COALESCING INTERACTIVE STRUCTURAL STUDIES IN THE FIRST YEAR B. ARCHITECTURE STUDIO

NAGARAJA S[1], ABIRAMI THILLAI GOVIND[2], AISHWARYA RAJESH[3], TANUSHREE MENON[4]
[1]Assistant Professor [2,3,4] U.G. Students
[1,2,3,4] School of Architecture, REVA University, Bangalore, Karnataka, India.

Abstract: An introduction to structural aspects of architecture in first year studio work sets in stone the importance of a hands-on learning experience along with lectures supplemented with ICT and digital technology. Using these methods, students are often encouraged to consider the stability and the level of structural soundness while designing and creating a space. This is accommodating of brilliant concepts from the students with well deliberated and tactful substructures. An amalgamation of different methods of the teaching-learning experience, exploring as many options as possible is often what comprises of a good, easily understood syllabus. The approach to this subject is done using educational models and similar experimentational activities to induce maximum understanding. This paper will elucidate the requirements of receptive models and designs which, not only, administer prime pedagogy which is useful in the informing of students in structural aspects, but manage to serve as an excellent hands-on extracurricular learning opportunity as well.

Index Terms: Hands-on, receptive models, pedagogy, structures, architectural design.

I. INTRODUCTION

The Bachelor of Architecture programme in REVA University chiefly consists of the art and science behind designing buildings and structures for numerous scenarios. Some of the courses included within this scope can range from furniture design to town planning and landscape architecture. These courses are frequently taught with lectures on the topic it encompasses and a myriad of daily life instances to allow maximum comprehension.

Beginning from the prehistoric time of the Stonehenge in which builders moved earth and stone into geometric forms, to the Art deco style, which was seen as mostly cubic and strongly linear, structural soundness was always highly crucial in the construction process. A disquisition of the early structures and their framework was something that we carried out as interdisciplinary studies with History of Architecture as well as the engineering angle through Structural Systems and Building Construction.

The cardinal challenge with the idea of structural studies is that it is seen as more of an obligatory task than an applicable concept due to the general process of it being taught by engineers. The students tend to be befuddled by the physics and mathematics and quickly lose sight of the many applications it may have in potential designs. The scientific and technical aspects are often considered confounding and increase in degree in terms of difficulty as the semesters change, incorporating more computation and figures, leading to a complex and rather dry subject. This is what introduces firsthand learning, where we are encouraged to build interactive models of different structural elements and visually understand through real-life examples.

Along with this, the idea of technological learning with online platforms prevents future luddites as well as allows a more voluminous base for information and to carry out research. These technological approaches also acquiesce the perception of each singular unit of said structures without any physical contact or any sort of site visitation. This leads to a deeper understanding of the elements that conjugate to form the next segment of a larger structure.

Aside from this, there are also numerous lectures and theoretical seminars to explain different abstractions and how to approach a certain design, considering all aspects of structural engineering and the materials to be used along with the creative outlook. These classes usually aim to provide students with a basic grasp of the subject as well as clear queries regarding existing forms and future designs. The intention of this paper is to shed light on erudition through interactive models, technological studies and similar experimentation for a better understanding of the subject to build a solid base for usage in the following semesters and is based on the experience of teaching-learning at REVA University and the implementation of real life examples to better grasp every concept at hand to the maximum ability of each student.

II. LITERATURE REVIEW

The engagement of architectural students in structurally oriented haptic learning exercises has been defined as a tutelage focused mainly on experiential exercises and project-based designs. Primarily immersed in the ideas of initial lab projects and ergonomic labs where students are encouraged more to use their bodies as a form of exploring basic structural principles, the concept of involving technologically concerned notions is almost lost.

The paper focuses on the process of reiterative design and looking beyond an education which revolves around basic statistics to assist in the process of a better understanding for pupils. It presents the first lab in a revised structural design sequence at the Iowa State University along with the course nature and the general use of aforementioned ergonomic laboratory. A study on the exploration of students in the lab was carried out with a conclusion of the limits of the human body and begs the question of how much can truly be understood of technical studies by a physically limited individual without assistance from a more flexible form. The priority of the teachings is centered more on the student and their perception of things rather than the traditional observations, which is cause for excellent understanding while also increasing the overall discombobulation, which can prove to turn out as quite a quandary.

While the idea of haptic learning is substantial in the teaching of technical subjects, it is best received by the pupil when collaborated with ICT-supplemented learning. A well merged combination of the two along with visits to sites and real-life explanations and examples of structure- based topics is what constitutes an exceptional learning experience.

