
ARCHITECTS AND STRUCTURAL ENGINEERS COLLABORATION IN CONCEPTUAL DESIGN STAGE

Saranya R Prasad

Student Architect, KMEA College of Architecture, Aluva, Kerala, India

Abstract: The key to successful collaboration is in understanding that it is not a technology but rather a psychology. Collaboration is not a process that can be codified into a system, it is more of an attitude that needs to be implemented in the culture of professions. It is important to acknowledge that each and every one brings something valuable to the project and their combined intelligence is more likely to deliver positive results than working isolated. The widening gap between architects and structural engineers who pursue different thoughts and ideas during the design process prompted this research. The findings from the primary and secondary survey conducted among a group of practising architects and structural engineers in Kerala shows that each profession has generally positive respect for the other even though some mutual criticism exists. It is clear that the required group-work skills and understanding of each profession should be acquired by architects and engineers during their professional education. The findings from the online survey conducted among a group of student architects revealed that they are facing difficulties in integrating structural knowledge into their design studio project. As a result, this research also explores the ways in which the structural education of student architects can be redesigned to make their future professional collaboration more harmonious.

Keywords: Architect, Collaboration, Integrated Design, Structural Engineer.

Introduction: Designing and building sustainable structures is not an easy task [1]. Which requires expertise from various fields including architects, structural engineers, project managers, contractors and other various authorities [2]. Collaboration and coordination is necessary between the design team members in various levels of designing. Among these, Architects and Structural engineers are two professionals who having vital importance [3]. According to architects user perception plays an important role in the design of spaces for them [4]. They design spaces based on certain guidelines and standards [5]. Whereas the structural engineer role consists mainly of designing the structural system and dimensioning structural element [3].

Understanding each professions is the most essential part. In order to design architectural shape and structure together, it is important for architect and structural engineer to work together in the early stages of design process because the structural system of the building is basically designed when the shape of the building is designed [6].

Looking Back to Look Forward: The current theories and literature on the collaboration of structural design and architecture reveals members of each discipline tend to have different perceptions of the same reality. This different modes of thought that engineers and architects possess is one of the biggest challenge and also the greatest strength to collaboration.

Macdonald (2010) presents an overview of the relationship between architects and structural engineers which developed from the beginning of the twentieth century. The development of steel and reinforced concrete resulted in the evolution of a new profession that of a consulting structural engineer who is responsible for the structural aspects of the design. Then two streams formed, at one end, engineers working as architects rather than with architects, at the other end, who form close collaborations with architects and to evolve designs in partnership with them. It considers the work of engineers such as P L Nervi and Eduardo Torroja whose designs largely in isolated from architects and also the work of engineers Ove Arup and Peter Rice, who developed close relationships with architects. The contribution of engineers to the evolution of Modern architecture is also critically analyzed [7].

Ozmen & Unay (2011) describes that the specialization in each profession brought along some advantages and disadvantages. The main disadvantage was the alienation of these professions. For architects, engineers had no idea about architectural design but all the technical issues of the structure had to be solved by them. But the greatest advantage of specialization was that, the possibility to design and construct stronger, complicated, elegant, efficient and more economic structural systems as a result of advanced technology, materials and knowledge [2].

Calzon (2010) insisted that in recent times there is a remarkable transformation experienced in the relationship between Architecture and Structural Engineering. The author reviews the scope and characteristics of this through analysis of a series of work trends in order to reach the best effectiveness in the collaboration between both of the professions [8].

Hu & Dai (2010) describes because of the different education backgrounds and methodologies there has been a long debate between architect and structural engineer. The art of structures were dominated by the architects in the eyes of the public, while structural engineers has been regard as the one who provide assistance. The necessity of collaboration has been emphasized by understanding the similarities and differences between structural engineering and architecture. Only in this way can the engineers and architects promote the art of structure [3].

Primary Survey – Interactive Section with Architects and Structural Engineers: The primary survey was conducted as an interactive section with a set of questionnaire and interviewed leading architects and structural engineers in Kerala with more than 20 years of experience in person. Also conducted telephonic interviews with practicing architects and structural engineers with more than 6 years of experience.

❖ Responses from architects

Architects agreed that:

- An average of 45% percentage of their time is used to involve in the conceptual design stage with structural engineers.

Time spent working with structural engineers on the following stages of construction.

