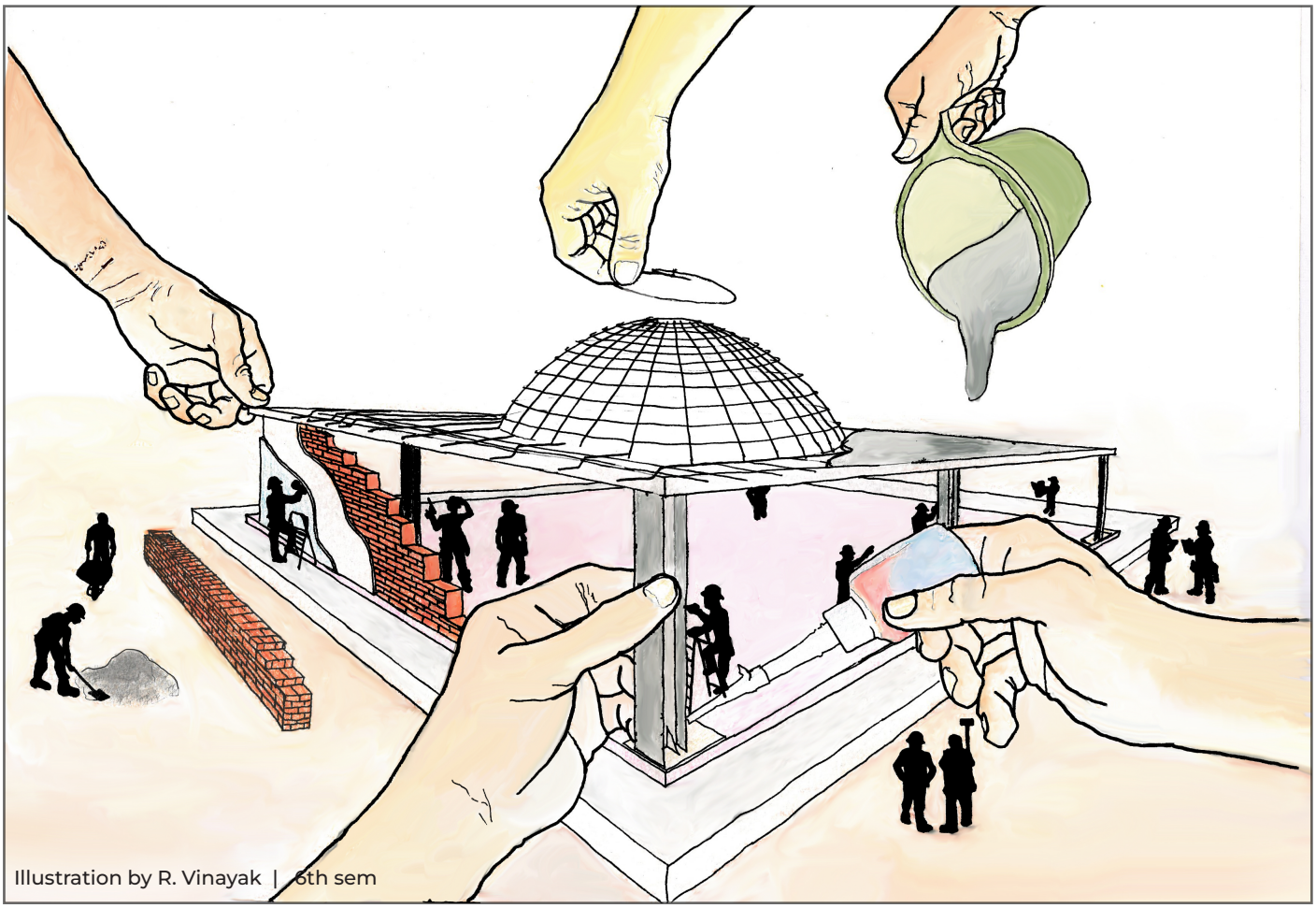

Illustration by R. Vinayak | 6th sem

07. Enhancing Material Understanding through Hands-On Experiences.

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Abstract :
The article examines the innovative approaches in pedagogy adopted by the faculty of the course "Materials and Methods of Building Construction" highlighting the benefits of hands-on workshops. The article demonstrates the effects of innovative on-site demonstrations and model-making methods that led to an improved cognition of construction techniques related to RCC, Bamboo, and other alternatives. Group activities, such as creating scaled models, mixing and application of composites, stress tests etc., provided a tangible understanding of construction processes. This departure from traditional lectures to experiential learning represents a noteworthy change, fostering practical thinking and problem-solving in students.