III. AIM

To understand the existing curriculum for structural studies in Architecture in first year studio work and the changes that can be made for an understanding beyond the basics.

IV. OBJECTIVES

1. To trace the system of pedagogy for Structural Systems and Building Construction in first year curriculum.
2. To understand the different approaches to the subject to simplify the learning process.
3. To identify the arduous aspects and the solutions for them, ranging from basic definitions to experiments carried out to induce maximum understanding.

V. CONTEXT

"The process of visualizing or conceiving a structure is an art. Basically it is motivated by an inner experience, by an intuition."—Eduardo Torroja, 1958

Engaging Architectural Students in Structurally oriented learning exercises with the experiences of hands on learning to various concepts of the subjects for easier and realistic learning. One of the easier ways is to understand the concepts visually and then carry forward the knowledge through representing and constructing them to get the clearer view to the subject, thus creating interests in the students. Visual learning, often called "book" learning, has long been the prevailing method, compelling students to read and remember the information on a page in reports, tests, and quizzes. This learning is more enhanced by the use of latest technologies for proper understanding through virtual media, presentations, laboratory learning, videos and site visits.

5.1 Hands on Learning

One of the most effective learning methods for all the students in a class is the progressive teaching methods and progressive assessments carried out by our professors. Barring severe shyness or anxiety, hands-on learning is uniquely positioned to support or elevate any type of learner, for example those students who prefer to listen to the lesson can hear the instructor as they follow along, and those that do well with visuals can watch the instructor, duplicating his or her steps after they're finished, this only familiarize students with the models and materials they'll use later in either professional, post-graduate employment or research positions thus giving the students a more enhanced learning experience.

5.2 Modular Representation of The Concepts Learnt

Making models with easily available local materials enhances the process of learning. Model making a fun learning exercise where students made models of the concepts and topics learnt in the class giving students a clearer view of the construction ideologies and a realistic experience. The model construction using materials like eraser, bamboo sticks, newspapers, cardboards, wires and even soap gives an easier and similar learning as using the actual construction materials in real life.

EXERCISE – Making a structure using basic materials: In this exercise students learnt about the proportions, stability, nature of different materials and the different ways by which each material can be used. Students also learned to work in groups and understand the realistic working nature in different parts of their subject.

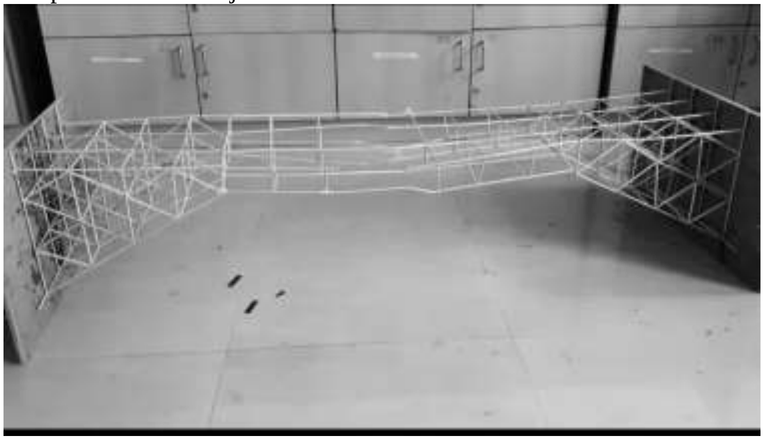

Fig1: Making a bridge using only bamboo sticks.

Fig2: Making a tall structure using newspaper, cardboard, and wires.

Fig3: Making arches using erasers.

Fig4: Making different timber joinery using soap.

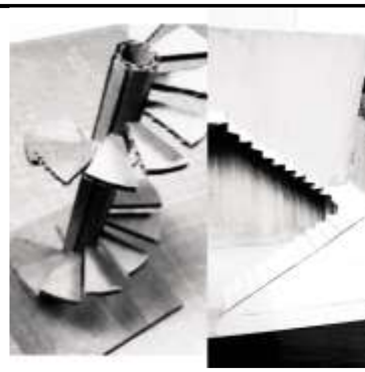

Fig5: Staircase construction using locally available materials.

Fig6: Understanding structures with a classroom activity.

All of these activities enhanced the structural knowledge of students. Activities like this also enhance the concepts learnt by students in the visual learning exercises, providing a clearer and deeper views to the basic concepts of the different materials available in the construction industries and their natural characteristics, thus leaving no doubts in the minds of the future architects and helping them to be wonderful learners.

