic growth- and rightly so. The concept is also mutually beneficial to all associated domains. Strategic growth is only sustained with relevant and associated research. veritable and planned accessibility to and from living spaces espousing sustainable, attractive, and high-quality urban designs. Pedagogy in the field of architecture hence, must be inclusive and not restricted one domain.

The human welfare and environment is challenged in many developing countries of due to rapid and uncontrolled Asia development of transportation (Ryosuke et all, 2006). Alongside the expansion in populace number of vehicles has likewise expanded. The vehicle populace in Bangalore has expanded from 41 lakh (1991) to 80.45 lakh (2019) during the recent years. The existing roads cannot be expanded due to permanent commercial and residential areas which have come into exisrtence in the name of development all along the ring road. The Ring road which acted as a catalyst for the unregulated development of neighbourhood is suffering due congestion due to the same development. Bengaluru is a ring-spiral/ radial-designed city like Delhi, Hyderabad, and Ahmedabad. Travel time in a ring-spiral/ radial designed city - without a well-formed grid network is more when contrasted with a city with non radial/ straight roads. (e.g., Mumbai, Chennai, and Kolkata). Bengaluru is a mix of towns devoured by the city's digestion. The city's normal road width is only 15 m or 50 ft, which is insufficient to utilise it for any mass transport public vehicle. For instance, BRTS (Bus Rapid Transit System) requires the least road width of 36 m. The BDA, Revised Master Plan (RMP 2031) reported that 7.39% of Bengaluru's territory utilized was for transport (which incorporates road and other vehicle-related frameworks). One may contend this is generally low when contrasted with 21% in Delhi (however, Delhi has many traffic issues despite its wide road network). Various arranging rules like the Urban and Regional Development Plans Formulation and Implementation (URDPFI) recommend between 10-15% land use for street framework in any metropolitan city. In Bengaluru, similar to some other city, the ring road is an economic corridor and facilitates

development. In any case, the development along the ring road was not directed or controlled. The road were not futuristically planned in a strategic manner to meet the requirement of future growth in traffic. When contrasted with Bengaluru, Hyderabad Nehru ORR is futuristically planned in a strategic manner in terms of design and the regulations to meet all the objectives.

#### 8. Recommendation

Any growth must be regulated and planned strategically. The planning of roads should not be restricted to a good design but should provide a balanced solution. A new strategically planned peripheral ring road (PRR) is required without any delay in Bengaluru to mitigate the ORR's traffic congestion issues. It is seen that the success of any road is not restricted only to an adept design. Many well-made plans have failed to meet its aim & objectives. Hence based on the case seen so far, the paper recommends the following: -

- Ring roads as Rapid Transit Corridor should be to decongest the traffic and not develop land space for commercial use. If the growth is not regulated, the development will congest the very ring road constructed to decongest the traffic. Though not planned or foreseen, the same has happened around ORR in Bengaluru.
- The policy on land use should be strategic. This policy on land use should be supported by allied regulations, adept design, and procedures for ring road use.
- Hike the cost of registration of new personal vehicles. However, regulations should be in place to monitor the private use of vehicles registered for commercial use.
- The congestion could be eased to some extent by congestion pricing for existing places.



- All (single or apartment) Home Plans to be only approved with designated car parking. This would reduce the cases of cars being parked on roads (Other than ring road). The minimum plot size could be decided based on other factors to cater to lower economic strata.
- No issue of license to do business if there is no provision of parking space. A perennial problem faces on New BEL Road and 80 feet road (RMV II stage). In fact, in the name of development, areas like New BEL road have been developed uncontrolled. The road has become a shopping destination, but there is no parking space by the road for shoppers.
- Regulations to put responsibility on the employer's so that the employees use more of the public transport system.
- The government could promote shared transport through policies by giving tax benefit/ any other benefit like no toll tax for four or more occupants in a car/ Priority lane or parking etc
- Facilitate mass transit by more creating more stations and ease the use of mass transport systems.
- The shift from design based towards an integrated approach to road planning. Incorporating the appended points enunciate an integrated approach:
  - a) Regulations on land use.
  - b) Socio-economic profile of the area where the road is being planned
  - c) Motor vehicle sales forecasts along with traffic growth forecasts
  - d) Public transport systems
  - e) Outcome-based strategic planning that focuses on area-based development and participation of the public

- f) Aligning the new roads with existing roads
- g) Dynamic for future expansions
- h) The design and standard specifications

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### TEACHING BUILDING STRUCTURES AS A SUBJECT IN ARCHITECTURE STUDIES

#### Abstract

A structure is beautiful, when it conveys and serves the purpose for which it is built. This is possible when an architect and structural engineer collaborate in all stages of a construction project for achieving structural stability. This collaboration necessitates the introduction of detailed structural engineering concepts in architectural education. In architecture education, building structures is taught as quantitative and separate entity and its importance is neglected as the time ascends in the course. This happens at the university level, where the studios of architecture studies is designed to concentrate more on architectural skills and with minimal importance on structural detailing of the building. The scheme, syllabus, exam patterns, credit points of building structure in architecture studies has seen a drastic change from time to time. This study focuses on the perception of students and faculty on the importance of structures in architecture studies and opportunities on various methods of teaching structures as a non-quantitative, important subject for UG (B.Arch) architecture students. It looks specifically at the scheme, syllabus and requirement of Visvesvaraya Technological University (VTU) in particular.

*Key words:* Architectural Education, Building Structures, Scheme, Perception, non-quantitative.

#### 1. Introduction

World famous structures attract common people with their appearance and multi-utility. These are the combined efforts of an architect and a structural engineer. Together they transform the imagination into reality by selecting suitable architectural elements, material and best conjugation of structural elements such that the structure fulfils the purpose for which it is built. These buildings motivate and inspire the students to take up architecture course. A graduated architect, in addition to the architectural skills needs to know the behaviour of a structural element so that the structure is in equilibrium and stable.

Over the period of time, many engineers and architects have developed some misconceptions that their responsibilities mutually excluded each other's concerns and sensibilities. This sensation is also expressed by Tom F. Peters in the book 'Bridging the Gap: Rethinking the Relationship of Architect and Engineer' as follows: While engineering hopes to be moving toward a more comprehensive approach to design and building, and the very nature of the word 'design' in engineering seems to be shifting to more 'configuration' mean than 'dimensioning', architecture is in danger of diversifying into literary and purely graphic pursuits, on occasion so strongly that some architects become mere aesthetic consultants or even abandon building altogether. (Peters 1991)

There is an increment tendency in architects, as structure is a technical subject who's which is left to engineers who would not involve in design and have to work within the boundaries and criteria set by the architects. Engineers, on the other hand, have begun to see architects as just artists whose, demands sometimes are in contradiction with the principles of equilibrium and economic structural design .However, both engineers and architects would agree that a building must be of aesthetically beautiful that satisfies both the conditions of serviceability and firmness. Though the main occupation of an architect is to design and hence in the academics of architectural studies the subject interest naturally goes to architectural design studio which is the center of curriculum across the world. Also, a complete design could be achieved with artistic skills. theoretical and scientific knowledge and the activities in design studio becomes most suitable when they are backed up with

supporting technical subjects in the curriculum.

#### 2. Current Architecture Scheme Under Vtu

The undergraduate Architecture education in VTU is mainly spread across full time 5years. Every year sees a gradual advancement in architectural skills and is a blend of theoretical and practical knowledge for students to learn the art of planning, designing and constructing physical structures of various kind. It consists important subjects like History of architecture, Architecture design (AD), Materials and Methods in Building Construction (MMBC), Building Structures, Building services etc...these subjects increase their level of knowledge and difficulty as the semester moves forward along with few other supporting technical subjects. Each of these subjects are allotted with the credit points depending on their importance of the subject for students. Maximum credit points is given for AD and MMBC.

## 2.1 Building Structure as a subject in architecture studies

Over the period of time in architecture curriculum the structures subject is taught as separate entity from the remaining of the architecture subjects.Building structures which consists of important design concepts for creating and building the structure is given minimum credits. In particular, structural design detailing and application is neglected from most of the desgin studios of the architecture curriculum. Structures education is a combination of physics .linear progression from mathematics rigid body statics, physics, mechanics of behaviour of materials, design and analysis of lateral forces and overall building behavior.

Prof. Keith E. Hedges says that "Many architects believe that mathematics interferes with design learning of structures, which has led to the detachment with the overall architectural design process" .Hedges (2014), Same like the saying building structures as a subject is losing its importance in architecture studies of VTU. It involves changes in the exam patterns, diluting the syllabus from design of structural elements to only drawing, reduction of credit points and also reduction of number of hours of teaching per week. All these efforts would help the student to somehow pass the exam but would lose his credibility of becoming a complete architect with his no understanding of behavior of the building. Hence, there is a need to develop a new way of approach about this current problem and explore a structures pedagogy that is consistent with the mental framework of architecture students.

### 2.2 Change in syllabus and scheme of Buiding Structures

The VTU has revision in their syllabus frequently, from past 10years 4 schemes have come up 2009, 2014, 2015 and currently 2018.

CBCS scheme was introduced in the curriculum from 2015 onwards. Svllabus of building structure subject has seen variations during these years and important one being method of conducting of exam for 3rd ,4th ,5th,6th,7th semester from written exam to viva-vase, from 2014 onwards. This change of pattern has also led to the dilution of syllabus like eliminating designing of the structural elements where students were taught to actually design each and every aspect of the structural element to mere drawing where an already designed data is given and are asked to draw the detailing of the element. Also this has led to the decrease in teaching hours from 4 hours per week to 3 hours per week (1hour instruction + 2 hours of drawing).

The main reason for these changes may be the pass percentage of building structures as a subject in the curriculum. For example, the statics of overall pass percentage of students taking up building structure -V in VTU of various schemes, shows that the pass percentage of this subject has increased drastically from 2018, where the exam pattern had changed from written to viva-vase and also due to the dilution of the syllabus from design to drawing.





#### TEACHING BUILDING STRUCTURES AS A SUBJECT IN ARCHITECTURE STUDIES

33

#### **3.** Results From Primary Survey

A random sample survey was conducted to get the first hand data separately for students of architecture and faculty teaching structures in architecture studies in VTU regarding building structure subject in architecture curriculum. Each survey form consisted of few questions to know their opinion on the subject. Where many faculties and students of 3rd, 5th ,7th, 9th semesters and also few graduated students from various architecture colleges across VTU. From the survey it was found out that student's mindset of taking up architecture in their under graduation mainly depended on their PUC subjects. 63.5% of students had taken up PCMB (Physics, Chemistry, Mathematics, **Biology**).Many students mentioned that they took architecture as a second choice, first being medical. Also 64.8% students responded that they don't like mathematics as a subject which led them to take up architecture, assuming that it only deals with drawing and sketching and no calculation is involved. However, building structures involves mathematics and calculations which has also led to the ignorance by many students and restrict the subject to mere passing. 53.6 % of the students responded that they study structure for mere passing.

One student in the survey stated that "They are unable to understand how the subjects during in the courses relate to studio works and corelate to their future professional life as architects. The student aso mentions that they are not abe to use the technical knowledge they acquire from other subjects in their project in desgin studio. They also feel that those technical detailing when they are successful in incorporating in their desgin studio the weightage of those works are rarely looked into and appritiated". Beacause of these reasons they tend to focus on architecture aspects of the desgin, which will help them fetch more grades and are also appriciated.

The current pattern of exam in VTU which is in viva - vase form requires the student to draw few elements of the structure with the given data. This has led to the lack of understanding of behavior of the element and ultimately understanding the equilibrium of the structure. For ex. A data is given along with the reinforcement details to draw a doubly reinforced beam. Say 350\*550 mm. the student however draws the diagram with reinforcement details. Here the important thing is, they fail to understand how these reinforcement numbers were arrived at, like number of bars in compression, number of bars in tension, is the reinforcement safe for bending, why stirrups to be provided, why are these stirrups placed closely near the supports, what is the behavior of these beams when the load is applied, what happens to the beam when it is about to fail or even why double reinforcement is required.

The main problem is the dual identity of a profession of an architect. Frequently architecture is defined as a combination of art and science. However, the question is how much art and how much science? To be more precise, what should be the content of structure courses in the architectural education and more importantly in which manner should this content be transferred to students. Maybe the most critical of the problems is the lack of coordination and the resulting problem of communication between structure courses and design studios. 89.88% of the students and 81% responded that collaboration of design studios and building structures in the curriculum is necessary.

The National Architectural Accreditation Board, Inc. (NAAB), one of the oldest accrediting agency for architectural education in the United States, requires that programs demonstrate satisfactory evidence of student achievement within a discrete structural systems criterion and under a broader design studio situation. The National Council of Architectural Registration Boards, Inc. (NCARB) licensing board for 50 US states defines structural systems as, "The study of the basic structural elements of buildings, their interaction as a support system, the forces that act on and in buildings, and the principles, theory, and appropriate applications of these in design studio systems." The NCARB approximates that the academy, on average, assign six credit hours to structures exclusive of any prerequisite mathematics and physics coursework.

#### 4. **Results And Discussion**

From the graph it is evident that bringing up the older syllabus would see more failures. ALI IHSAN U NAY and CENG IZ OZMEN says "Majority of architectural students are visual learners, which means that, they tend to make use of their sensory skills besides their analytical mind. The sensory skills, on the other hand, are all interconnected. The senses of touching, tasting, seeing, hearing and smelling all work as a whole in the process of making the mind aware of the outside world"(2014). The perception level and interpretation of an object depends with the ability of senses that support the absorption of an information related to that object. Based on this, it can be said that actual models will help the students to percieve and interpret in a better way as their senses like seeing, touching and hearing act as primary mediums for Also models learning. help in the demonstration of theoretical concepts such as displacements, torsion, bending, behaviour of structural element under loading more practically. Hence a concept of model making and drawing combination would be bought up where the behavior of structural element is shown live in the class. 89% of the students and 91% of the faculty members responded that they need a combination of practical knowledge as well as theory for this subject.



# Figure 2 : Demonstration of failing of a normal beam bridge constructed from straws Source: pinterest.com

Framing of content of syllabus of building structure should laterally run according to the structural details requirement in design studios of the respective semester. Presence of a member with technical knowledge of structures in Board of Studies (BOS) and Board of Examiners (BOE) of the university would be required for the same.