Keywords:
Pedagogy, Hands-on techniques, Experiential learning, Innovative education.

Architecture as a course of study has always been closely related to its practice & profession. Since the birth of the profession and structuring of its curriculum, there has always been a very close association and influence of the practice on the curriculum. Architecture, as an art and science, stands at the intersection of creativity and functionality. It involves designing spaces that not only inspire and uplift, but also serve the needs of individuals and communities. In the realm of architecture, hands-on workshops hold a pivotal role in shaping the education and development of future architects. In addition to architectural design being a core course, "Materials and Methods in Building Construction" hereafter mentioned as MMBC, has consistently been recognized as an essential component for the comprehensive development of an architect.

On the contrary, this hands-on building construction course has gradually started taking a didactic approach

of pedagogy and this may affect the objectives of the course being limited to a lecture-based course with the outcomes being condensed to merely drafting of sheets. Unfortunately, in today's extremely fast paced digital world, the importance of hands-on experiences in education is often overlooked. Actively engaging with materials firsthand nurtures, a more profound grasp of their characteristics and potential uses. Dr. Niloufar Emami, Assistant Professor, University of Illinois Urbana-Champaign in her article "Teaching structures to architecture students through hands-on activities" emphasised on the visual and tactile understanding of building materials and stated how the inability to directly interact with real materials hinders learners' progress in this regard. This article explores the transformative power of workshops and gives an in- depth understanding of various pedagogical techniques that some of the hands-on workshops can bring forth in the overall development of a student in the architectural curriculum.

This study has a deep exploration of the third semester course of (MMBC) syllabus prescribed under Visvesvaraya Technological University hereafter referred to as (VTU). This course work includes understanding of Reinforced Cement Concrete hereafter referred as (RCC). RCC slabs like one-way slab, two-way slab, continuous slab, cantilever slab & RCC domes & vaults, alternate roofing materials and techniques, understanding paints and finishes, masonry domes, vaults and funicular domes. The academic plan for this studio was curated by the faculty team in order to enlighten the students by immersing them in practical activities, with the workshops not only imparting technical knowledge but also sparking creativity and innovation in material explorations .

Demonstrations:

1) Reinforced Cement Concrete

Reinforced Cement Concrete (RCC) slabs represent a ubiquitous construction technique employed throughout the country for building floors. They find application in structures of all sizes and types. A crucial aspect of working with RCC involves a comprehensive understanding of the intricate process of laying steel reinforcement bars, their bending, correct placement, and the utilisation of support elements like chair bars[1].To effectively convey these complex concepts to students, educators have found that model making emerges as an exceptionally efficient teaching method. The teaching approach involves dividing students into groups, each tasked with crafting a scaled-down 1:10 model, illustrating the reinforcement details of various slab types. Additionally, students attempted to replicate reinforcement details for more complex structures, such as RCC domes and vaults. Materials used for making the model were foam sheet, GI wire, Aluminium wire, Wire mesh etc.

