

# Physical Modelling - Essence of Learning Architecture

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**Abstract:-** Architectural education primarily combines intellectual rigor and practical skills. It is an educational discipline where the students learn to think deeply about the interconnectedness of the culture, the built environment, technology and the creative world of ideas. Architectural education is potentially infinite in its scope and subject matter. Understanding the subject through making physical models has great positive impact on the students, and teaching architecture using the concept of modeling gives scope to teach, and discuss certain aspects of design that cannot be effectively thought or understood otherwise. This paper is an expression of an experiment conducted to examine the impact of making manual model a part of the classwork.

**Keywords:-** Architecture, learning methods, physical modeling, teaching approach.

## I. INTRODUCTION

Architecture is believed to be an art and technique of designing that helps build a habitable environment, while the skills associated with construction are different. An architect's solution to a design problem is expected to fulfill both practical and expressive requirements. Both utilitarian and aesthetic ends of a design solution are like two sides of a coin as they may be distinguished, but they coexist and needs considerable attention. Because every society—in spite of varied socio-economic, cultural disparities has a spatial relationship to nature and other communities and societies, the structures they produce reveal much about their environment (including climate and weather), history, tradition, culture and artistic sensibility, as well as life style.

## II. LEARNING ARCHITECTURE

Design essentially is a Solution to a problem, where the problem is defined by User & Use. Design solutions are based on "form", "function", and "construction". Finding and regulating the components for creating a functional, sustainable built environment is highly essential. Technical subjects such as building construction, structural mechanics, building materials, building services etc., included in architectural curriculum are important concepts that help understanding and learning "form" and "function" approaches, that help designers to bring architectural design into reality.

## III. TEACHING APPROACH

In a professional course, the subjects one learns need to be applied in practice or career. In majority of cases, numbers

of subjects are thought from the perspective of theoretical approach where approach to its application is not stressed upon. "You can teach a student a lesson for a day; but if you can teach him to learn by creating curiosity, he will continue the learning process as long as he lives" --Clay p. Bedford.

"Our senses evolved to work together – vision influencing hearing, for Example – which means that we learn best if we stimulate several senses at once" -John Medina.

Research has discovered that there are seven primary learning styles or categories in which, every individual processes information at their own pace in their own way.

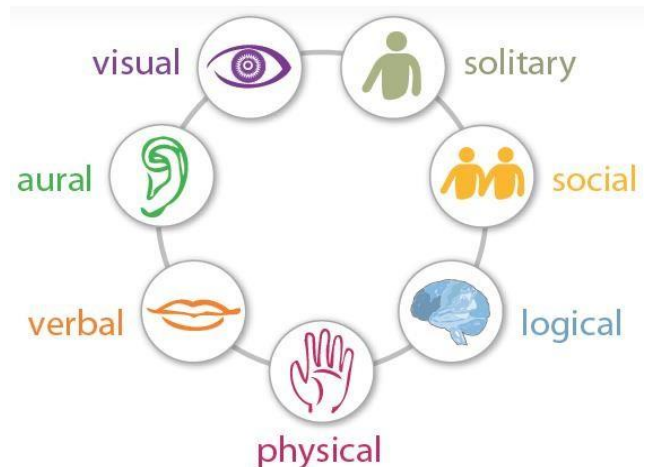


Fig 1:- Styles of Learning

Source: Teaching and learning with technology. <http://moodleforeducationandbusiness.blogspot.com/2012/12/the-seven-learning-styles-in-online.html>

Visual	• Learning using pictures, images, maps, spatial understanding
Aural	• Learning through music, sound
Verbal	• Learning using words both speech and writing.
Physical	• Learning using body, hands and sense of touch
Logical	• Learning using logic reasoning and systems
Social	• Learning through groups or working with other people.
Solitary	• Preference to work alone or self study

Fig 2:- Styles of Learning.

Source: *Teaching and learning with technology*. <http://moodleforeducationandbusiness.blogspot.com/2012/12/the-seven-learning-styles-in-online.html>.