#### Collaboration

of subjects like MMBC and building structures. MMBC which also deals with the materials and detailing of structural elements but does not concentrate on understanding the behavior of the structural element, is given second most credit in the exams. Since, these two subjects are similar in their objective, a syllabus could be formed in such a way that at every semester these two subjects could go laterally. For example a design of certain element could be done in building structures class while the same drawing could be done in MMBC. In such a manner deeper knowledge of the structure could be achieved in both the subjects. The behavior of the element could be studied in Building structures class while the suitable material for the element could be analyzed in MMBC class. It is required to give equal credits for both the subjects.

A new system has to be bought up by developing a studio that is multidisciplinary in nature by including faculty from different technical disciplines. Where along with architectural design faculty, one common faculty with knowledge of structural design and occasionally a mechanical engineer to be present. Also considering structural element of the design as critical part for evaluation. This would create a sense of interest and enthusiasm students to learn the design parameters in depth and ultimately overall architectural skill development of the students. Such a method is also followed in Hence, one of the major step in improving the method of education of building structure would be to increase the appropriate staff specialized in structures in design studios of the curriculum.. Council of Architecture (COA) considers faculty teaching structures as well as artistic skills as allied faculties and not core faculties.

Hence, in most of the cases tenure faculties and visiting faculties are hired to teach building structures and not the core faculties. Also professor post for a faculty teaching structure is absent. 71.9% of the faculty teaching building structures replied that they would not continue to teach in architecture if they are not promoted to professor post in spite of having adequate qualification. This would lead to decrease in the interest among the faculty members to teach the subject.



Figure 3: Isometric structural diagram of a design studio project to illustrate the relationship between structure and architectural space. Detailing of every element of the structure is shown.

Source: Prof. Keith E.Hedges, Drury University

TEACHING BUILDING STRUCTURES AS A SUBJECT IN ARCHITECTURE STUDIES

Hence, one of the major step in improving the method of education of building structure would be to increase the appropriate staff specialized in structures in design studios of the curriculum.. Council of Architecture (COA) considers faculty teaching structures as well as artistic skills as allied faculties and not core faculties. Hence, in most of the cases tenure faculties and visiting faculties are hired to teach building structures and not the core faculties. Also professor post for a faculty teaching structure is absent. 71.9% of the faculty teaching building structures replied that they would not continue to teach in architecture if they are not promoted to professor post in spite of having adequate qualification. This would lead to decrease in the interest among the faculty members to teach the subject.

#### 5. Conclusion

Conjugation of architectural skills and structural skills is possible from an appropriate form of architectural education. Teaching building structures should have more of hands- on activities along with the soft method of teaching with lot of options for trial and error method, which makes the students to get the hang of concept easily. Small scale lab experiment where the behavior of the element could be observed under loading, where failures of a structural element could be understood. Collaboration of subjects like MMBC and building structures could help give equal importance to both the subjects. Considering structural detailing as also important criteria in design studios for marking could help the students to take up building structures seriously and implement in their design.

It is the responsibility of schools of architecture and universities that take up the

task of future generations who pursue architecture with the skills and knowledge of building future buildings. It should be remembered that building structures design not only makes the building firm but when skillfully designed it becomes one of the key elements that decides the spatial functions, serviceability and aesthetic quality of a building. Architecture and structures cannot mutually exclude each other, if done, its like building a structure without foundation.

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### DELIBERATING IN THE RETROSPECT ON DICHOTOMIES IN TEACHING HISTORY OF ARCHITECTURE

History of Architecture in Architecture course is introduced from the very first semester which is typically presented as a facet of cultural history tracing the advent of man's achievements as development over time and across world. The syllabus thus attempts to cover world perspectives in Art and Architecture tracing from prehistoric to contemporary times. Early years of teaching started and ended in classroom with a quest to make subject more interesting to students. However this quest not only led teaching and learning out of classroom but also to a series of experiments to explore challenges of pedagogy which always seemed to manifest in a dual and conflicting situations. This paper does not take a polemical approach to decide one method over the other but rather tries to investigate in retrospect approaches taken over 13 years to address various challenges presented by institutional changes (one system to another) students and teaching experience, capsuling this journey by identifying dualities implored by various situations as a pedagogical approach that is evolutionary and subjective.

*key words* : Pedagogy; History of Architecture ; dichotomy, teaching plan; expository & explorative

#### 1. Introduction

The objective of History of architecture (HOA) course is introductory and broadly varies from providing an understanding to evolution of architecture both in India and western world with stylistic modes, characterized by technology, aesthetics, planning practices, to identifying socio- cultural changes aptly reflected in the typologies and building theory of that period. The most illustrious historical works from each period which exemplifies the characteristic features of that time are identified to be discussed. However the course objective fails to mention any conscious induction of skills in pedagogy. This brings to the very first dichotomy presented by course objective itself.

### **1.1. Dichotomy- teaching either knowledge or skills?**

Basic Gestural skills in teachinglearning are key factors. They becomes all the more important for a teacher when the learning requires to be evaluated for "understanding" the content taught to a student and to "express" the understanding to be evaluated for a student. The approach in the first semester was clearly Expository.



Figure 1 :Pedagogy model for teacher centric approach, Source: Author

#### 1.2 Teaching plan- Teaching approach was direct with Conventional teaching framework and deductive reasoning

**First semester - Lecture structure** – Introduction covering geographical and historical contexts.

Each classical example mentioned was discussed in terms of style, architecture and

materials. Session was concluded summarizing with pointers for the next class.

*Student Activities-* Sketchbook – list of sketches facilitated to be sketched and submit after every module.

Assignment book- Important questions from each chapter were asked to answer and submit after each module for Continuous Internal Assessment (CIA). Mandatory three tests were conducted .Mock test (3hr) was given at the end of semester to prepare them for Semester End Exam (SEE). The performance of students both in CIA and SEE were not satisfactory. Both assignments came in largely incomplete, clearly indicating inadequate basic skills required for both. SEE results also showed an average performance. The dichotomy whether to teach knowledge or skill resurfaced. Thus in the second semester focus of teaching though still teacher centric, attempted to enhance their gestural skills. Lesson plan, student activates and assessment mechanism remained same. Teaching mode became demonstrative and group activities were included which seem to have triggered the interest.



Figure 2 :Sketch demonstrated in the class

Source: Author

	Semester	Syllabus	Issue focused	Assessment Mechanism
1	First	Early	Lack of interest and	Test performance –Average from three
		civilizations	motivation in the	tests=70%
		-world	subject	Sketchbook and Assignment book
		perspective		submissions 30%
2	Second	Hindu	Lack of basic Gestural	Test performance –Average from three
		architecture	skills and non-	tests=70%, Sketchbook and Assignment
		-India	participatory attitude	book submissions 30%

Table 1 : Issue focused and Assessment Mechanisms used in the first two semesters.Batch -2007- Class of 58, Source: Author

Second year threw me into a whole new perspective of pedagogy when both system and students changed. Students of this batch were quite smart and demanding. They seemed more enthusiastic, eager to learn, willing to work both individually and as a group, were also open for experiments. They asked several questions demanding an exposure to many examples which the syllabus did not mention. Perhaps this was the reason that second year despite being short semesters and a roller coaster ride was still the best and productive year of pedagogy. This also led to pedagogical leap from teacher centric to student entric.

#### 2. Dichotomy

Institutional context- System change-VTU (state university led) to Autonomy -16 weeks vs 13 weeks – Introduction of quiz along with tests. Dichotomy in pedagogy -Direct instruction vs indirect instructions (Autonomy gave some flexibility with respect to desired outcomes) Conventional teaching framework VS Explorative Teaching framework (Time frame vs Autonomy). Aptitude of students- Smart, enthusiastic, willing to work and experimental approach, gestural were good at skills. Monuments/classical examples vs local and humble examples (students demanded examples other than mentioned in the syllabus) Examples as products (Style,

architectural features and spatial organization) vs process (world context, Sociopolitical, economic, cultural and climatic contexts. Construction process, material significance etc.)

## **2.1** Teaching plan- Explorative (student centric) with innovative teaching techniques

Teaching plan was discussed in the introduction class to accommodate their interest both in terms of extra examples and type of activities. This was a mutual agreement and commitment session.

Lecture structure - lectures were planned with exclusive titles for each time period based on the factors which dictated their architectural manifestation. Introduction covered not only geographical and historical layers but also political, socio-religious, philosophical and economic layers. Slides briefly discussing lesser known but otherwise important examples apart from syllabus were included. Small session end tasks were given extended learning which was not as compulsory, hence giving a choice for both not keen and very keen students.





Figure 3: Models done by this batch (I&II semesters). Source: Author

Student Activities- Sketchbook - list of sketches facilitated were asked to sketch during class and post class in the sketchbook. Debates were conducted to discuss important topics. Important questions from each chapter were asked to answer based on the demonstrated structure, with an exclusive opinion based conclusion. Mandatory three tests were conducted .Mock test (3hr) was given in the end of the semester to prepare them for Semester End Exam (SEE).

Group activities- Students were divided into groups to make model of classical examples ,wall mount model/chart to discuss lesser known examples of the period. Assessment was now divided as 50% for tests and 50% for Assignments. Equal weightage gave them motivation.

This batch did well in terms of activities and submissions producing excellent models (Fig 3) which were used in the later years for teaching. This approach was continued for the

same batch in their 4th covering Renaissance to Modern period and 5th semester covering contemporary architecture. Both the semesters went well and were successful. Haptic tools and group activities worked very well with this batch. However the result was quite shocking when the same approach was followed for the next batch. The impact, response and performance varied greatly. Students were reluctant to make models and work in group activities leading to the next dichotomy.

#### 3. Dichotomy- Students activities – Group Vs Individual

#### **3.1 Teaching Plan- Explorative & reflective** teaching

Group activities not only encourage peer interaction but also help each to identify their own strength and weakness while contributing constructively to the team. Obvious lack of interaction among themselves in this batch led to formulate group assignments. However, submissions which came in were either incomplete or of unacceptable quality. The group activities suffered, productive time was wasted in blame game. They expected me to discuss and furnish tailored reference material for every topic which meant no time for any extra activities at all. Despite what appeared as not so successful semester their performance in semester end exam was astonishing. With 100% result there were more number of students scoring A grade and majority scoring B grade. This prompted me to change my tools  $\ge$ and techniques for teaching and crafting on various assignments specifically individual on activities in the following semester. In a jiffy students were more open, active and surprisingly each student connected with me when individual assignments were set and discussed.

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#### ACROSS:

Minoan City-(5) 1 Slenderness of a Maiden -(10,5) 6 A circular colonnaded building- (6) 7 Temple of Nike - (5) 11 Prevalent as a prominent feature in Greek Houses.-(6) 14 Surrounded by a single row of columns-(9) 16 Across Athens-(11) 18 Archives in Agora-(7) 19 Walkway- (7) 20) A Sanctuary surrounded by a wall- (7) 21 Civic & Religious buildings erected progressively around i 23 Carved detail in wood adapted to Greek temples - (6) 24 Person responsible for visual drama of Parthenon on acrop 25 Hall for cultural needs in Agora.-(6) DOWN: 3 Ovolo molding between the shaft and the Abacus- (7) Triglyph & Metope -(5) 4 Parthenon-(9) 8 Formative age of the Greek City states.-(7) 9 Proportions greatly exaggerated in columns - (7) 10 Principal part of the Greek temple- (4) 12 Dedicated to city's Patron - (9) 13 Golden age of Greek-(9, 6) 15 Public office buildings - (5, 4)

#### Figure 3: Crossword designed for Classical Greek chapter

22 Principal Hall of Preclassical palaces. (7)

17 A stage building - (5)

#### Source: Author

POMAN ARCHIT	ECTURE
- The Element Statistics - The Elements early used Reasons for the - Theor control statistics early in the - Theory and optical challenges and - Theory mains construction and dealthous Briden's Theory and photoestic parts - Elements, Line and photoestic parts for - Elements, Line and photoestic parts for	a viententiere og server, medden § med- tel ving skale. Granke a vierten Anske viente viertenset kan § servegenter. En vierte setter in Forme
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**Figure 4 :**Characteristic features of Roman architecture, **Source:** Author

Cross Words, Buzz word, Name it & sketch, many more such fun assignments were framed. The class did no model. But best from previous bach were used for learning. These techniques had an excellent impact on their cognitive skills. I too enjoyed the semester eventually designing interesting tasks for every new topic. Following year I encountered yet another challenging batch of students who successfully nudged me back into questioning the objective of teaching HOA once again. Students were inquisitive. They argued that it is totally waste of time learning HOA without any practical application of content studied. They wanted to learn with real examples. I guess it was Massive open online course (MOOC) on sustainability which I had taken helped me this time with pedagogy.

4. Dichotomy- Theory (classroom teaching) Vs Practical Application (Field study) -Deductive Vs Inductive reasoning

4.1 Teaching Plan - Explorative & ∠ Experimental 0

The objective of course was to understand topics with a perspective of sustainability. Every topic culminated with a broad question that required students to represent examples discussed based on its

sustainable attributes. As group work they were asked to bring open models and explain. As individual exercise each student was given a specific example to write an essay on the same but with sustainability (design, Construction &Material) as their focus. Took students to historical buildings in the city which exhibited certain style that we were studying in that semester. Temples in the city were documented & Inductive reasoning was used to learn salient features of the style.



Figure 5 :Shows Open model to explain sustainable layer, Source: Author

5. Dichotomy- Passive teaching- learning vs Active teaching learning- Less collaborative vs more collaborative teaching-learning.

### 5.1 Teaching Plan – Collaborative and peer teaching

Visual tools such as videos, movie clippings, documentaries and techniques such as photo quiz, Sketch from the model etc were used along with haptic tools like making models for next 3 years. They have been fairly successful semesters. However in recent years there has been a paradigm shift in my pedagogy from passive teaching to Active teaching essentially to create an active learning environment for the students. Apart from usual lectures, several brainstorming sessions were designed. Small topics were handpicked and guided where team of students would present and answer the queries of the class .Some portions were identified to be covered in these sessions. These sessions were helpful in peer teaching and learning among students. Workshops were conducted roping in experts from other disciplines like historians and Artists. This aided in collaborative learning and multidisciplinary understanding. Lectures, Assignments and activities are designed on the expected outcome of learning. This method of outcome based learning has proved more effective way of teaching so far.