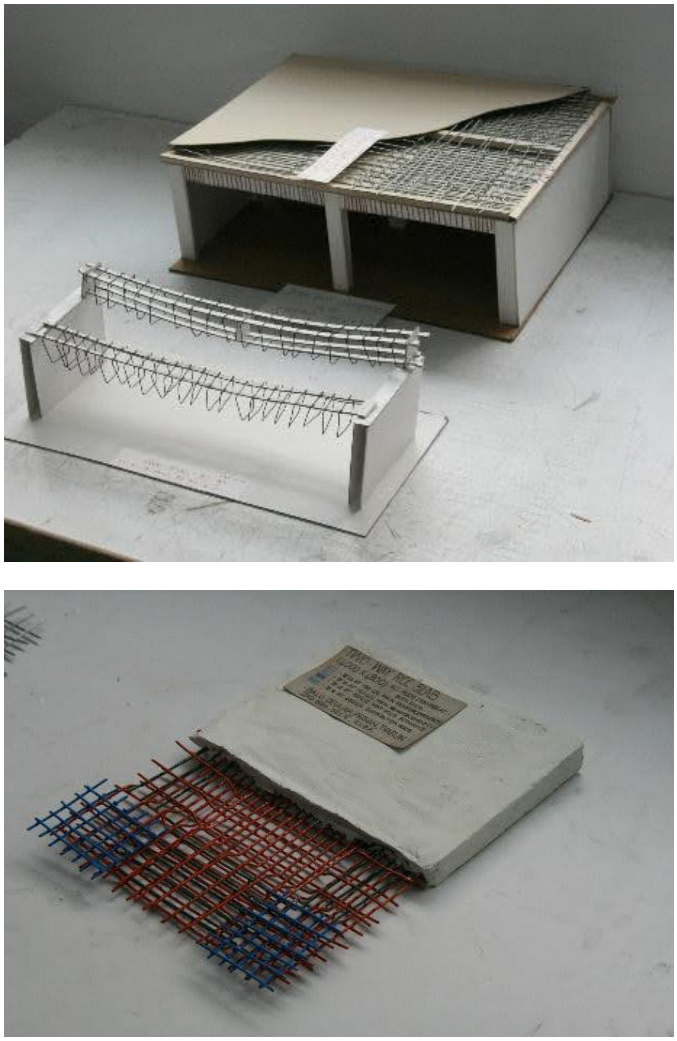

Fig 1: Showcasing final models made by the students (Batch 2016-2020 in groups of 8)-(Source : Author)

2) Bamboo,a material exploration through 1:1 scale models

The basics of bamboo workshop was a three-day workshop for students to construct five bamboo pavilions on the campus as an attempt to gain insight into alternate roofing materials and techniques. The intent of the workshop also included to test and understand the flexibility of bamboo as a structural material, working hands-on with it and having a basic knowledge of the joinery details. Bamboo's versatility, strength, and sustainability make it an ideal material for various uses in

Fig 2: Final outcome of the bamboo workshop. (Made my students of 2018- 2023 under the guidance of Ar. Vinutha S N & Ar. Amit K)

[1]chair bars-chair bars are supports places at predetermined heights to ensure proper spacing and holding up of main reinforcement bars.

the construction industry. The workshop began with an introduction to bamboo's anatomy and growth patterns, followed by a lecture discourse on harvesting, treating and procurement of bamboo poles. The students then set foot on making bamboo vaults - from bending, shaping, cutting and joining they were deeply involved with the material and its behaviour. Participants learnt about construction techniques by constructing a simple structure in the days' time.

3) Exploring Vault and domes as masonry roofs

The objective of the workshop was to provide participatory sessions on two masonry roofing types as alternative construction techniques. The materials used for the masonry vault and funicular dome were hollow clay blocks and custom-sized clay bricks respectively. The exercise was done with the partnership of Ar. Gouthama D M (Mud Hands) for the batch of 2017- 2022(fig 3,4). The workshop introduced the participants to the innovative world of lightweight structures. Funicular domes, inspired by nature's efficiency, emphasise tension and compression forces for stability. This workshop combines engineering principles with hands-on activities to build small-scale models of funicular domes using materials like bamboo, timber, or lightweight metals. Participants learn about geometry, structural analysis, and the delicate equilibrium that makes these structures possible. Through practical experience, participants comprehend the complex interplay of forces that dictate the stability of funicular domes. They explore the concept of form-finding, where the shape of the structure arises from the balance of internal and external forces. By physically assembling these models, participants grasp the engineering challenges and aesthetic potential of lightweight, efficient structures. A similar exercise was done for the students of batch 2022- 2027 in collaboration with Eco Home Solutions where they attempted a masonry vault in the construction yard in the RVCA campus.

Fig 3 : Students attempting scaled prototypes of funicular domes before the construction of the dome (Source: Author)

Fig 4: Process of construction of Masonry vault (Source : Author)

4) Natural plasters

Sustainable practices in building construction are becoming the need of the hour. The next interactive workshop was done to enhance the understanding of natural plasters. The students were introduced to various vernacular plastering materials like clay, lime, and earth. They were taught the art of mixing, applying, and finishing natural plasters, The workshop aimed to highlight the historical and cultural significance of natural plaster techniques, encouraging the preservation of traditional building methods and demonstrating that natural plastering can be a cost-effective and sustainable choice for both new construction and renovation projects. Unlike processed building materials like cement, earth requires higher-order thinking skills (from Bloom's Taxonomy- Cognitive Domain) and several rounds of tests that make plaster workable. The workshop also emphasised on the importance of locally sourced materials and the low environmental impact of non-toxic finishes. The students experimented with the ratio of water to be added to various mixes for perfect workability and the role of pigments in the overall aesthetics of the plaster. Engaging with natural plasters also offers a tactile understanding of its properties like breathability & thermal performance which is difficult to

Fig 5 : Showcasing the display of different types natural plastering materials (Source : Author)

Fig 6– Students preparing batches of natural plaster (Source : Author)

understand through verbal communication. The balance between material composition and artistic expression is a valuable takeaway from the workshop. This was supported by the architectural firm Made in Earth for the batch 2016- 2021 (fig 5,6) and a similar exercise was repeated with the batch 2021- 2026 under the guidance of Ar. Ajinkya Unhale (Unearth) (fig 7).