<u>RESULTANT OF FORCE</u>

If a body is acted upon by different forces A and B simultaneously, it is possible to find out one single force R which could replace them, i.e this single force can produce the same effect as produced by two forces. This single force R is the resultant force of A and B.

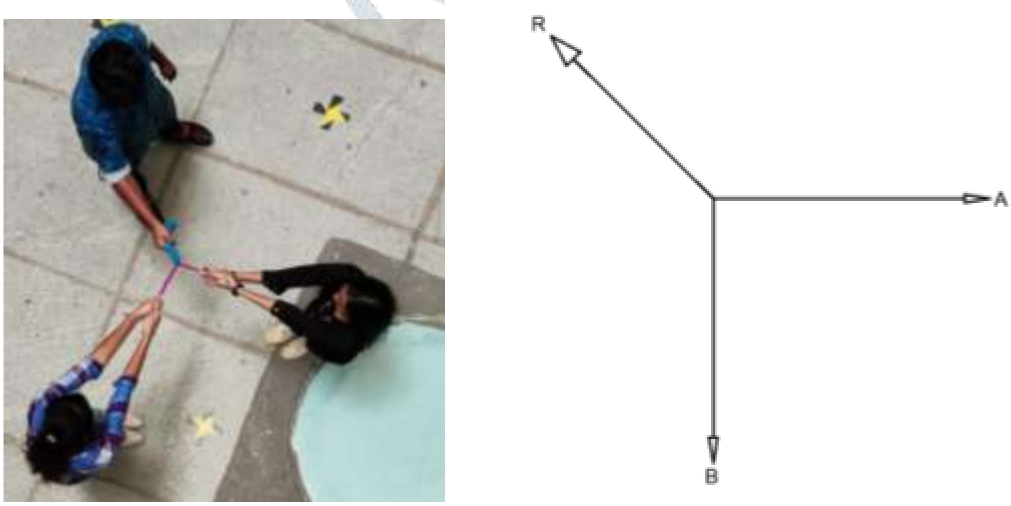

Fig7: Resultant force

5.3 Combining Virtual and Offline Learning Patterns:

One of the most effective methods of learning where the professors interact with students. Students are engaged to the learning platform using virtual technology and traditional teaching methods for better understanding through presentations, videos, seminars, interactive learning and many other ways by creating realistic outlook to the young minds.

To receive the most benefits out of this valuable teaching method in the structures subject, students should arrive to each lesson ready to explore the projects and components in front of them. That means:

- Familiarizing themselves with any safety procedures beforehand in the subject
- Ensuring they have any necessary personal protective equipment (PPE) ready to use
- Arriving on time, so as not to miss preliminary show-and-tell steps
- Using hands-free recording devices so they can focus on doing rather than note-taking
- Never missing a class (barring emergencies) so that they always feel comfortable with the current expertise level being demonstrated thus having a better understanding to the structural concepts.
- Setting aside extra time before or after a class to work with an instructor on any problem areas, this gives students more confidence and better understanding to the structural concepts practically and theoretically.

Each structural topic is taught in class is properly corelated with other subjects like History of Architecture and Architectural Design for making it a subject without any barriers and realising the value of structure in all part of our Architecture course. Considering structures as one of the most important part of any buildings and architecture it is taken into consideration that each student is understanding all the concepts properly before moving into any other topic. Proper use of modern aids and teaching methods has helped students in better understanding of the subject with required technical, theoretical, experimental knowledge and to flourish the concepts of structures in depth.

5.4 Site Visits

Another interesting learning technique used in the School of Architecture, which enhances quick learning in Structures. Students are made to visit industrial manufacturing units and places related to constructions, where they see and explore how the materials used in the construction industry are extracted, processed, packed and stored for the structural constructions. The site visits included brick factory, timber yard and many other places where students explored out the real-life situations faced by the structural engineers, architects, craftsmen and other industry-based workers.

Thus, giving a clear perspective to the students about the structural concepts and learnings done in the classroom exercises. This has also added on to the theoretically studies into a combination of practical skills and conceptual learning.

Fig8: Photos of brick factory visit.

Fig9: Photos of timber yard visit.

5.5 Co-Relating Theory with Life

5.5.1 Tension stress: (or tensile stress) occurs when two forces pull on an object in opposite directions so as to stretch it and make it longer and thinner. Example of tension is when you hang from a pullup bar. Gravity pulls down on your body which causes tension in the spine.