Figure 6: Workshop conducted by Sanjhi artist, Source: Author

#### 6. Discussion

Every batch present new both invariable limitations and possible opportunity in pedagogy. Every time a new dichotomy ascend, it is difficult to decide on one over the other, when they are diametrically opposite. It is also easy to dismiss dichotomy blaming either time, syllabus or students. However, if one thinks that answers lie somewhere inbetween hoping to draw best from both then we are compromising more often than doing justice. Middle ground is a refuge of the unprincipled. We may opt for a bit of both but we will do neither well. Then what? More than a decade I have taken paths less travelled to explore and experiment. It is paramount for a teacher to decide first whether you want students to Mug-up, practice & score vs Learn,

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understand and perform. Teacher centric methods discussed in first year will work fine if opted former. Later method requires an immense amount of dedicated time and involvement from teacher. In every class one can find students with different level both skills and aptitude for learning. It is very crucial at this point for a teacher to take position (pedagogy method, tools and technique) based on the maximum scope in terms of interest and aptitude that majority of the students in class offer. It is but natural when a teacher grows with deeper knowledge pertaining the subject to elaborate their lecture sessions. However this should not confuse or burden them unnecessarily taking away the quintessential knowledge that students must get at that level.

Year	Pedagogy	Pedagogy	Pedagogy	Pedagogy	Induced skills		
	Method and	Objective	Tools	Techniques			
	Mode						
I year	Expository	Stimulate	Visual –	Sketching,	To Enhance		
	Method	curiosity,	PPT,	Architectural	Gestural skills and		
	Teacher centric-	Motivate	Reading	Writing	Interactive skills,		
	Instructive mode	SEE	Reference		To develop		
	&	preparation	material		participatory		
	Demonstrative				attitude.		
II	Exploratory	To test their	Visual	Sketch& Write	To instigate		
year	method	creative and	PPT,	Quick and	associative		
& III	Student centric-	artistic	Reading	Detailed sketches	memory		
year	Discovery and	aptitude.	and Haptic	Structuring &	To develop		
	Constructive	Learning	tools and	tailoring answers	observe-		
	mode	through	Assessme	to the questions	understand,		
		multimode of	nt	Writing- opinion	comprehend and		
		actives	Mechanis	based conclusions	demonstrate		
			m(tool to	Group Model	To develop		
		Time	motivate)	making and	Technical and apt		
		management		Presentation	writing skills		
		for the extra					
		activities			To develop		
					creative thinking		
					and writing		
					To develop peer		
					interaction and		
					oratory skills		
IV	Exploratory	To instigate	Visual	Games, Cross	To build and		
year	method	team working	PPT,	Words, Buzz	develop their		
	Student centric-	ability	Reading	word, Name it &	cognitive Skills.		
	Reflective,	To strengthen	and	sketch,			
	Problem solving	their	Assessme	Questioning			
	and Meta	individual	nt	sessions many			

	cognitive mode	skills	Mechanis	more such fun	
			m (tool to	assignments	
17	<b>D 1</b>		motivate)		<b>T</b> 1 1 0 1
V	Experimental	10	Video	Site visits &	To develop On site
Year	method	Understand	Lectures,	documentation	research skills and
	Student centric-	the subject	PPT,	Report, essay	pragmatic
	Pragmatic and	with	Research	writing	analysis. Logical
	Inductive mode	sustainability	references		Application of
		layer	Case		knowledge by
			studies		inductive
					reasoning.
VI,VI	Explorative,	Comprehensi	Video	Site visits,	Improve gestural
I,	Student centric	ve learning	Lectures,	documentation	skills, Cognitive
VIII&	& Experimental		PPT,	Report, essay	skills,
IX	mode		Research	writing	Demonstrative
Year			references	Oral presentations	skills and
			Case		Narrative skills
			studies		
X, XI	Explorative,	Comprehensi	Workshop	Paper writing,	Lateral thinking
& XII	Student centric	ve,	s Guest	Article reading	and Analytical
	& Collaborative	collaborative	lectures	(apart from	skills
	and active mode	& peer	Extended	technical writing	
		teaching	lectures,	for exam &	
		learning	Panel	Creative writing	
			discussion		
XIII	Back to teacher	Efficient	Visual	Narrative History	To induce
Pande	centric-	learning from	tools	Critical and	cognitive skills
mic	expository	virtual		analytical writing	Focused &
semes	method	system			sustained
ter	Instructive mode				attention) (Visual
					& auditory
					memory), Visual
					& Auditory
					perception)

Table 2: Comprehensive table below shows decision on pedagogy based on the student aptitude

#### Source: Author

#### 7. Conclusion

The success for a teacher per say is largely a relative measure. As a teacher one must elevate from short term objectives such as classroom motivation, participation, SEE results so on to measure success instead help on students to grasp bigger takeaway from this subject that how past could direct future. It is prudent for a teacher to make sure their students go through the six stages of learning sensing, receiving, absorbing, understanding, in

comprehending and demonstrating. Teachers should aid students in acquiring cognitive knowledge, enhance their existing skillsets and induce certain new skills, to cultivate right attitude for learning, unlearning, adaptability, responsiveness and gratitude to equip them for competence in the industry through every subject they teach.



Figure 7 : Success model for student centric approach, Source: Author

Outcome based learning aids in application of the acquired knowledge. Teacher must shift from direct instructive to indirect guided approach. Role change from teacher to mentor offers ample scope to provide values beyond lessons taught in class that one can apply in their field. The journey discussed above tries to give an insight on two important pedagogical lessons. First effective teaching for any indivdual is evolutionary that evolves with experience and pedagogical method is subjective for it depends on the objective of a tearcher herself varies with the context (student aptitude,time and teaching-learning objective).

However at this point with Covid 19 Pandemic there seems to be yet another set of dichotomy, **Real Vs Virtual Classes**, and **Haptic Vs Digital tools and techniques**. If anything in this world is constant it is the "**change**" itself. Thus pedagogy of HOA continues to evolve with the perpetual changing dichotomy.

#### 8. Acknowledgements

There cannot be a good teacher without good students. I would like to extend my heart felt thanks to all my students of History of Architecture from 2007 batch to 2020 ( BMSCE and DSCA schools). Their entusiasm and support to every explorative journy that I proposed were commendable.





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### STUDYING THE ARCHITECTURAL PAST FOR A BETTER FUTURE

#### Abstract

Analysis of past and learning from it is a basic lesson for life, so study of history is a necessity in any learning process. Studying History of architecture not only reveals the past happenings but teaches us basics of many core subjects of Architecture from material study, building construction, climatology, services etc. This article explains with an example of temples of Karnataka, the purpose and analytic appreciation of History as a literature case study rather than just evolutional progression of mankind.

*Key words: Civilisation; Historical analysis; Monuments:Temple Architecture; Complex design* 

#### 1. Introduction

Norman Foster a famous British Architect had once quoted that designing by an Architect for the present has to be done by not only keeping in mind the future, but also with an awareness of the past. Analysing the history through the study of historical Architectural buildings will guide us in this process. Past human behaviour specific to climatic influence and regional local material availability will teach us on the importance of study of History in Architecture.

So What is History:

Yesterday, Yesteryear, past, ancient times.....any thing could be History ....SO WHAT. Why should we know what happened in the past, "let bygones be bygones"? Architecture is an art, and a science of building structures using varied analytic techniques serving utilitarian and aesthetic purpose. Architectural study is a blend of many basic subjects like Physics in terms of calculation of weight and load distribution, acoustics etc. Chemistry in terms of chemical composition of material, Botany in terms of landscape, along with lighting, Town planning, Financial estimation etc. So architectural study is a field which blends in with the system of universal studies, with knowledge of various topics.



#### 2. History in Architecture

The students of architecture in their core subject of Architectural design, start with literature study, case study and site analysis, the outcomes of which is a process resulting in a unique individual design formulation. In this the literature case study is a historical analysis of a similar proposal executed by architects/designers, analysing their positives and negatives and incorporating the findings in their final design.

#### 2.1. Why learn History

History is thus a study of any event which happened in the past one year, ten years or ten thousand years ago. History of Architecture is by far a completely different genre where we get to know from why a settlement was formed in a particular location, to how it vanished, what caused a complete civilization disappear. How the local materials were efficiently used proof of which can be seen in existing monuments still standing tall withstanding complete climatic effect to withstanding natural disasters. OK "So What" The history thus shows us how what and why, of every era. Each style of every age having a distinct principle and formula representing the particular style of art, architecture and culture.

#### 3. A brief Architectural history:

The horizon of experience and the regional extension of human relations constantly expand from the basic adaptation to the natural environment to the establishment of great civilisation. Before we delve in to the details let's see in brief about what learning we get from each age:

## 3.1. Pre-historic Cave man: Basic need was food and shelter

The prehistoric cave man was a hunter and food gatherer, shelter from wild animals and climate was by residing in caves. But as it was a short term solution, they kept wandering from place to place. Rock art carvings were prominent in this era. Invention of metals and tools were major game changers.

#### 3.2. River valley Civilisation:

With abundant availability of water, and rich soil man started to settle near rivers, and started growing crops for food. He started to use various tools for farming, protection from wild animals and started new art forms like farming, pottery, poultry farming, brick making for construction of houses etc. colonisation in an area and learning new techniques of self protection was primary goal, belief in super natural power and trust in nature was of high prominence. Priests rose in prominence as concept of God came into picture. Temple started to become buildings of prime concentration.

Civilisations then grew from a few hundred people in one settlement to a few thousands and much more. Inter civilisational rivalry started leading to wars. Competition amongst different group heads like priests, craftsmen, warriors etc started and this led to a ruler being initiated. Till this time there was no significant construction of structures. Here starts the fun of architectural construction phenomenon. War success stories framed with victory towers, rulers showing their power with phenomenal palaces, priests building temples of great grandeur and luxury started.

#### 3.2.1. Indus valley civilisation

Residential quarters and other essential buildings were simple. Indus valley civilisation was one such civilisation which displayed a different character, an advanced civilisation similar to the present day in many ways, uniform sized bricks for construction, grid iron pattern for roads, special storage spaces for grains etc. Though this civilisation was much simpler in terms of grandeur, with no massive construction, what is appalling is the presence of 'The great bath', similar to our present-day swimming pool, the technique used to store the water and drain it out is mesmerising. Floor of the tank was made water tight with finely fitted bricks, with gypsum plaster, and a thick layer

laid along the sides and base of the tank as water proofing is enough proof to showcase their intelligence.

Greek architecture exhibited strict formulaic building design with a lot of sophistication in appearance, Roman architecture started using higher level of technology and monumental scale started Italian renaissance displayed dominating. artistic expression of built form. Early Indian architecture displayed a high level of spirituality in the form of temples. The temple architecture of India had a simple basic form which was mathematically multiplied to create complex built forms. Below is a comparative study of some structures which have withstood time.

	1	1					
S. No	Civilisation	Monuments	Specification				
1.	Mesopotamia	Ziggurat at ur Around	210 by 150 feet, constructed with three				
	_	2100 BCE by king Ur-	levels of terraces, standing originally				
		Nammu	between 70 and 100 feet high. Mud brick				
			with burnt brick facins				
2.	Egyptian	The Great Pyramid, the	height of 146 meters (481 feet) with a base				
		largest of the three, was	length of more than 230 meters (750 feet)				
		built by the pharaoh	per side. Quarried Core stones				
		Khufu 2540BC					
3.	Indus	Great Bath	12 meters north-south and 7 meters wide,				
		Built around 2600BC	with a maximum depth of 2.4 meters.				
4.	Chinese	The Forbidden city 1420	Measuring 961 meters in length and 753				
			meters in width,6.6m height				
5.	Greek	Parthenon 500 BCE	Measured at the stylobate, the dimensions of				
			the base of the Parthenon are 69.5 by 30.9				
			metres (228 by 101 ft). The cella was 29.8				
			meters long by 19.2 meters wide (97.8 $\times$				
			63.0 ft)				
6.	Roman	Arch of Constantine,	Approximately 20 meters high, 25 meters				
		312-315 C.E	wide and 7 meters deep.				
7.	Indian	Brihadeswara temple	The temple complex is a rectangle covering				
		Tanjavur (1004-1010)	240.79 metres (790.0 ft) east to west, and				
			121.92 metres (400.0 ft) north to south.				

Table 1 - Astonishing monuments of other civilisations
Source: Author

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From the above table we can see that each civilisation had a distinct character to it and drastic difference in the building typology shows that each era had dreams and aspiration of their own.

Though not much is known of the day to day activities of the people in those times, the presence of these massive structures is proof of high-level precision in construction techniques. Moving forward the civilisations spread and the settlements develop into towns and cities. Industrial Revolution happens which create a new revolution in the architectural development of cities and townships planned. Urbanisation starts and the introduction of concrete and steel creates a revolution in varied construction techniques and buildings of different forms, size, shape and colour which helped them build structure of large span but much lighter compared to the massive structures of Greek and Roman.

#### 4.1. Historical Analysis

From the above brief the question now arises what is the take away from the study of history of architecture, History of architecture teaches us why how and what of building construction, we can learn the following aspects of architectural design parameters. Behavioural approach of the city as a visual experience. Socio-cultural approach which influence the city design, Morphological approach in terms of built and un-built in relation to scale and size from monumental to human scale. Environmental approach of relation of blending nature with the structures with nature as an inspiration. Quantitative analysis in terms of proportion, scale etc Materials: locally available, easily workable, Climatic influence and its design parameters taken into consideration. Qualitative

approach in terms of texture, feel, visual impact etc.

4.2. **Temples of karnataka : An example** Let's see how we can analyse a historical building like a literature case study with an example: Temples of Karnataka reflect the cultural values of the region, they were also symbol of royalty, source of authority displayed through the ornate complexity in the form of size and scale and ornateness. But based on the region the format has differed. The temples of Karnataka have seen the impact of all design from Bhuddist monstery form to hindu form of Vesara style to Dravidan style. During the Badami Chalukya dynasty reign (535-757 CE) the temple plan was very simple with a Garba Griha (main deity) and a simple pillared porch arranged axially. As the dynasties changed, the form of the temple changed Rashtrakutas (750-973 CE) introduced an antarala(ante space between the main deity and the gathering space or mantapa). Kalyana Chalukyas (973-1198) had intricate ornate exterior with elaborate geometry. The Hoylsalas adopted high plinth with multiple mandapas both open and closed for certain functions, all this enclosed in a prakara (outline wall) with Gopurams (entrance). Multiple shrines were also introduced within this complex. Vijayanagar dynasty (1485-1570 CE) showed elaborate royalty in scale and volume. The became massive with many complex prakaras, many mantapas dedicated for specific function and gigantic gopurams displaying symbol of royalty.