**IV. THE MISSING LINK**

The best way to learn is to do; the worst way to teach is to talk -Paul Hamos. According to the "Learning Pyramid", sometimes referred to as the "Cone of Learning", developed by the National Training Laboratory advocates that, amongst the various methods of teaching and learning, students remember nearly

90% of what they learn through teaching others and about 75% of retention happens when they practice doing it. In architectural context, we can implement the concept of model making and its presentation in class, to integrate all cooperative learning methods that demonstrate major retention rate by the learners.

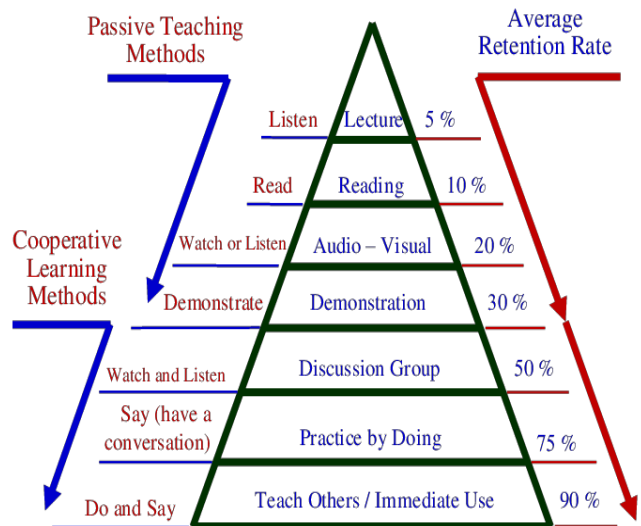


Fig 3:- Learning Pyramid. (Adapted From National Training Laboratories Bethel, Maine, USA)

**V. CONCEPT OF PHYSICAL MODELING**

Often architectural design is placed at centre of the cycle of learning and rest of the other subjects are treated to be complimentary. In the process of evolving creative conceptual designs, the studio exercises mostly limit its students to analyze the case and attempt 2d exploration in the initial stages of the design, while other technical subjects are limited to sketching and drafting exercises. An approach to transform the learnt text and concept into a physical model (although rough finish) at different stages of learning in various subject across semesters would make great difference to students in integrating and practicing multidisciplinary approach to the design solving process. Learner would easily understand the problems encountered in bringing the concepts into reality and work towards its solutions right from the beginning.

Intensive, imaginative and realistic ideas are the major criterion for the architectural student fraternity. The integration of all these together would be more effective modes of learning in the studio. Manual or digital planning abilities are vital to professionals in creative fields of design.

**VI. TASK**

Students and few faculty members of Architecture Department, School of Planning and Architecture, JNA&FAU, Hyderabad, have taken up making physical model as major criteria of learning and teaching methodology. This assignment was introduced with varied parameters pertaining to the subject context across semesters. To start with - the exercise was introduced in subjects like advanced construction materials, site analysis and conceptual design process of fifth and sixth semesters, building codes and byelawsetc...

*A. Advanced Construction and Materials- VII Semester*

*Syllabus-* Advanced construction methods in RCC, folded plate structures, space frames, suspended roofs, membrane and cable structures, shell structures and construction of curtain walls.

*Task assigned-* Class has been divided into a group of 5 students. Each group has been assigned a topic from the subject syllabus, for instance first group shall work on shell structure, second group on membrane structure so on. The students were given 3 class sessions to work on a model with material of their choice. Parameters with in which models were to be made were.

Model has to be to scale. At least one side of the base of the model shall be measuring 50cm.

- Students are free to fix the dimensions of the model based on the spatial volume and proportions theyadopt.
- The structural model shall withstand a weight of minimum 2kgs.