5.5.2 Compression: pushes or presses an object so as to make it shorter and thicker. Tension and compression stress are both sometimes referred to as axial stress because the forces act along a structure's longitudinal axis.

5.5.3 Shear stress: Are two forces acting parallel to each other but in opposite directions so that one part of the object is moved or displaced relative to another part.

5.5.4 Torsion: occurs when a member is being twisted by the forces acting upon it.

5.5.5 Supports: are arguably one of the most important aspects of a structure, as it specifies how the forces within the structure are transferred to the ground. The fixed support provides all the constraints necessary to ensure the structure is static. It is most widely used as the only support for a cantilever. Pinned supports can be used in trusses. By linking multiple members joined by hinge connections, the members will push against each other; Inducing an axial force within the member. The benefit of this is that the members contain no internal moment forces, and can be designed according to their axial force only. The most common use of a roller support is in a bridge. a bridge will typically contain a roller support at one end to account for vertical displacement and expansion from changes in temperature. This is required to prevent the expansion causing damage to a pinned support. Simple support is basically just where the member rests on an external structure. They are quite similar to roller supports in a sense that they are able to restrain vertical forces but not horizontal forces.

I-beams are the most commonly seen and widely used beams, because these are economical sections. As these beams are strong, they are used to create large and spacious rooms with minimal support channels. When a house is redeveloped, these beams are used to replace old structural channels. Apart from supporting commercial and residential constructions, I-beams are also used to construct frames for trolley ways, elevators, trailer and truck beds, etc. H-shaped beams have thicker walls and flanges and are used to construct mezzanines, platforms and bridges, and common building constructions. W -shaped, wide flange beams are most commonly seen in residential construction. These cross sectioned beams are inefficient in carrying torsion or twisting load.

The concept of beams has also been studied to an extent in the course of first year structures.

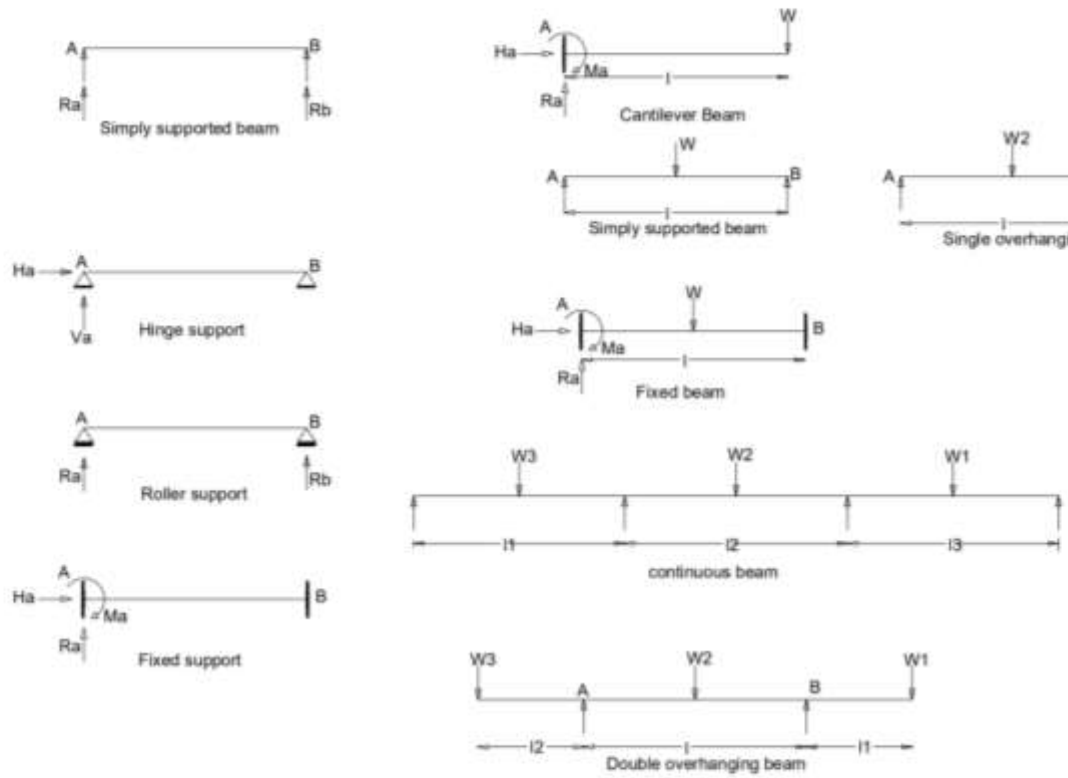

Fig10: for different types of beams and supports and support reactions learnt in 1st year.