**Figure 1:** VIEW OF CHENNAKESAVA TEMPLE AT BELUR



Source: http://www.karnataka.com/wpcontent/uploads/2007/07/chennakeshava-templebelur.jpg Figure 2: View Of Anantheswara Temple At Udupi

Source:http://3.bp.blogspot.com/LXY7hdzA\_yU/ UynhszM0eOI/AAAAAAAAAKOM/xLiyaNxsTh Q/s640/Ananteshwara+Temple+1.JPG

**Table 2:** A comparative study of temples of Karnataka from the coastal region and central region shows complete contrast. The below table exhibits the difference in their character.

 **Source:** Author

	Central Karnataka	Coastal Karnataka		
Example	Hoysala Temples – Halebid, Belur	Anantheswra Temple Udupi		
	• Vijaya Vittal temple complex at	Mahalingeswara Temple, Brahmavara		
	Hampi			
Plan	• Varied forms from star shaped	Single base structure		
	platform to multiple shrine complex	Apsidal or regular plan		
	• Eka kuta, dwi kuta, tri kuta etc	• Small complex with one main deity		
	• One main deity with many adjunct	and other deities in the same		
	deities alongside in the huge	circumambulatory path		
	complex			
	• Many mandapas in one complex			
	serving different purpose.			
Elevation	Complex carving depicting many epics	Simple elevation with wooden replicas		
	and thematic forms on it, Vimana and	reaching a height of 10-15 m reflecting a	Z	
	gopuram go up to 50-60m, reflecting a	human scale, sloped roof as a climate		
	monumental scale	response, cladded with clay tiles to drain		
		our the rain water.	_	
Material	Soap stone temple, lathe turned chlorite	Laterite stone, single shrined, lattice	4	
	schist stone columns, shikaras also made	wooden work, slope timber truss with	_ ⊲	
	of stone	clay tile or copper tiles.	I	
	Gopuram made of stone nearly 30m		н С	

Temple	Extended up to 3 – 4 prakarams	Temple complex is small, concept of
complex	containing several shrines and mandapas	Ratha Beedhi(car street), central vista for
	inside a walled compound	the utsava murthy in the chariot to go
		around during festivals dedicated to
		serving a few villages around the temple.
Climate	Low to medium rain fall, this is the main	Heavy rainfall with thunder storms, cause
	reason the construction of huge	of which construction techniques have
	structures was possible	remained very simple.
Special	Easy availability of the local soap stone	Thick forest cover in the region has
character	has been a boon which has been the	helped timber roofing possible with tile
	reason for which the beautiful carvings	roof, available in the fertile river zone.
	have been possible.	Need for regular change in tiles, which
		usually get damaged during the rains is
		one of the reasons for low rise structures.
Qualitative	Monumental scale and high precision of	Human scale and best use of locally
analysis	ornamentation shows the skilled ability	available material makes the temple gel
	and the varied taste of the royal	along the temple complex with the
	patronage	general public in and around the village /
		town.



Figure 3: View of Belur Chennakesava Temple Complex

Source:https://live.staticflickr.com/2146/1868222 082\_5d76098ad8\_b.jpg

#### 5. Conclusion

In the above comparative analysis, we can understand that climate has been a major influential factor for the drastic difference in the style and form of temple, of the Kanara coastal region temples and Central Karnataka



Figure 4: View of Ratha Beedhi of Anantheswara Temple, Udupi.

Source:https://images.livemint.com/img/2020/03/ 16/600x338/Karnataka\_Temple\_1584338833956. png

temples. Analysis in this format helps understand all aspects of the structures and the same methodology can be applied to every project the student undertakes. Mies Van Der Rohe was inspired by Parthenon which can be seen in his design of Barcelona Pavilion. Charles Correa designed the Jawahar Kala Kendra based on the Navagraha (nine planet) concept of Indian astronomy and also the resembling the square grid plan of Jaipur city. He also designed the Vidhan Bhavan Bhopal, taking inspiration from the Sanchi Stupa.Historic structure could be taken as an inspiration by the present-day designers, the world is a very complex place to live in but learning is not so.

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### KNOWLEDGE MANAGEMENT THROUGH **ARCHITECTURAL HISTORY AS AN EFFICIENT TOOL FOR RISK MANAGEMENT OF HERITAGE TOURISM INFRASTRUCTURE DEVELOPMENT PROJECTS**

#### Abstract

Heritage tourism plays a major role in the development of Indian tourism industry. While the importance of tourism infrastructure development is evident, there rests a research gap on a specific approach and vision for tourism infrastructure project management. The research paper is a response to the need for a specific vision and approach towards the development of heritage tourism infrastructure through projects implementation of knowledge management parameters. It examines the need for understanding the architectural history. It further evaluates the impact of architectural knowledge based risk management, on the inclusive and sustainable heritage tourism infrastructure development. This study includes analysis of existing research to identify and document the role of knowledge management in enhancing the performance of tourism infrastructure development projects. The paper aims at understanding importance of architectural history as an efficient tool for risk of infrastructure management heritage tourism development projects.

#### Keywords

Heritage tourism, history, architetcure, project vision, adaptive usability.

#### 1. Introduction

India come under the G-20, geographic group. Tourism Industry contributed to the FEE (Foreign Exchange Z Earnings) of 44 Lakhs in 2018 and FTA (Foreign Tourist on Arrival) of Rs.89,693 Crores in 2018. During December 2019, Indian tourism revenue reached all time high of 3,177 USD million [1]. As per the World Travel and Tourism Council, "tourism generated 9.2% (16.91 lakh Crore) of India's GDP and supported 8.1% (4.2673 Crore) nation's total employment in the year 2018".

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Tourism is one of the agendas of UN sustainable development Goals. Tourism has the potential to support each of 17 sustainable development goals (like hunger removal, health, education, equality of gender, no poverty, clean water & Sanitation, affordable employment, clean energy sectorial innovation and infrastructure, climate action, sustainable cities and communities, peace and partnership achieving goals) [2]. Infrastructure development is required amongst all the products and schemes and thus an emphasis on knowledge based project management of tourism infrastructure development project is desired. In the specific case of heritage tourism projects the knowledge of architectural history amongst the stakeholders impacts the overall project scope and vision.

## 2. Heritage tourism infrastructure development project management.

Tourism and heritage have a complex relationship as the heritage is reinterpreted and reconstructed constantly in order to meet the changing demand of tourists. Heritage reflects the socio-cultural changes of the contemporary world by representing both, the tangible and intangible aspects of the past [3]. Most of the infrastructure projects related to heritage tourism include renovation and conservation of historical monuments and places.

Provision of proper tourism infrastructure is one of the primary driving forces for the tourism demand. This has resulted in various projects by public and government funds that aim at serving maximum population at the earliest. The competition for increased state and national revenue has further increased the demand of "Project Management in Tourism Infrastructure" [4].

O.A. Burukina emphasizes that tourism Infrastructure is different from other construction projects due to its human perception-based demand. Heritage tourism involves consideration of several factors including culture, society, environment and historical importance of the project. Understanding of architectural history plays an important role in project management and improvement of the implementation process.

## 3. Risks involved in Tourism Infrastructure development projects.

The Tourism Infrastructure development projects in India varies largely in terms of scale and scope. The process of risk management involves a methodical approach of identifying the project risk followed by analysis and response. "The six steps of Risk management are: Risk planning, identification of risks, risk analysis (qualitative and quantitative), response planning, risk monitoring and control" [5]. The aim of identifying risks is to clearly understand them to ensure effective management [6]. This can reduce the risk to an acceptable extent [7]. A systematic web-based maturity model based on knowledge management can enhance the success of a risk management tool in an inclusive project.

### The PMBok (2017)

describes the input for risk identification stage as Brain Storming Sessions and/or Checklist analysis and output as the Risk register (Figure 1) [8].

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International Infrastructure projects have been observed in a study to identify the key risks by using previously collected data and studies. The key risks have been categorized using the Risk Breakdown Structure. After analysis of the checklist, the Risk register is prepared based on risk priority and categorization. These include technical. financial, external and project management Risks. Figure 2 shows the priority of different risks types identified in the infrastructure projects. The risks implemented by an organization of contractor in an infrastructure construction project, represent internal risks. Internal risks include project management risks, technical risks, financial risks, organizational risks and environmental risks.

The risks external to the constructed infrastructure environment represent External risks [9].

Each step of risk management process in the heritage tourism projects involves the consideration of architectural history related to that project. This knowledge can be implemented during the planning and mitigation of several internal and external risks by strengthening the risk identification process.



#### Figure 1: Risk Identification Process Source: PMBOK



**Figure 2**: Percentage of Authors agreed and infrastructure Risks Categories in International Studies.

Source: Khodeir, L.M. and Nabawy, M. Identifying key risks in infrastructure projects–Case study of Cairo Festival City project in Egypt.

Type of Risk		Stakeholders							
	Public	Management	Construction	Shareholders	Financial	Consultants			
	sector	Company	Company		institution				
Design	~	√		✓		✓			
Legal/Political	~	✓		✓		✓			
Contractual	~	√		✓					
Construction			✓						
Operation		✓	✓						
Labour		√	✓						
Clients/users/society	~	√							
Financial/ economic		√		✓	~	<ul> <li>✓</li> </ul>			
Force Majeure	✓	✓	✓						

In the case of mega projects, nine main risks have been identified and allocated to stakeholders based on the study of existing research papers as shown in Figure 3 [10].

 Table1: Transfer of Risk allocated to stakeholder

Source: Irimia-Diéguez, A.I., Sanchez-Cazorla, A. and Alfalla-Luque, R. Risk management in megaprojects.

## 4. Knowledge management in risk management of infrastructure projects.

The main steps included in a risk management process are: (1) Risk planning; (2) Risk identification; (3) Risk assessment (qualitative and quantitative); (4) Risk analysis; (5) Risk response; (6) Risk monitoring, and (7) Risk management process record and documentation", (ISO 31.000, 2009; Baloi and Price, 2003). Construction projects are influenced by the triple constrains for quality (time, Cost, scope) [11] and involve both internal and external risks [12]. However, these risks are not communicated throughout the construction supply chain in a consistent, complete and efficient manner [13]. Alfredo Federico Serpella (2014) suggests a useful and interesting framework

based on knowledge management approach aiming to reduce the risk management process deficiencies. This can be achieved using tools like the Risk management maturity model (RMMM). It is created and designed to gauge the risk management capability of an organization (Hopkinson, 2011). The gaps detected in risk management function (RMMM) of organization are then related to the best practices and ways of improvement. A Continuous addition and improvement in the knowledge base shall be ensured [14]." Dysfunctional culture, ineffective controls and unmanaged organizational knowledge are identified as the three main causes of risk management failure [15].

#### ORGANIZATIONAL CULTURE

Consciousness about risk management

Management support Collaboration and communications within and between work teams

News about risk management in the organization Recognition of the benefits and importance of risk management

Change resistance

#### APPLICATION OF RISK MANAGEMENT PROCESS

Application of Risk management Resource's allocation Responsibilities Available technologies Risk identification Risk analysis Risk response Risk monitoring

#### PROCESS STRUCTURE

Process formality Motivation of implementation Expert knowledge Documentation of the process and availability of information Training and development of skills Involvement of key stakeholders

#### DEVELOPMENT AND EXPERIENCE IN RISK MANAGEMENT

Performance evaluation of risk management Personnel' experience Distribution of knowledge

**Figure 4:** Key evaluation factors in project management and their dimensions. **Source:** Marshall, C., Prusak, L. and Shpilberg, D., Financial risk and the need for superior knowledge

management.

Hsu and Shen (2005) describe about knowledge management as an organized and systematic approach that can support the underlying business by enhancing the decision making, action taking and result delivering of an organization through improving the ability to mobilize knowledge [16]. Knowledge management helps to store, share and distribute the information amongst all the stakeholders. It impacts the careful management and decision making by the analyzing the project information and knowledge [17]. In tourism development projects knowledge management for the use of key evaluation factors and their level (Figure 4) can help to achieve efficient, methodologies inclusive and resource availability, leading to a positive impact on the cost, time and quality of the project. The knowledge of architectural history enhances the development through the experience in risk management.

## 5. Knowledge management in risk based inclusive PPP development.

Tourism infrastructure development in Indian context aim at optimizing the use of available resource (human, financial and material) and make it inclusive, while incorporating latest technologies that demand high funds that can be arranged through PPP models. Risk management of these models is a priority task, as this can severely affect the cost and duration of the project. The major risk categorization for heritage tourism PPP projects includes structure construction risks, project preparation risks, structure utilization risks and risks of changing the approved PPP model [18]. The solution given by the author is the awareness and contribution of public and structure users developers in the preparation stage. Emphasis is laid on

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defining the design task clearly along with the functional, technical, and energy framework of the structure. In the construction stage the vital monitoring regardless of the risk allocation has been suggested.

The solutions to risk management in PPP models, emphasize the need for Knowledge management and identification of technical and financial risks in redevelopment projects. The understanding of architectural history can help in analysis of various social, cultural, technical and environmental aspects of a project. It further emphasizes the need to understand the adaptive usability of this infrastructure in terms of architectural and structural design. The risk structure in public infrastructure PPP project, aims at identifying all hidden risks under various categories [18]. Figure 5 shows the systematic approach towards risk management process [19].

Consideration of architectural history by the stakeholders can enhance the project funding by realization of the public interest and predict the future financial returns during the operational stages. Also, the possibility of adaptive reusability of the space can be evaluated based on the comparison of historical cultural and social parameters with the present supply demand scenario for heritage tourism infrastructure projects.



Figure 5: Risk management process Source: Irimia-Diéguez, A.I., Sanchez-Cazorla, A. and Alfalla-Luque, R., Risk management in megaprojects

#### 6. Conclusion

- The heritage tourism infrastructure projects in India include conservation and redevelopment projects that require consideration of additional risks pertaining to PPP model and structural needs.
- The study emphasizes the need for a systematic approach for risk identification through knowledge management that involves knowledge of architectural history along with other historical factors influencing the stakeholders, culture, and society and funding mechanism.
- It also emphasizes the importance of timely communication amongst all the stakeholders through knowledge management, thus considering the role of documentation of architectural history.
- Tourism infrastructure projects involving existing building requires consideration of additional external (Ground -building relationship) and project risks (project realization risks). This can be achieved by including team members with expertise in architectural history.