Paints and finishes make a small part of a module in this curriculum. Previously, various interactive theory sessions on paints were conducted to make students understand its application. It was observed that during assessments the students would often have severe confusion between the painting materials, surface compatibility, constituent of paints and various other details. In order to counter this challenge the students were divided in groups of 4-5 where each one of them were given a particular type of paint. Paint samples were bought from the market and tried on different surfaces like wood, metal, concrete, paper, stone etc. They had interesting observations and tabulated their entire study. (fig 8, 9)This was discussed in length in class. During a verbal feedback session students expressed that they had a deeper and easier understanding of the topic which was initially difficult to correlate and recollect when it was limited to lecture-based teaching. This was one of the simplest yet effective approaches that helped cut down long theory hours of classes.

Hands-on experiences offer an unparalleled pathway to material understanding. Workshops such as basics of bamboo, natural plasters, and funicular domes go beyond theoretical knowledge, allowing the students to forge intimate connections with the materials they work with. These immersive experiences empower individuals to create, innovate, and think critically about material applications. As we continue to advance technologically, the timeless value of tactile engagement remains a cornerstone of meaningful education and sustainable creativity. Overall, the pedagogical approach presented in this article promotes a shift from passive learning to active exploration, enabling students to become more independent and resourceful learners. It aligns with the idea that true understanding emerges from direct experience, and it can be particularly effective in disciplines where tangible, hands-on interactions with materials are integral to the subject matter.

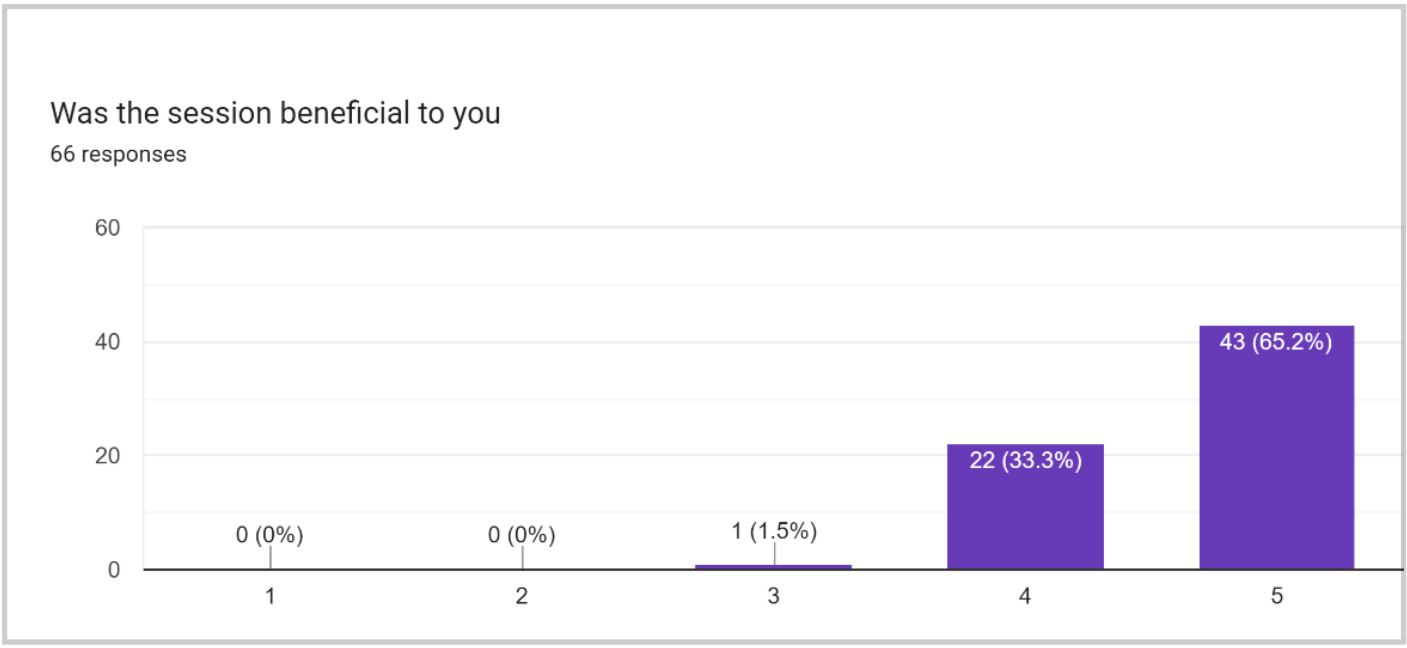

Fig 7. Feedback from students of batch 2021- 2023 (Source : Author)