Students have learnt about the different types of beams and their applications by observing their surroundings and construction using such beams. As one of the most primary and considerably important structural units, students were taught the main qualities of beams, which include the ability to resist laterally applied load and produce shear forces and bending moments within the beam, which, in turn, induce internal stress and strain. Students have also been taught the important types of beams such as 1. Cantilever beam, which is known for having one end fixed and other end free, cantilever beam has three support reactions i.e ventricle, horizontal and moment eg: chajja or sunshade. 2- simply supported beam, which has simple supports to hold it in place as required, it has only one vertical reaction in one support eg: beam resting on two walls. 3- over hanging beam, in which there is a part that hangs past the support, either on one side or both sides of the supports. And 4- fixed beam, which, from the name itself, we understand, is fixed into the column at both ends to ensure maximum stability possible, it has three reactions in each support i.e vertical, horizontal and moment eg: beam to column connection. Along with these, discussed different types of loads- point load, uniformly distributed load, uniformly varying load acting on beam.

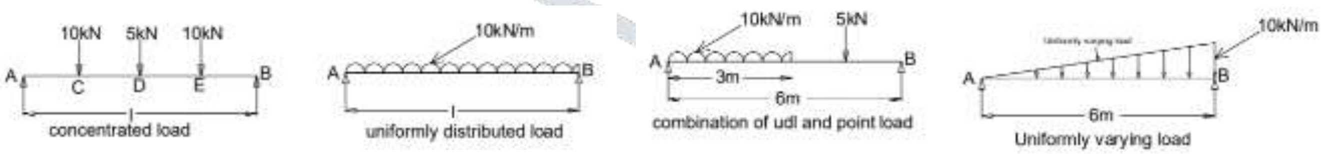

Fig11: Different types of loads acting on beam

VI. CONCLUSION

The focus of this study is to determine the perceptions of the students in physical and social learning environments and thus to find the changes in the way the architecture students characterize design through their learning experiences. Design definitions taken from design studies that reflect different aspects of design were presented to the students and the student's conceptions of design are associated with their experiences of design education. The structures part play an important role in design education as it allows us to understand the spaces required , the way of construction using bricks with different types of bond like English ,Flemish , rattrap bond, materials used, necessary dimensions of furniture like doors ,windows, trusses , and construction of arches , staircase ,wooden and wire structures using basic materials were done to understand the concept. Knowing structures is the basic need in design education.

Each successful installation, champions a sense of wonder, a commitment to craft and an honesty of material expression. Each failure contributes to the growing body of knowledge produced in our studio, and confirms the role that the design process plays in the advancement of structural inquiry with the context of the design studio, we create culture that views structural expertise as valuable asset for the design and practice of architecture.

The quality and ambition of design-built installations demonstrate that students can achieve an understanding of complex structural ideas in limited time if they had the opportunity to develop tactile, interactive, visual knowledge of structural performance and we were lucky to have had that opportunity. The approach created an architectural understanding of structures, one that developed to align with the practices and expertise. The findings and modular representations have shown that the studio has very active social environment. The nature of the learning environment of the studio has as much effect on student's enculturation into studio culture as the curriculum, the engagement in the learning process as formal instruction. Some aspects of the type of interaction goes on within this space can Avenue for Future research.

VII. REFERENCES

1. Catherine Wetzel, Journal of Architectural Education ISSN: 1046-4883 (Print) 1531-314X (Online) Journal homepage: https://www.tandfonline.com/loi/rjae20 -Integrating Structures and Design in the First-Year Studio.
2. Rob Whitehead Iowa State University, rwhitehd@iastate.edu, Supporting Students Structurally: Engaging Architectural Students in Structurally Oriented Haptic Learning Exercises
3. Barsalou, L. (2008), "Grounded Cognition", Annual Review of Psychology, Vol. 59, pp. 617---45. diSessa, A. (1993) "Towards an epistemology of physics", Cognition and Instruction, Vol.10, no.2, pp. 105---225.
4. Williams II, R.L., He, X., Franklin, T., Wang, S. (2003), "Haptics---augmented engineering mechanics education tools", Journal of Science Education and Technology, Vol.12 No.1, pp.1---12.
5. Han, I., Black, J. (2011) "Incorporating haptic feedback in simulation for learning physics", Computers & Education, Vol.57, Issue 4, pp. 281---290.
6. Underwood, R., Chiuini M. (1998), Structural Design: A Practical Guide for Architects, John Wiley & Sons, New York, p.515.