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KNOWLEDGE MANAGEMENT THROUGH ARCHITECTURAL HISTORY AS AN EFFICIENT TOOL FOR RISK MANAGEMENT OF HERITAGE TOURISM INFRASTRUCTURE DEVELOPMENT PROJECTS Z



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### THE MANY FACETS OF WASTE MANAGEMENT: A CASE OF BENGALURU METROPOLITAN AREA

#### Abstract

Metropolitan cities around the world today deal with several macro-issues, one of them being waste management. One such city, Bengaluru, for long known as the Garden City, has been clumsily grappling with the giant that is waste management. Bengaluru is one of the fastest growing cities in the world, with the migrant population soon to surpass the non-migrant population. The consequence is a high rate of unplanned and unregulated development, causing large-scale urban sprawl. With urban sprawl comes several issues such as pollution, deforestation, need for mass transportation, water and sewerage system, the waste management system, etc. The importance given to various aspects of the urban metabolism of this city are disproportionate to the actual weightage of these aspects in our day-to-day lives, and consequently, are often overlooked in the architectural and urban design process. The present paper focuses on the ties between one such under-rated aspect, waste management, and architecture, illustrated using the case example of Bengaluru. It briefly explores design solutions successfully applied in other countries, which can be used to cultivate indegenous answers to Bengaluru's needs. It further suggests key strategies to introduce waste management studies into architectural education.

*Key words:* Garbage; waste management; urban metabolism; urbanisation; Waste-to-Energy

#### 1. Introduction

The 21<sup>st</sup> century is recongnised as the first Urban Century in history, as more than half of the world's population lives in cities as of 2007. This population is projected to go up to two-thirds by 2050, which would generate around 3.4 billion tons of solid waste. United Nations' Sustainable Development Goals (SDGs).



the Paris Agreement and the New Urban Agenda mention solid waste management as a key issue to be addressed, and had in fact selected it as the theme for the 2018 World Habitat Day. Bengaluru, one of the most rapidly expanding metropolitans in the world, is currently home to over 1.2 crore residents.. The census of 2011 shows that over 47% of this population is made up of immigrants, the trend showing this number grows by 4% per annum. Various factors have contributed to this influx of population to the city, the biggest one being the booming IT sector. This expanding and diversifying population creates a robust urban metabolism. The city is analagous to the human body. As human metabolism refers to flow of food, air and water through the body, urban metabolism refers to the flows of goods, people, waste, biota, energy, food, freshwater, sand and air, through any given urban region. The urban metabolism of most cities, especially in developing countries, tend to be linear in funciton, similar to the human metabolism. That is, there is a linear progression of material or products from freshly produced, to consumed, to finally the waste which is discarded after consumption. Bengaluru is an example of such a city with linear urban metabolism. On the other hand, some developed cities in the world, such as Paris and Rotterdam, are in process of converting their urban metabolism from a linear one to a circular one. This in essence means that they are adopting practices which use waste generated at the end of the product life, as resource for further uses, thereby largely reducing or altogether eliminating the waste sent to landfills or incinerators. They are introducing volarisation techniques on a large scale, whereby maximum uses are extracted out of waste. This realisation has come after

several years of research that points out that a linear urban metabolism is not a sustainable one, and if cities are to continue thriving and growing, they must transition to a circular urban metabolism.

In а linear urban metabolism, such as Bengaluru, the vast population consumes vast amounts of resources such as land, fresh water, air, food, electricity, clothes, appliances, vehicles, etc. Moreover, in a metropolitan city like Bengaluru, the amount of consumption is compounded due to the prevailing culture of capitalist consumerism, one of the lesser desirable imports from the Western world. Consequently, the consumption of these resources results in vast quantities of solid Currently, Bengaluru waste. generates upwards of 3,500 ton of municipal solid waste, or MSW, per day, most of it unseggregated and fated to be unscientifically dumped at landfills. The BBMP, the main governing body for solid waste management in the city, has two designated landfill sites, although there are tens of unapproved landfill sites being used by the private contractors for dumping unsegregated solid waste. While the BBMP is committed to safely and regularly collecting MSW from 100% of residents and commercial buildings, it only carries out 30% of the collection, outsourcing the remaining 70% to private contractors. The BBMP has in place a system that genuinely attempts to collect and dispose of waste as efficiently as possible. The process takes place in two phases. The primary collection of MSW is done door-to-door by Pourakarmikas on a daily basis using auto-tippers or push-carts. These then converge to a secondary location where the waste is loaded into a compactor or a tipper-truck and sent away to one of the

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landfill sites. In addition, dry waste collection centres or DWCCs have been set up in nearly all wards for the segregation of dry waste such as paper, cardboard, plastic, glass, etc. This segregated waste is then sent to recycling plants for processing. The BBMP has set up this waste collection method in all 198 wards of the city.

The system, however, is not perfect. The basic shortfall is two-fold. The first is that while the BBMP is very clear about managing door-to-door collection, it ambiguous about waste that gets accumulated in street corners, emply lots and other public areas. In addition, when it comes to the disposal of industrial waste, the Hazardous Wastes (Management and Handling) Rules, 1989 (as amended in 2003) lays out the guidelines for proper handling, treatment and disposal of industrial waste, but the execution is left to the discretion of the industries. The second is the apathy of the residents and lack of sensibility towards segregation of solid waste. For a solution, we need only look at our basic behavioral tendencies. A better system would be to incorporate the waste hierarchy into our lives. residents need daily The to conscientiously follow the waste hierarchy as a basic principle of waste management. In fact, this principle is suitable for adoption on all levels of society, individual, urban, state, national and even global level. As described by the International Solid Waste Association (ISWA 2009):

*...the waste hierarchy is a valuable* conceptual and political prioritisation tool which can assist in developing waste management strategies aimed at limiting resource consumption and protecting the environment'.



Figure 1: The Waste Hierarchy; Source: UNEP report 'Waste and Climate Change: Global trends and strategy framework' 2010

#### 2. Waste and its dimensions

The BBMP caters to approximately 25 lac households and 3.5 lac commercial properties, spread over 8 zones and 198 wards, as per its own city statistics based on the 2011 census. The estimated per capita waste produced is 0.4-0.6 kg/ capita/day. At present only 10% of the waste is recycled. Biodegradable waste makes up 55-60% of the overall MSW. Recyclable material such as paper, cardboard, glass, metal, plastic, electronic make up 16-25%. The remaining 15% are inert materials that go to landfill.

Bengaluru, being an IT hub, generates large quantities of e-waste. Recyclers identified by the KSPCB (Karnataka State Pollution Control Board) are managing the e-waste at large IT companies. Today e-waste is one of the rapidly growing environmental problems. With extensive use of computers and other Z equipments electronic coupled with discarding increasing habits, rapid technological change, there is a significant increase in e-waste generation at the household level and public sectors. E-waste is a goldmine of resources, quite literally speaking. For example, 1 tonne of telephones

yields 140 kg of copper, 3.14 kg of silver, 300 gm of gold,

130 gm of palladium and 3 gm of platinum. It is in the city's own good interests to extract these resources rather than discard them.



The composition of waste, as per BBMP data is as follows:



## 2.1. Physical-Social-Economical dimensions of waste

In today's globalised world, everybody wants to live in an attractive city. One of the characteristics of globally attractive cities such as London, Paris and Florence is their visual cleanliness and lack of littering. The visual cleanliness speaks of efficient governing systems. Successful waste management has a direct effect on the percieved image of a city, and it positively enhances the sense of pride that a resident feels in living in that particular city. Not only this, a city whose image is positively percieved around the world is more likely to attract higher land value, talented individuals, industries and businesses, and educational instituitions, all of which are codependant drivers of development in that city. Conversely, mismanagement of solid waste can have negative impacts on the image of the city. Municipal solid waste, if left uncollected and untreated, is a health hazard, likely to breed insects, and worms, release toxins, GHG and unpleasant odour, and even contaminate the land, water and air around. These impacts are also refered to as disamenities due to MSW and they affect the health of people living in that locality. The failure to address MSW also causes the governing bodies to appear incapable, thus bringing down the desirability to invest in the city.

Municipal solid waste in any city, but especially in cities in developing countries, have high content of human/animal fecal matter, toxins, allergenic and infectious substances. Insects and rodents breed on solid wastes and can spread diseases like cholera, malaria, chicken guinea and dengue fever. Workers who handle solid wastes seldom work with safety equipment such as gloves and masks, putting their health at risk on a daily basis. Although waste management has

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THE MANY FACETS OF WASTE MANAGEMENT: A CASE OF BENGALURU METROPOLITAN AREA

provided employment opportunity for over 20,000 workers, including Pourakarmikas, rag pickers and scrap dealers, majority of whom are mostly from the BPL community, they often carry social stigma due to the conditions that they work in, and due to their vulnerability to skin ailments and other infections. This situation can be improved if the waste generators as well as managers conscientiously follow the procedures for hygienic waste disposal, to create better working environment for the waste workers.

#### 2.2 Environmental Impact of waste

The method of waste management has a direct impact on the environment. Research the United Nations published bv Environmental Program (UNEP) has shown that landfills around the globe contribute to greenhouse gas (GHG) emissions, estimated at approximately 3-5% of total anthropogenic emissions in 2005. Mixed waste dumped in landfills generate methane (approx. 50%) and carbon dioxide (50%) due to action of microbes in an anaerobic environment. Methane and carbon dioxide are greenhouse gases, whose presence in the atmosphere contribute to global warming and climate change. Methane is a particularly potent GHG, and is currently considered to have a global warming potential (GWP) 25 times that of carbon dioxide. Landfills, however, are not the only sources of GHG emissions. The process of transporting waste, treating it and recycling are all activities which contribute to the greenhouse effect. UNEP has shown that prevention and recovery of wastes (i.e. as secondary materials or source of energy) avoids GHG emissions in all other sectors of the economy, such as energy, forestry, agriculture, mining, transport, and manufacturing. In addition, landfill leachate is

one of the main sources of groundwater and surface water contamination when it is not scientifically collected, treated and safely disposed as it may percolate through soil reaching water aquifers.

Non-biodegradable waste such as plastics, glass, batteries, etc. take anywhere between few decades to a millenium, depending on the type of compound. Hence, it is preferable that the use of such non-biodegradable material be reduced, or avoided althogether. Overall, an effective approach to waste management is one which is guided by the waste hierarchy on all levels, ranging from individual to global.

#### 3. Waste and its positive attributes

Waste management plays an important role in raising or lowering the quality of our lives. Successful waste management not only has the power to add to the aesthetics of a city, but it also helps to improve the health of the city and its people. Cleaner neighbourhoods, water and air all contribute towards a higher quality of life. A city with a circular metabolism does lesser irreversible damage to the environment, and hence, is more sustainable in the long run. Waste, when segregated and processed properly, can be a source of material through recycling, a source of manure when composted, and a source of energy when used in waste-to-energy or WtE plants. While first preference undeniably needs to be given to reducing and reusing waste at the source level, waste that is  $\mathbf{z}$ unavoidable needs to be segregated and on diverted into these various pathways if we are to extract maximum resourcefulness from waste.

#### **3.1.** Waste as a resource

Segregated waste yields several types of material, organic, recyclable and other inert material. The waste generated in Bengaluru consists largely of organic and recyclable material. Of these, organic waste makes up more than half of the total waste generated in the city. To address this type of waste, the BBMP has contracted a vendor to set up an organic waste converter plant in Jayanagar. The plant processes 1,000 kg of organic waste from the ward everyday, producing 300 kg of manure every 10 days. The contractor is able to sell 15 ton of good quality manure every month. The success of this project has prompted the BBMP to search our other suitable locations in the city, such as fruits and vegetable markets, for such plants.

Hygienically separated waste can be used a second source of material like glass, metal, cardboard and paper by recycling or upcycling. Another, rather innovative method to upcycle such inorganic waste is by reusing it to conduct activities where members of the community can gather and create art. One such not-for-profit organisation in Australia, called Reverse environmental Garbage, promotes sustainability and resource reuse. They conduct art workshops and provide environmental education. Their raw material is made up of high quality industrial discards and pre-approved, hygienic discards from households.



### Figure 3: Reverse Garbage facility in New South Wales, Australia

Source:https://www.howwemontessori.com/howwe-montessori/2020/03/outdoor-loose-parts-playvisit-to-reverse-garbage-sydney.html

Another industry in which waste can be used as a major resource is the energy industry. The example of Sweden, with its WtE success, has shown us that putting in place extensive and efficient waste management systems means that municipal waste in landfills can be almost non-existent. About 99.3 % of all household waste in Sweden is recycled or recovered as energy, making it the leader in efficient waste management. Sweden's waste is recycled as district heating, electricity, biogas, fertilizer and materials. Sweden is the only country in the world to import garbage, attesting to the usefulness of waste, when dealt with using optimal technology.

#### 3.2. Various challenges and opportunities

In a city like Bengaluru, the volume of waste generated offers a constant, reliable and major source of material and energy. Waste is a resource that no country can run out of. With the current growth rate, the quantity of waste can only increase. It is essential that systems be put in place for timely collection and

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scientific treatment of such waste, which can further lead to recycling or WtE plants, whichever is more appropriate. In a country which relies mostly on thermal and hydrothermal power plants for all its energy requirements, WtE plants could be set up to provide supplemental energy. Similarly, identifying suitable locations to set up organic waste converters which can cheaply produce vast amounts of good quality manure is the right direction to take for a country like India, which is still largely dependant on its agricultural sector. Currently the most pressing requirement is for cities to organise themselves into systematic machineries that efficiently address the issue of waste management, and to search out or innovate new technology that would help them to tackle this issue.

#### 4. Waste and Architecture

The workings of urban metabolism of a city is sheltered within the small and large architecture and urban planning of the city. If urban metabolism can be likened to the metabolism in the human body, then the architecture and planning of that city is the human body itself. Just as the city's communities need to be planned for efficient inflow of goods, vehicles and people, they need to be planned for efficient outflow of wastes without hindering the functions of the communities. For the city to perform optimally, the network of waste collection and processing needs to be set up in a way that addresses waste from all sources and in all forms. Hence, architecture and planning are inseparable from waste management. The study of waste management in architectural education and practice worldwide must be made indispensible, if buildings, and in turn cities are to be designed for sustainable and

efficient waste management. This can be done through study of literature, case studies of successful waste management techniques and through experimentation. This knowledge, along with the study of city's waste generation patterns, can then be used to create innovative, but indegenous solutions. The current situation calls for architectural intervention based on research and innovation in waste management systems and techniques, crucial not only for evolving holistic design for the future, but ultimately for achieving a circular metabolism for any city.