*Objective of the exercise:* This exercise enables students to understand the cohesion between different materials and the decision making required based on the properties of different materials and their behavior under varied circumstances. They gain hands on experience on how to construct a structure that can resist various forces and understand the factors influencing the structural stability and design. The task is also aimed at providing scope for the students to explore the amalgamation of varied construction technology,



Fig 4:- Student works as part of Advanced Construction & Materialsstudio

design principles, aesthetics and structures in a process of space design.

*Observation-* Students worked with more enthusiasm and vigor to complete the task. They have made a decision regarding the structure, materials and techniques of making it initially, and as they proceeded, they realized the structure failed to stand. Closer inspection of the properties of materials they chose, techniques of construction and the structural design with timely discussion with faculty and among their peer group, they realized the faults and got back to working with renewed interest, focus and enthusiasm. The second time, they emerged successful in completing the task. They have precisely understood the objective of the exercise and the concept behind the construction of the chosen structures and its applicability. Process and product of all groups were discussed in class which gave them a much clear understanding of the subject, its applicability in various contexts. The scope to fail could be taken in the stage of learning, made them strong with the basics and concepts of the topic which is highly necessary to gain command on the subject.

Student expression - "While designing cable- membrane structures, 3 factors need at most focus and they are- shape finding loads, dynamic characteristics of the structure, structural response to wind loads. In the process of making the structure, we understood the importance and interdependence of factors such as selection of materials, calculation of loads, deciding on the strong and rigid support systems for the cables to be stable and stiff. Understanding the properties of pre-tension membrane material based on the shape required is very essential. Height of roof at various points of the space in reference to the floor plays a major role in making the structure stand. This experience made great impact in understanding the concept and designing of membrane structures. Theoretical approach would not have given the required insight as we would limit ourselves to the written information." says Likitha and her team.

On the other hand, Harish, Navya and their other teammates who explored making suspended

structures say that "model making helped us to know how different materials work at different conditions. It helps in understanding how cables are capable of withstanding tension while offering no resistance to compression. It enabled us to identify the loading distribution pattern for the structure precisely. Theoretical knowledge gave us an insight about the subject where as practical experience helped in understanding the relevance and application of the structure, material and form under various contexts."

*B. Building Codes and byelaws- VI Semester*

*Syllabus-* Study of building codes, norms, byelaws and building regulations, norms for vehicular areas, norms for fire protection, norms for building services, requirements for parts of buildings. Building codes in special regions like heritage zones, air funnels, disaster prone regions etc., are part of the syllabus.

*Task assigned-* Class had been divided into a group of 5 students. Each group has been assigned a topic from the subject syllabus, for example, first group shall work on fire protection norms, second group shall work with standards for lighting and ventilation in buildings and so on . The students were given 3 class sessions to work on a model. Rules of the game were simple. Each team had to produce a model that displays 10 important norms/codes/byelaws required for construction of the space. Each team could use 3 different models as reference to explain their case indifferent



Fig 5:- Models of assigned task for Building Codes & Byelaws subject

contexts such as commercial, residential etc. The condition given was that the model shall be a scaled working model.

*Objective of the exercise:* This task aims at enabling the students to sink in the major required norms, standards and the basic concept behind its applicability and application in varied contexts.

*Observation-* The learning experience differed from the routine theoretical discussion approach. During the process of making the model, students had to select 10 important codes that can be implemented and displayed clearly in the model. This helped them enhance their decision making ability, reading and understanding the documents. While transforming them into the model, they understood the concept behind the application of norms and how creatively they could provide solutions incorporating the rules and regulations.

Student expression- "Model making helped me visualize space in reality, with introducing the standards of lighting and ventilation into the space. Execution of the designed solution into a scaled model helped me understand the amount of natural light required to reduce the usage of artificial light in different categories such as residential, commercial and institutional spaces." says Yamini Sumedha, student of Sixth Semester, Architecture Department, SPA, JNAFAU. She and her team have worked on the standards for lighting and ventilation in built spaces as part of the assigned task.