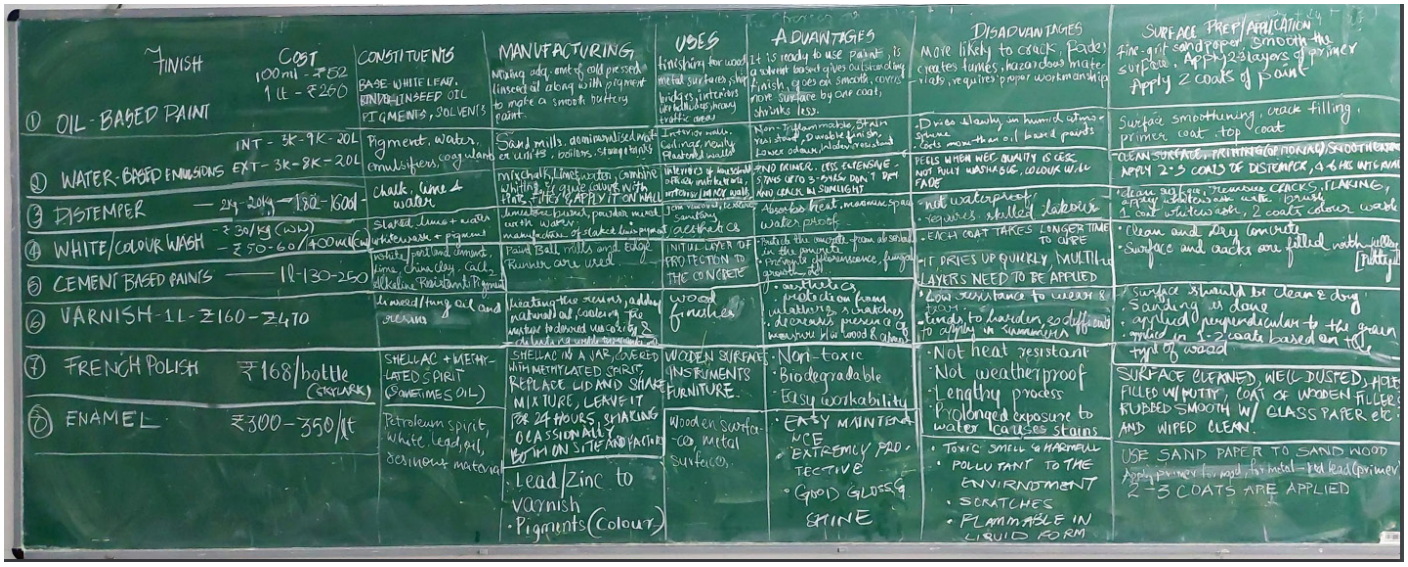

Fig 8. Showing the table filled post market study done by the students of batch 2021- 2023. (Source : Author)

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Shweta Pedaparthi, B.Arch graduate from R.V College of Architecture, Bangalore, has a diverse professional background. She worked with Praveen Vashisht and Associates in Delhi, followed by RSP Design Consultants, Bangalore. Shweta's passion for teaching led her to serve as an assistant professor at R R School Of Architecture, focusing on architectural design and related courses. Since 2017, she has been contributing to R V College Of Architecture, not only academically but also in cultural and alumni activities, showcasing her dedication to holistic education and practical space management in architecture.

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Akanksha Singh holds a Bachelor's degree in Architecture from Priyadarshini Institute of Architecture and Design Studies, Nagpur (2017) and a Master's degree in Landscape Architecture from School of Planning and Architecture, Bhopal (2020). She worked in an architectural firm 'studio RAH' in 2019. Her areas of research include healing and therapeutic landscapes, hospital landscapes, sacred landscapes and landscape and mythology. Apart from being registered under COA, she is also a member of ISOLA (Indian Society Of Landscape Architects).

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