#### 4.1. Waste from Architecture

The debris from construction activities is known as construction and demolition waste. or C&D waste. The quantity of C&D waste generated in Bengaluru is around 2,500-3,000 ton per day. Although there is a C&D waste processing plant, privately run by Rock Crystal in north Bengaluru's Chikkajala area, with a processing capacity of 1,000 ton per day, it currently only processes 80 ton per day. The remaining construction debris is dumped into quarries, empty lots, and lakebeds. The setting up of a second C&D waste processing plant, with 750 ton per day capacity, in Kannur is in the works. However, the inaccessibility of the processing plant and lack of demarcated aggregation points for collecting and transporting construction debris, along with the fee that is charged for utilizing the services means waste generators have no incentive to transport their debris to the processing plant. This problem could be solved by demarcating 6-8 aggregation points for C&D waste collection, as suggested by experts, and by reimbursement provided by the municipality for transportation expense, as it is done in the cities of Delhi and Indore. In addition, in expansion or renovation projects,

THE MANY FACETS OF WASTE MANAGEMENT: A CASE OF BENGALURU METROPOLITAN AREA

architects can consider the possibility of constructing around or over existing buildings, if they have retained their strength and stability. This would help to reduce the overall quantity of C&D waste generated in the city.

#### 4.2. Architecture from Waste

There are endless opportunities for architects to explore and innovate with waste material as resources for building. Already several experiments have been carried out around the world using discarded material, directly and without any form of processing, as building material. Few examples are illustrated below.



Figure 4: Waste House, Brighton, UK (made of 85% waste material) Architect: Duncan Baker-Brown (collaboration with undergraduate Brighton students.) Source:https://www.dezeen.com/2014/06/19/wast e-house-by-bbm-architects-is-uks-firstpermanent-building-made-from-rubbish/



Figure 5:Salvaged tyres used to build retaining walls Source: https://in.pinterest.com/pin/87961617596 75465/



Figure 6: The Cardboard Office / Studio VDGA, Pimpri-Chinchwada, India Source:https://www.archdaily.com/931438/thecardboard-office-studiovdga/5e14bada3312fdf5c9000252-the-cardboardoffice-studio-vdga-photo

#### 4.3 Waste in Architecture

The consideration given to handling, storing and segregating waste in all types of  $\geq$ including office, residential, building, industrial, institutional, etc, needs to be stressed by the designer/architect in order to shift the mindset of the users of the building. Architects and planners need to provide for waste management at all scales of building and planning if the tendency of the user is to

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change from repulsion to accepting the truth about waste. Making waste management an integral part of building program helps to set a routine for waste disposal. Building design and urban planning need to provide proper segregated storage and circulation path for waste, making it clear to the users and residents that waste is an unavoidable part of day-to-day life and that it needs to be addressed in a practical and sustainable manner.

#### 4.4. Architecture for Waste

The design trend for the foreseeable future is likely to follow innovative solutions for waste management, be it products, buildings or urbanscape. Not only that, architects are being commissioned to design such facilities as waste sorting and treatment centres, which were previously considered as purely functional, but dull buildings. Such centres are adopting innovative methods of highlighting waste as resource and opening up to public to help spread awareness about the usefulness of waste. Few examples are illustrated below.



Figure 8: Rooftop view of Maag Recycling, Winterthur, Switzerland Architects: OOS Source: https://archidose.blogspot.com/2005/11/maagrecycling.html



Figure 9: The WtE Design Lab, Northeast Coastal Park, Barcelona, Spain

Architects: Abalos & Herreros

Source:https://research.gsd.harvard.edu/wte/item/ interview-inaki-abalos/



Figure 10: North Granada Ecoparque - Clean Point (waste collection centre) Architect: Gonzalo Arias Recalde Source: http://ariasrecalde.com/ficha.aspx?proy=34



Figure 11: One of the several mobile waste collection vehicles in Granada Source:https://www.interempresas.net/Reciclaje/ Articulos/104113-Ecoparque-movil-conocerinvita-a-hacer.html

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THE MANY FACETS OF WASTE MANAGEMENT: A CASE OF BENGALURU METROPOLITAN AREA



Figure 12: Kara/Noveren Thermal Power Plant, Roskilde, Denmark Architect: Erick Van Egeraat. Source:http://www.martinbiopower.com/projects/ case-studies/roskilde-plant-denmark/

A deeper involvement of architects and urban designers in designing a city's waste management system may be facilitated by introducing the subject of waste management in the educational and training process, i.e., strengthening the foundation laid at an early stage of education in these desciplines by making it a vital part of the curriculum.

#### 5. Way forward

The need of the hour is for architects, designers and planners to look at waste management as being in a key position to affect the aesthetics and health of our homes, streets, neighbourhoods, cities and ultimately our countries. The design approach would be made more holistic by incorporating the needs of waste management into the design from the earliest stage. It needs to be looked at as a service requirement, on par with other services like electricals, water supply and drainage. As generators of waste, we need to be aware of how waste management, or the lack of it, may affect the quality of our lives. The basic values of waste management, such as the waste hierarchy, need to be taught and inculcated in young minds. Higher education in the fields of architecture, engineering, urban planning and other allied fields, need to teach waste management as a dedicated subjects, through contextual study of waste management technologies and system of circular metabolism in cities around the world, through the means of literature study, site visits and problem solving exercises. It needs to be made an indispensible subject in higher studies and training, with special encouragement given to research in this field, especially for architects, designers, engineers and planners. Accordingly, given below is a suggestive program for step-by-step introduction of waste management studies in Architectural Education.

Source: Author

Semester	Study topic	Methodology/approach	Learning and outcome	Assessment
01	Introduction to solid waste management and principles of waste hierarchy	Textbook study Comparative case studies of one indian and one western city	Understanding of depth and range of solid waste management in daily living and design	Submission of Case study report and Viva voce
03	Components of	Textbook study	Appreciation for	Submission of



	Solid Waste and Urban metabolism	Visits to local sorting centres and landfills	resource that can be extracted from solid waste	site visit report and Viva voce
05	Study of recyclable and non-recyclable waste	Textbook study Visits to recycling plants Isolated design exercises Case studies	How to design for solid waste management and integrate waste hierarchy principles into design	Submission of short portfolio containing site visit reports, case studies and design exercises and Viva voce
07	Design Solid waste management system for design project	Incorporation of solid waste management facilities into main design project	Understanding of solid waste management as a must-have for all design projects	Assessed as part of main design project

Additionally, below are some activities that may be taken up at a community or city level. **Table 02:** Suggested activities at community or city level for addressal of MSW.

Source: Author

Method	Activity			
Summer/Winter	1. Composting techniques for various scales			
workshops	2. Building structures to scale using upcycled dry waste			
	3. Art, sculpture and installations out of upcycled waste			
	4. Making public facilities such as benches and rain shelters using upcycled waste			
Proposals to governing authorities	1. Study and suggest efficient collection schedule for various types of wastes based on ward-wise Municipal Solid Waste profile			
	2. Design mobile collection vehicles for recyclable wastes			
	3. Design local collection points to receive segregated waste and facilitate waste compactor/ auto-tipper movement			
	4. Introduction of basic principles of solid waste management and waste hierarchy in government and private schools and colleges.			
Social responsibilit activities	1. Carrying out awareness drives and demonstrating the usefulness of waste and the need for conscientious segregation at source			
	2. Putting up street plays and posters to inform about waste hierarchy			

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The above program, though only suggestive, dilineates the various ways that the study and understanding of waste management could be made part of architectural education, and hopes to open up possibilities that these could be adopted by educational institutions. A holistic education and training process will ensure a holistic way of looking at the design process at the building, community, city level and further on. This, in combination with research and science based regulations, will systematically help our cities to transform into cyclic metabolisms for sustainable, selfsufficient and eco-friendly growth.

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## **POST DISASTER RECONSTRUCTION : URBAN CONTEXT**

A thought to include resource planning during post disaster reconstruction of urban neighbourhoods : An integral part of academics in an Urban Design program

#### Abstract

The paper intends to first understand the importance of Post disaster reconstruction in an urban context; it analyzes the importance of managing urban reconstruction projects. It clearly projects the effects on the community that in turn impacts the socio economic stature of a nation. A micro analysis of the project reveals various knowledge areas that need to be managed in a post disaster reconstruction of urban neighborhoods that all urban designers and architects must learn to plan and manage the resources. The resources play a crucial role in the success of the project. It affects the key parameters of managing urban reconstruction like scope, time, cost and quality. The paper gives an insight into the material and human resources that are presented contextually, further it gives various sources for each type that may be considered during resource planning. This paper intends to make one understand the grave importance of the aspect and make it an integral part of urban design academic program.

*Key words:* Disaster resilience; Post Disaster Reconstruction; Post Disaster Waste; Beneficiarie

#### 1. Introduction

Natural disasters are an integral part of the physical environment which impacts human settlements inhabiting any geographic region. The communities adapt themselves to the context on the pretext of conserving the available resources for their livelihood and wellbeing, binding themselves to the region through generations. The development of the society from generation to generation has made the communities more advanced backed by technological innovations resulting in its dependency on complex infrastructure [1]. The dependency of communities on the complex systems has presented more open ends vulnerable to disasters and its impact severely affecting the communities. Disasters take a toll on the communities, even though the human beings are technically advanced in terms of early warning systems, preparedness face anticipated to an catastrophe; it is very negligible in comparison to the massive unpredictable forces of nature. Though the preparedness helps in reducing the impact destruction is bound to happen. Scale of natural disasters are signified by the extent of fatalities and loss of physical assets like homes, socioeconomic infrastructure including, roads, bridges, railways, connecting airports. harbors, power and communication lines. Fatalities and loss of assets directly impacts the productivity leading to economic loss affecting the GDP of the nation. A quick resilience is of utmost priority to be addressed by the urban planners, to prevent socio economic degeneration that further weakens a country's economic stature.

The situation calls for an effective management of the entire reconstruction process to bring the communities back to a state of resilience that existed prior to the disaster. To achieve effective resilience the urban designers must manage all necessary knowledge areas during Post Disaster Reconstruction (PDR) of the assets.

#### 2. Need for managing knowledge areas

Any disaster brings assistance to revive the affected communities on humane grounds. Help pours in various forms depending on the scale of destruction at both domestic and international levels. It calls for the involvement of all levels of the government statutes from the local authorities to state and central governance including expert planners and architects. Aids are provided in the form of relief funds, donations in cash and various forms like materials and technology for reconstruction.

This generates the need to manage the following aspects in unison during PDR:

- Stakeholders
- Scope, Time and Cost
- Resources
- Communication
- Quality & Safety
- Procurement & Contracts

An effective management to handle these complexities is a must to overcome delays, cost overruns during reconstruction enabling the communities to come out of the ordeal and continue their normal routines.

# 3. Resources and Its importance in PDR Projects

The scale of PDR is often massive. The success lies in achieving the objectives through efficient management of the knowledge areas throughout its lifecycle. The PDR requires the necessary resources to facilitate its planned process. Here the resources play a vital role. Its availability controls time and cost schedules. A resource available timely reduces time delays and its availability in abundance locally reduces cost overruns. Out of the three categories of resources- Materials. Human resources and Z Machinery, the first two have to be organized ഗ whereas the machinery is prerequisite.

#### 4. Accumulation of resources

The PDR requires accumulation of requisite materials and human resources necessary for

its uninterrupted execution to achieve the set objectives within planned time and cost.

Materials suitable for the hazard resistant construction as stipulated by codes have to be stacked in what is termed as Material banks along with an efficient workforce skilled in hazard resistant construction techniques and methods need to be organized.

#### 4.1 Sources of Materials

New material in the form of steel, wood, bricks, cement and sand are readily available, that can be procured from vendors. However the initial activity during post impact phase of any disaster involves clearing debris and demolition waste of structures on the verge of collapse termed as Post Disaster Waste (PDW). PDW management itself becomes a major activity.

#### 4.1.1 PDW as a source for material

Disasters destroy physical property leaving a huge amount of debris, further many structures are damaged beyond repair that needs to be demolished, which also generates demolition waste.

Many experts have classified the waste in different ways.

In 1995 Kobayashi classified PDW as [2]:

- Rubble and waste accumulated on roads
- Demolition and dismantling waste of buildings
- Bulky waste and raw materials. In 2004 Baycan refined the classification to [3]
- Recyclable materials (concrete, wood, masonry, metal, soil and excavated material)
- Non-recyclable materials (Household inventories, organic and inert material)
- Hazardous material (Asbestos, Chemicals)

The listed classification of PDW is based on the objectives of PDW management. This gives an insight into the materials that are available from the point of view of PDR. The PDW can be re classified in accordance with the PDR as follows.

- Recyclable material ( concrete, Masonry, steel and wood)
- Reusable material (dismantled building elements like doors, windows, columns, girders, gates, roofing sheets and tiles)
- Non-recyclable material that is dumped in landfills.
  - A. Recyclable building material requires to be converted to a usable form. This calls for an industrial setup to recycle massive quantities that are collected during disasters. An analysis from the project management point of view reveals the following points making it not viable for PDR.
    - It requires a huge industrial setup with heavy investments, resources to process the material.
    - Setup requires good amount of time which might delay the PDR process.
    - It requires technical knowhow and skilled Human resources for the management of the facility.
    - It incurs huge cost to recycle a given material increasing its output costs thereby making it financially feasible to implement recycled material.
  - B. Reusable building materials can be used with a little refurbishment. These materials are easily and quickly available. This has an advantage over the recyclable materials in PDR situation such as:

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- No major setup is required.
- The materials can be refurbished at a low cost as and when it is to be installed.
- Procurement cost is very low and equal to salvage value there by reducing the project costs.
- Since it's readily available saves precious project time.
- Though the quantity available is very minimal it helps in reducing the burden during procurement in terms of cost and time.

This justifies the feasibility of adopting dismantled building elements and materials, saving time and cost incurred due to material resources, though not fully but marginally reducing the resource burden of PDR projects.