*C. Architectural Design- Fifth & Sixth Semester Syllabus- Focuses on learning the passive recreation for public use buildings.*

*Objective-* To enable the student detail the skills, enhance and sensitize the design for good living environment and the structural systems in urban context.

*The design issues addressed include-*

- User behavior and requirement relevant to the barrier free concepts.
- Integration of function: movement, climate, acoustics, structure and services.
- Landscaping and site planning and.
- Various attitudes to building in urban context.

To enhance and sensitize the students in design preparation and its relation to structural systems, an exercise of making a 3D model in the above context proves helpful.

*Task for V semester:* Students of the class had to make a scaled model of 10 Acre site, proposed for a 50 bedded Pediatric hospital in Rajendranagar, Hyderabad. Hospital design was introduced as the major design problem for the semester. Students had to draw site analysis from the site model. The same site model was used for another activity of the task, where in each student shall make an abstract conceptual model of their design ideas that would be placed on the site model in the class and be analyzed.



Fig 6:- Models of assigned task of site model for fifth semester Design Studio

Task for VI semester: Students are required to make a 3D model of a structure encompassing a grid of 15M X 30 M to a fixed scale. Structure can either be a part of a large span public structure or an individual entity or a prototype. Work can be done in a group of 2. Students need to explore and incorporate 4 major components of design that include.

- Site Context
- User Behavior
- Circulation
- Relation between Form & Structure

*Observation-* Making a manual model as part of design studio for two consecutive semesters has inculcated a hands on working culture in students. This form of learning is helping them understand credentials of their design concepts that help them turn into a functional structure. This experience is making them understand the interim lessons that one comprehends by self experiencing and not mere teaching or listening. Preparation required before facing the audience in the class has made them more technically, conceptually strong regarding their exploration. The solutions have been noticed to be more creative and workable.



Fig 7:- Models of assigned task of large span structures for sixth semester Design Studio

*Student expression.*

Fifth Semester- “The process started with a simple site model, from which the first architectural idea developed. The models lacked details, but contributed significantly to the development of an appropriate and integrated response to the design problem. They helped to develop our architectural idea from concept to detail.

Sixth semester- The increasing ease with which computer technology can be utilized nowadays results in students avoiding the use of physical models. Instead they tend to favor the development of three dimensional computer models. By making physical models we got an understanding of the space, and its volume with respect to scale and its structure. We understood the structure’s technicality in constructing it and its various interior and acoustical properties by physically experimenting on it”- Says Navyata Rayala, Student of Sixth Semester (IIIYear).



Fig 8:- Models of assigned task of large span structures for sixth semester Design Studio

Another student from the same batch, Hafsa Sameen, Student of Sixth Semester (III Year) says, Fifth Semester- “The hospital pre design model has helped me explore many design options, visualize the design quickly and communicate what insights I had for the final product. It also helped in recognizing errors before the design process began.

3D model helped me understand how natural factors such as a shadow can have a huge impact on the design.

Sixth semester- The model making has helped us broaden our perspective about the various types of structures that are possible, such as tensile structures, rigid structures, shell structures, etc. I got a better idea of the structure being developed. Feedback during the discussions helped me recognize the places where I was missing out on function and further helped me improve my design. The model gave me a better understanding of the design as compared to the everyday discussions based on 2D terms.”

## VII. CONCLUSION

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The looms and techniques for all the subjects related to architecture, the field of design and creativity, guide students acquire the essential skills and learn them. In this study, we observe the relationships of models to the theoretical approach of the curriculum learning process for the students benefit. The above observations states that the role played by models in learning, acts a tool for design and learning in an effectiveway.

Model making methodology facilitates the students with artistic, efficient, and aesthetic perception and renders a clear and logical learning of the subject. This method assists the students perspective of form, function, relationship of materials to the structure, contributing to the practical and implementable design of buildings.

As a closing statement for the editorial, the process of model making in the learning stages perks up students' proficient skills and helps them providing assistance in learning besides experiencing the contribution of reality on ground for the building.

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