#### 4.1.2 Aid and procurement as a source

PDR involves many stakeholders like Donors, NGO's, INGO's and the Government. Accordingly material for PDR is sourced through vendors and supply chains that are procured and aid in the form of materials by humanitarian agencies. This forms a major source for necessary construction materials.

- Can be procured to the required quantity
- Needs lead time to procure the requisite quantity
- Scarcity of materials suitable for the context might force the vendors to outsource it.
- Risk in terms of time delay and cost overruns due to demand supply gaps.
- Pilferage and overbilling.

In spite of some lapses this forms the conventional method of sourcing and gathering resources controlled by binding the vendors in strict contract agreements to mitigate the risks mentioned above.

#### 4.2 Sources of Human resources

Skilled human resources are equally important to achieve the intended objectives. All levels of Human resources are necessary during a PDR project. In a PDR skilled, semiskilled and unskilled are required. The sources to these can be classified as:

- Voluntary human resources
- Sourced human resources and
- Beneficiaries as human resources

#### 4.2.1 Voluntary Human resources

Most PDR projects witnesses the roles of various levels of human resources representing NGO's and INGO's who work on humanitarian grounds performing various activities including PDR. The volunteers are trained to deal with such situations at all levels of skills. They are well acquainted with hazard resistant building codes and methods and form a reliable source.

#### 4.2.2 Sourced Human resources

In normal PDR projects skilled human resourced of all levels are outsourced contractually for the duration of the project. They are usually local professionals hired for PDR. Their expertise and contextual understanding forms an added advantage to the PDR projects. Outsourcing incurs cost and must be included in the budget. The added advantage is they can be made to strictly adhere to the norms thereby ensuring a proper implementation of hazard safety codes and construction techniques.

#### 4.2.3 Beneficiaries as Human resources

Beneficiaries are those people of the communities identified as the disaster affected by the governing authorities in need of help and aid. This proved to be very successful in many cases especially in PDR project after 2001 Bhuj earthquake. The involvement of the beneficiaries in what is called Owner driven Reconstruction, the beneficiaries were trained and made to build their own homes all by themselves, with assistance in hazard resistant techniques and materials. This case of ODR in Gujarat was a worldwide success in achieving the targets within the stipulated time, cost and quality [4].

- The beneficiaries showed extreme interest and participation in the process
- They followed the safety codes and techniques since they were building their homes with their own hands.
- They were ready to work on their homes.
- They participated in the hands on workshops to learn the techniques to be implemented on their homes.
- For many it became an alternate livelihood.

#### 5. Conclusion

A PDR project is crucial for the resilience of affected communities, and so is its management this brief study analyzes the various possible ways of amassing resources that include materials and human resources that give insights to urban planners and architects about resources in case of a PDR scenario. With resources being important to projects, it prepares the future planners in understanding the options available for

securing and utilizing resources in a sustainable manner. The reusing method not only reduces burden on the procurement but also cost and making it an option environmentally feasible reducing the exploitation of natural resources that are otherwise used to produce new material. It also gives rise to new strategies to manage PDW. With the need of the hour to go green this seems to be a feasible technique in managing disaster waste. The ODR is an ideal way to engage the beneficiaries enabling them to achieve quickly recover from the trauma and lead a better life. The management of resources helps affected communities reestablish themselves in a shortest period of time, there by engaging themselves in their livelihood, contributing their bit to the economy of the country avoiding its socioeconomic degeneration. It gives the urban planners, architects and policy makers to make suitable provisions while planning any PDR of destroyed neighborhoods thereby making disaster resilience and resource management a necessary academic part of the Urban design program.

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### PREFAB CONSTRUCTION SYSTEM & ITS AID IN PANDEMIC FIGHT

#### Abstract

The intent in this journal is aimed at studying standard prefabricated and modular design and also try to go beyond the research that typically centers around what prefab is and its general applications; this research additionally targets considering the effects, positive or negative, that preassembled/prefabricated structure has on structures in urban regions, and its development techniques and property market and how prefab aids during pandemics and facilitate in the country's GDP growth.

Prefabricated construction is being utilized generally by several nations around the globe, which is one of the most practical and quality pragmatic framework. Because of the protective condition, the quality and productivity can be checked and wellbeing can be guaranteed. The study intends at finding out and understanding as to why the prefabricated system has taken such a long time to break into the Indian construction and development markets; and will prefabricated systems have an impact on the Architecture, Design and how it affects on the buildings aesthetically in comparison to conventional buildings in mid & large scale segments. This also studies the impacts of prefabricated structures on a structure's uniqueness and sustainability.

Furthermore, the purpose is in like manner to examine development delays because of which tasks experience time deferrals and cost overrun and how prefabricated structures can aid to solve this to a large extent. Construction delay is an incessant issue in the development business and it adversely affects activities' achievement in terms of time, cost and quality. The variables like time and cost are examined in conventional and in prefabricated construction. The purpose of this research iis assessing distinctive prefabrication advancements and systems in developing nations. Prefabrication in development has the ability to have any sort Ζ of impact inside various nations' construction industry in money related, social and ecological terms.

The study and research also intends to find what the future holds on prefabrication in Bengaluru's mid & high rise segments. The issue focused here is interpreted through surveys and interviews, and dependent on contextual analysis Architectural & Interior Design, Sustainable Architecture, Energy Efficient Buildings and alternative building technology. from comparable procedures of prefabrication frameworks been brought into different nations.

Also, the study intends to find advantages of introducing the prefab construction system and technologies in the Architectural curriculum as a course material, as we can foresee this technology as the future of construction industry.

#### Keywords :

Prefabricated & Modular Construction; Pandemic, time delays and cost overrun; Property Markets

#### 1. Precast and Prefabrication

In the world of construction, there are numerous methodologies used during the creation of buildings, structural foundations, and modules. Two important processes that are regularly used during construction projects are Precast and Prefabrication.

These two processes have a similar concept but offer two different solutions for construction business.

#### **Purpose :**

As per a survey, Prefab Construction have many potential advantages over site-built projects for the following reasons :

• The site waste /Construction waste is reduced.

• Construction in a controlled environment ensures better quality standards & insulation

• Accurate measurements and connections.

• Reduce the overall energy consumption .

The demands on infrastructure in India are huge. Given the country's decentralization and its building trades' reliance on manual labor, this level of modular building integration has been a far-off dream across all sectors.

As far as affordable housing sector is concerned, prefab construction offers itself to be of higher quality and more durability than the public sector can supply. Aim is to study and understand the prefab building technologies and all practical aspects of transport and installation of the prefab unitsand how this advanced construction system and technology could be introduced in the architetcural curriculam as a coused material.

#### Need :

Looking ahead to building trends in postpandemic world !

Post Pandemic 2020 ; world is changing, changes that disrupt previous relationships and naturally change the future of the city, architecture and construction .

From accelerating existing trends to inspiring technological advances, the Covid-19 pandemic is poised to have a lasting impact on the way future buildings are designed, built and used.

Engineering, construction, and building materials have a vital role to play in a postpandemic recovery of our communities and economies.

#### Post-pandemic construction should be driven by *Collaboration, Innovation and Sustainability.*

Prefabricated Modular Buildings are ideal for providing workforce housing accommodation, real estate offices, banks, classrooms, medical centers, recreation centers and others.

#### **1.1 Prefabrication in India:**

Prefabricated Construction in India began with Hindustan Housing Factory production.

The organization was founded by India's first Prime Minister, Pandit Jawaharlal Nehru, as a response to the emergency accommodation that existed during the 1950's due to the refugee deluge. Construction in India will continue to grow as demand for fast, affordable accommodation increases.

Nevertheless,

the innovation revolution of the prefabrication process, including materials and digital devices, may have an opposite effect on the embracing nation's climate, economy and culture. There are risks associated with moving to creativity in prefabrication design. Delays and cost overruns reduce the efficiency of the available economic resources, limit the potential for growth and reduce the economic competitiveness.

#### 1.2 Prefabrication Construction Market in Bengaluru, India

In Bengaluru real estate developers have shifted their focus from traditional brick and mortar construction techniques to contemporary prefabricated technology. The prefabricated construction not only ensures optimal use of steel and concrete, but also reduces up to 15 per cent of the average construction cost. Prefabricated technology has emerged today as a solution to stringent deadlines for construction and to maintaining consistent project quality. Increased precision, timely completion and faster project delivery have made it a popular choice among metrospecific real estate developers, especially Bengaluru.

Many developers who trade in the affordable housing sector or have recently forayed into the market are embracing prefabrication technology as it complies with building quality requirements, decreases waste and accelerates project growth without raising construction fees. As a popular builder has said, prefabrication technology not only overcomes the need for skilled labour, but also eliminates lags in time. Some of the city's prefabricated projects lie along the Ring Roads, Balagere Road and Kanakpura Road. In addition, many builders still use prefab technology in leisure ventures, such as farmhouses and holiday cottages.

# **1.3 Comparison of Prefabrication to Conventional In-Situ Building**

All the below mentioned points of interest in comparison to conventional in-situ building erection technique can be summed up in the accompanying table 1.

#### 2. Literature Reviews

Few of the literature studies concluded that prefabricated structures can be used as an alternative to the ordinary masonry or normal structural construction method that consumes  $\geq$ far less materials, complete in less time with higher quality standards and are more  $\sim$ resistant to the loads.

Factor	Prefabrication	On-Site
Quality	In a controlled condition utilizing proficient technology and by trained personnel.	Uncertain climate can bring about not exactly anticipated development quality.
Speed	Speedy process (up to 70% less)	The procedure can be deferred by climate or scheduling clashes.
Cost	Better control in manufacturing resulting in lesser chances of cost overruns.	Uncontrollable factors, for example, climate, work issues and scheduling can increase the cost.
Flexibility	Less	More
Site space	Panels arrive on a level bed trailer and are set up with adequate lifting plants.	Bigger space is required. Moreover scaffolding is often necessary.
Site Wastages	Less waste at site.	A large quantity of waste is produced and removed from the site, adding to costs.

 Table 1: Comparison of prefabricated structures with on-site building erection process

 Source Author

#### 2. Literature Reviews

Few of the literature studies concluded that prefabricated structures can be used as an alternative to the ordinary masonry or normal structural construction method that consumes far less materials, complete in less time with higher quality standards and are more resistant to the loads.

It is anticipated that the utilization of prefabrication and pre-assembly has almost expanded over the most recent 15 years, ascending by 86%. The utilization of precast solid development will significantly decrease the measure of building waste created on building sites. Diminish harmful effects on the air & soil. Increase quality control of the concreting activities. Reduce the sum of labor on site. Increase protection for the staff. Other advantages of using Prefabricated structures in these papers are prefabricated structures which increase the possibility of conversion, disassembly and movement to another site, possibility of erection in areas where a traditional construction practice is not possible or difficult, low labor intensity This can also reduce material wastage, as well as simpler building site management. Great overall construction efficiency.

Over and above, prefabricated construction depends heavily on the efficient transport of prefabricated parts and this has a direct influence on many ways on the overall building cycle, such as cost savings, time savings and spaces.

Other benefits of prefabrication over traditional construction, including decreased time and cost in construction and assembly of parts on a site, as well as less waste since factory production is more efficient. Microorganisms are easier to eliminate in an interior build environment that makes greater use of machinery and reduces human touch and interaction. Now, many prefab and modular companies are considering how they can best get ahead of the curve before the next wave of Covid-19 or another crisis emerges in the future.

#### 3. Key Benefits:

• *Cost-Effectiveness* - Pre-fabrication makes efficient use of steel and concrete that helps reduce waste and provides end consumers with sustainable solutions, lowering the overall cost of construction by up to 15 percent. The method avoids the spending on practices such as plastering.

The increase in a property's expense is often directly related to the raw material costs. Any increase in raw materials costs reflects on the overall construction costs. Efficient use of materials in prefabricated manufacturing, however, means less expense compared to conventional methods of construction; making it a cost-effective production tool for developers.

• *Time Efficiency* - Time-efficiency is one of the mainly important Unique Selling Proposition (USP) of prefab technology. Here, the units are assembled in the factory and transported within a short span of time to the site where they are mounted, resulting in faster project growth. Overall it is possible to save 40 per cent -50 % of the time of the project.

• *Minimum Waste* – Prefab Structures are built in factories using cutting-edge technology, using stricter standards and specific conditions. The precision helps to minimize waste and use the available resources in a sensible way. This also solves environmental concerns by reducing the carbon footprint, as units are being produced under regulated conditions in the factory. Fifty per cent less waste is generated overall.

*Environmental performance:* Prefabricated Construction will reduce the amount of building waste produced, increase the rate of material recycling and encourage sustainable development during all life cycle phases.

*Economic performance:* Prefabricated building is capable of reducing costs over the life cycle, raising the profits of construction firms and enhancing supply chain management.

*Social performance:* Prefabricated construction will boost industrial production, create new jobs, encourage the growth of industry and improve public quality of life.

When the prefabricated building is built to some degree, economies of scale impact and cost savings may occur. Today, realistically selecting a prefabricated part is a novel mode to be economical.

For the "social atmosphere and public opinion" element, the characteristic of prefabricated buildings, such as energy conservation, environmental protection, and excellent efficiency, should be given more publicity. At the national level, the government will make acceptable policies, rules, and guidelines to shape the frame. The undertakings should pay more attention to improving standards of enterprise. With Ζ government incentives and the development of policies, prefabricated construction will become more popular.

To the safety of prefabricated construction, designers should choose the appropriate assembly speed according to the level of the technique. The design stage should be given more attention to needed problems occurring in the prefabrication and assembly process. Factory prefabrication should be encouraged to improve component manufacture.

#### 4. Conclusion

Pre-fabricated Construction in Bengaluru is still in its initial stage, but it will undoubtedly be the direction of future industrialization of buildings. This research has limitations. Note that few factors were selected to demonstrate the state of Pre-fabricated assembly.

• The expense of receiving prefabricated innovation is 15-30 percent higher than the expense of customary/traditional innovation for the examination ventures.

• The key considerations to be deal with in Prefab construction planning are transport restrictions, legislation and special traffic control within the construction area.

• An absence of perceptiveness of the effectiveness, advantages of the prefabricated frameworks is a first test for the promoting of prefabricated structures.

• Reception by the Public: Public acceptances as an outside environment play a very significant part in the promotion of Prefabricated Construction. A pessimistic view and lack of Prefabricated Constructions' awareness hinder consumer demand.

• Promotion of prefabricated construction requires cooperation of all interested parties. The concerns need to be tackled before steps to encourage prefabricated construction can be taken. The growth of the Prefabricated Construction Industry will begin with paying attention to policy and regulatory formulation.

• The utilization of prefab can assist with accomplishing results for the general public's prompt needs on the grounds that the quick evolving condition, business, financial aspects, industrialization, private needs, settlements and numerous different variables of transportation like extensions, towers, railroads calls for quick settlement and prerequisite for structures, workplaces and ventures, consequently construction is the answer for quick and efficient development.

• The utilization of precast concrete will extraordinarily diminish the measure of building waste delivered on building destinations. Diminish destructive effects on the air on grounds. Increment quality control of the cementing exercises. Diminish the aggregate of work nearby. Improve work environment wellbeing and safety.

• The fundamental advantage of prefabrication is that construction time is minimal, waste diminished and the quality extended.

• The Prefab construction system is recommended to be to introduced in the Architectural curriculum as a course material, as we can foresee this technology as the future of construction industry consodering all the above advantages.

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## RETHINKING ARCHITECTURE PEDAGOGY IN THE ERA OF PANDEMICS

#### Abstract

Conventionally architecture education is always an interactive process that involved group working with collaborative teaching and learning to develop students creative skills. The sudden shift to digital media and distant learning by the sudden urgency of Covid 19 Pandemic with the closure of educational institutions and the students stuck at home, confronting many obstacles by the students and teachers as well while teaching and learning through Emergency remote teaching (ERT) process. The challenges faced by the virtual learning in Architecture courses were tried to address at the most, though the unprepared teachers struggled during this unexpected urgency and change, it was a stressful situation for both students and the educators. This research paper attempts to understand the influence on architecture education in three different stages i.e, pre-pandemic, during pandemic and post-pandemic stages. Further, deliberates on developing framework and strategies to the process of shifting the teaching and learning mode from face-to-face to ERT. The deliberations are discussed and presented in detail through a case example of University of Nizwa, Sultanate of Oman.

*Key words: Syncronous;Asyncronous;Elearning;Emergency remote teaching ;Distant learning* 

#### 1. Introduction

"We want that education by which character is formed, strength of mind is increased, the intellect is expanded, and by which one can stand on one's own feet". "You cannot teach a child any more than you can grow a plant. All you can do is on the negative side - you can only help. It is a manifestation from within; it develops its own nature you can only take away obstructions". "Education is the manifestation of the perfection already in man. All power is within you; you can do anything and everything. Arise, Awake and Stop not till the goal is reached.

Swami Vivekananda

Conventionally architecture education is always an interactive process that involved group working with collaborative teaching and learning to develop students creative skills. The students need to interact, discuss and debate in design studios with their teachers and other students. The sudden shift of conventional way of design studio teaching and learning to digital media and distant learning by the sudden urgency of Covid 19 pandemic with the closure of educational institutions and the students stuck at home resulted in the confrontation of many obstacles by the students and teachers as well while teaching and learning through ERT process. The challenges faced by the virtual learning in Architecture courses were addressed at the most, in spite of unprepared teachers struggling during this unexpected urgency and change; it is a stressful situation for both students and the educators. This research paper attempts to understand the influence on architecture education in three different stages i.e. pre-pandemic, during pandemic and post-pandemic stages. Further, deliberates on developing framework and strategies to the process of shifting the teaching and learning mode from face-to-face to ERT. Virtual learning in architecture is not a new phenomenon, many architecture schools around the world have been offering courses in virtual media, but noticeable point here is E Learning in normal situations is different from E Learning in emergency situations, carefully understanding the impact of this virtual classes for skill based courses Graphics, like Free hand sketching, Engineering drawing etc. Knowledge and Value based theory courses, Digital courses like BIM and Design courses etc.also to understand whether face to face interaction on campus is more effective or face to face

online. Weather the rate of interaction between student teacher has increased or decresed. Is there a need for the reorientation of architectural education which can be runned in any critical pandemics or emergency closures, in this paper the author has tried to understand the current trends and future directives and vision for Architecture design education. Solutions to effective teaching during pandemic requires creative thinking to get best from individual students. This study uses the data collected from literature study, self experience in ERT during Covid 19 pandemic in Spring 2019/20 at department of Architecture and interior design at university of Nizwa in Sultanate of Oman and discussion with other architecture faculties in the department and their observations.

#### 2.A view at Architecture Education in Pre Pandemic times

This part of the paper, the author talks about Architecture Education in Pre Pandemic. explores the conventional architecture education having the mix of activities, Events, Workshops, Seminars, Exhibitions, Group works, Field/Site visits, Documentation works, face to face Jury critics, Competitions, working with international collaborations etc with the physical connection of students to their work and educators resulted in a healthy, active teaching and learning, the main aim of design studios was to develop students visualization, ideas. concepts and imaginations with practical context.



Figure 2.1 Showing the amalgamation of various activities and events in Architecture education in university of Nizwa.

#### Source : Author

#### 3. ERT during Covid 19 lockdown

In this part of the study, the process of shifting the teaching and learning mode from face-to-face on campus to ERT at University of Nizwa, is considered as a case study. one of the leading higher education institutions in the Sultanate of Oman accredited by Oman Academic Accreditation Authority (OAAA). The University offers over 30 undergraduate majors and 6 masters programs to a student body of nearly 6500 both Omani and international students from Egypt, Syria, India, Pakisthan, Bangladesh, Ethiopia, Iraq, Iran Tuneshia, Libya etc, With faculties coming also from many different countries. During this crisis, Architecture studios at the University of Nizwa quickly adopted the virtual learning environment by the training and support provided by the university's CIS Center for information system department to all the faculties on Moodle, Eduwave, E learning, Big Blue Button (BBB) etc. apart from these the faculties of Architecture are using virtual platforms like The ZOOM, GOOGLE MEET. SCREENCAST  $\mathbf{O}$ MATIC, digital pen and the touch screen computer to sketch on the drawings to

provide instant feedback for design courses, social media platforms like Skype, Whatsapp Facebook, Instagram, Youtube channels were used to communicate effectively, both the methods of Synchronous and asynchronous were implemented as an alternative media supporting the traditional studio based learning for architecture courses as well as the entire university. Teaching assessment plans (TAPS), academic calender were modified by giving extra marks for students attendance and participation to make the ERT more effective, deadlines were postponed for Design oriented courses specially for Thesis projects and for beginner studios who were just introduced with the concept of drafting and design, Weekly status for faculty and students readiness and weekly status of ERT were collected from each faculties. Surveys were conducted on course and instructor evaluations. Inactive students were been Z contacted by the course teachers and student advicing center just to understand their situations in pandemic and encourage them to participate in E learning. Its really challenging for both students and educators, difficult to understand the design by only means of digital media, the quality of design

have reduced. Covid-19. worldwide Ouarantine, self-isolation, lockdown, curfew, and the sudden closure of the academic universities and institutions have influenced the normal progress of the educational process, specially for architecture students who found difficult to convey their true talents without proper tools and materials with them. The digital oriented courses like the BIM faced several obstacles and technical problems as it needs a very good IT skills to install the software and use the computer aided softwares specially rectifying the problems at time of sudden shut down of internet or crash, some students were relying on computer labs who don't even have laptops with them, theory courses may have a good teaching effectiveness though its tedeous for educators to keep students without getting distracted online, but student learning effectiveness might have gone down as per the observation made by many faculties.

Online quizzes, assignments and projects were conducted in theory courses but the problem of plagiarism arises here. Coming to the design courses some of the faculties feel teaching design courses completely online is not effective as the evaluation and criticism has to be done on 20" computer screen is difficult as compared to evaluating on the sheet. some of the students showing no interest in design process and frustrated with workloads. Analyzing the remote the architecture design studio problems which could be related to the sudden shift from conventional methods of studio culture, the architecture education has to proactively address the changing world with reorientation of architecture education system. On the other hand self motivation is also a biggest requirement during pandemic for both faculty and students as work from home is a biggest challenge with all the household chores, it's a real struggle expecting 100% efficient work done by students spending hours in single room is unimaginable.



Figure 3.1 showing the screen shots and photos during the process of ERT in Architecture education in university of Nizwa.



#### Source : Author.



#### RETHINKING ARCHITECTURE PEDAGOGY IN THE ERA OF PANDEMICS



Figure 3.2 showing the screen shots and photos during the process of ERT in Architecture education in university of Nizwa.

Source : Faculties of Architecture @ UNIZWA

# 4. Architecture Education in post Pandemic

"Tough times require tough measures". In post-pandemic society, the academe has the biggest role to play and formulate better methodologies by looking into the strenghts and weeknesses\shortcomings as experienced during ERT in Covid 19 pandemic. This is a confusing time for everyone globally forcing to reconfigure the educational system in the short-term and potentially long-term as well. Perhaps this difficult period will mark a positive culture shift in the Architecture education. Its important to reasses redefine the architecture education system and it's a time for taking intelligent and collective action to promote students participation, A student centric perspective is an essential and first step for the effective learning. Preparing students for the unknown, uncertain and unpredictable future and to motivate and their abilities, develop awareness of responsibilities, involvement in self studies, learning attitudes, time management and students have to be directed to self-research, self judgement on their designs. research and teaching may also manifest student centred activities, such as problem based learning, where the students become responsible for exploring and developing their own concepts and ideas by rational thinking rather than

enforcing for final presentation. encouraging team work among students and peer reviewing each others works helps in active enjoyment while teaching-learning. Apart from studying the maximum credits hours per semester, vacational programs and online collaborative studios for collective learning where several colleges and students can come together gives a good exposure for teachinglearning for both students and educators and can allow for the possibility of collaboration and exchange of concepts and best practices among each other.

Coming to the teaching methods, asyncronous and syncronous teaching which was a best practice quickly adopted by almost all educators should be incorporated in the curriculum along with the conventional studio based teaching to support each other more effectively in design education in post pandemic, Distant education courses should be identified and carefully designed and developed to offer better and timely solutions for all students. Restricting no. of students in the class depending on social distancing by increasing sections is required as the teaching is carried out by a single faculty unlike other universities in other countries have multiple faculties for design courses which requires individual discussions effective for interactive sessions with every student. As



remote work might continue in post pandemic, we should only expect the reliance on software and technology utilizing digital for maximum productivity and tools communication while travelling less, but the design courses can be carried out with 50% of classes for online consultation and rest 50% on campus for evaluation. for the effectiveness and to produce quality architectural designs with maximum details which was lagging during lockdowns. Theory courses sync well in online teaching but to reassure effective learning by students, quizzes and exams should be conducted on campus. Turnitin softwares should be used to get authentic assignments by the students and not a copy paste versions. For the purpose of facilitating and supporting the educational process adequate support system and access to resourses and services online should be provided, effective teaching can happen through any medium by adopting and inventing new methods and tools. Continued learning in the post Covid-19 education

requires collaborative understanding, support, and compassion.

#### 5. Conclusion

Keeping in mind the changing Architecture educational practices due to various interruptions by pandemics or any kind of natural disasters in future, Educators and course designers must be able to apply selflearning theories to create assimilative learning environment in online education. Learners should be ready to learn anytime. anywhere, any platform and with any company even while the students may face psychological technical, barriers and emotional challenges due to the effects of hence student centric pandemics, а perspective is an essential and first step for the effective learning rather than teacher based, the gap in online atmosphere between teacher -student should be addressed effectively with an empathetic approach, the Table 5.1 summarizes various deliberations on developing framework and strategies suitable for all critical pandemics.

 Table 5.1 Deliberations on developing framework and strategies for post pandemic architecture education.

Type of Era	Type of courses offered	Mode of teaching/ learning & exams	Effectiveness in teaching and learning in different time periods	Recommendations / Frameworks and strategies for Post pandemic and suitable for all critical Pandemics.
Pre Pandemic	Skill, Knowledge, Digital and Design based courses	On campus conventional methods of teaching/learnin g, and exams	Effective teaching and learning, Rate of interaction between student teacher was good	<ul> <li>A student centric perspective rather than teacher based to create assimilative learning</li> <li>the gap in online atmosphere between teacher student should be</li> </ul>
Pandemic Spring & Summer	Skill, Knowledge, Digital and Design	E R T Syncronous and Asyncronous.	Quickly adopted the emergency situations by teachers and	<ul> <li>dressed effectively,</li> <li>create a supportive learning environment and</li> </ul>

#### Source: Author

2010/20	lagad	Online avame in	ates danta resitle 41.	1	annaista diregniterie
2019/20	Dased	Unline exams in	students with the		appretate diversity in
	courses	moodle which is	online atmosphere,		students,
		not fully	learning	$\checkmark$	teacher-student ratio have
		effective	effectiveness has	-	to be reorganized
			come down as		to be reorganized,
			there are diverse	~	Continous career guidance
			set of students with		for the students to be
			diverse responses,		given,
			Rate of interaction	$\checkmark$	Motivation, awareness of
			between student		responsibilities.
			teacher has		involvement in self
			reduced.		studies learning attitudes
				1	studies, learning attitudes,
		Suggesting 50%	Teaching and		time management self-
PostPande	Skill,	Remote teaching	learning both		research, self judgement
i osti allue	Knowledge,	/ consultation	should be tackeld		rational thinking.
line	Digital and	and 50% on	to get best results		encouraging team work.
Fall	Design	campus for	in effectiveness.	$\checkmark$	Syncronous Asyncronous
2020/21	based	evaluation and	Reorientation of		along with on compus
	courses	exams with	architectural		tooching avaluations and
		Syncronous and	education is needed		teaching, evaluations and
		Asymptonous	with identifying		exams
		mathada of	distant advastian	$\checkmark$	Rethinking pedagogical
		to only a miter 1-1-			approach along with
		teaching suitable	courses. Turnitin		Andragogy and
		tor any kind of	software to be used		Houtagogy and
		pandemics	for assignments		neulagogy.

As these pandemic occurrences are unsure and uncertain, there may be many more such waves in future hence understanding, support, and compassion to the learners by motivating and guiding them to be self-learners successfully not only enhances the effectiveness in learning but also allows one to stand on one's own feet in their future endeavours as guided in the quote by Swami Vivekananda.





RETHINKING ARCHITECTURE PEDAGOGY IN THE ERA OF PANDEMICS

While framing the strategies for effective teaching and learning processes in architecture education in any kind of Era's should be remembering to enhance the students by increasing their intellect, strength of mind to reach their goal should be the primary goal of the teachers.

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