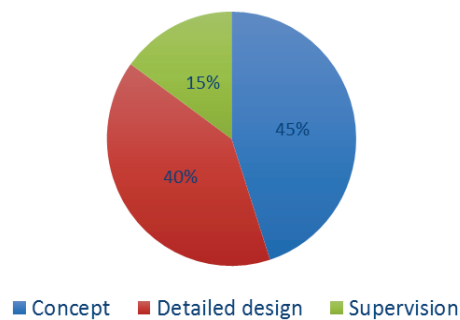


Figure 1: Time Spent Working with Structural Engineers. (Author)

- The existing levels of collaboration is satisfactory.
- have a positive attitude towards structural engineers appreciation of design ideas and how they clearly communicate structural requirements

Architects are also frustrated because of engineer's lack of innovation and awareness about architectural issues.

Architects suggests, structural engineer should:

- Apply lateral thinking
- Develop more creative options because there can be more than one solution to a structural problem.

- Should come up with a solution that enhances or follows design.

❖ Responses from structural engineers

Structural engineers agreed that:

- An average of 47% percentage of their time is used to involve in the conceptual design stage with architects.

Time spent working with Architects on the following stages of construction.

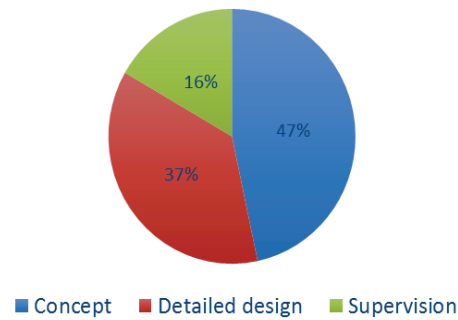


Figure 2: Time Spent Working with Architects. (Author)

- They appreciate architects who understand the structural requirements
- They are positive about architects who involve them in the initial stages of design.

Structural engineers are more frustrated about:

- Architect's lack of structural understanding
- Seeking engineering advice too late in a project.
- Architect's attitude of not allowing more time to work for structural details.

Structural engineers are demanding a considerable time rather than 1 or 2 days to complete their works and which helps to produce more efficient and detailed drawings.

When asked about how much structural knowledge an architect should need to this same structural engineers, they replied "architects should have a basic structural knowledge but not too much because it will affect their creative thinking and it will limit their ideas."

But architects had a different approach to this question. They said "if we know more about structure then we will become more creative".

Secondary Survey - Online Survey among Practicing Architects and Structural Engineers:

❖ Responses from Architects

- An average of 40% percentage of their time is used to involve in the conceptual design stage with structural engineers.
- Architects viewing structural engineer's contributions very positively in the initial stage of design.

Questions asked:

- Q1. Structural engineers and you collaborate well together.
- Q2. Structural engineers produce structural solutions according to your design ideas.
- Q3. Structural engineers convey structural requirements clearly.
- Q4. Structural engineers appreciate architectural requirements.
- Q5. Architects should have structural knowledge.

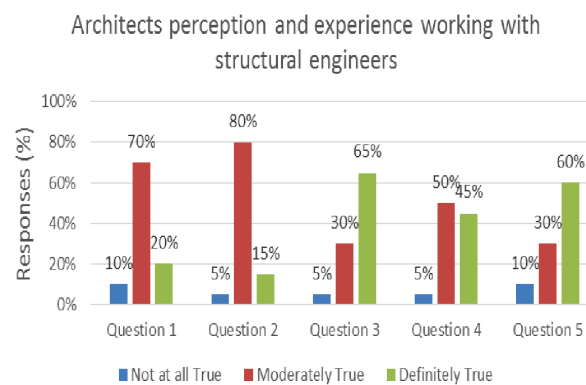


Figure 1: Architects Perception and Experience Working with Structural Engineers (Author).

❖ Responses from Structural Engineers

- An average of 50% percentage of their time is used to involve in the conceptual design stage with architects.

- Structural engineers viewing architectural contributions very positively in the initial stage of design.

Questions asked:

- Q1. Architects and you collaborate well together.
- Q2. Architects produce architectural solutions according to your design ideas.
- Q3. Architects convey architectural requirements clearly.
- Q4. Architects appreciate structural requirements.
- Q5. Architects should have structural knowledge.

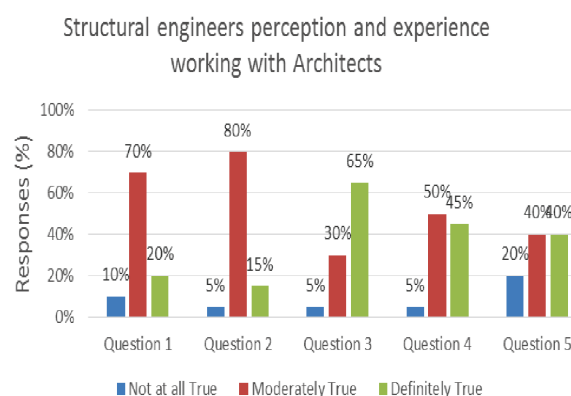


Figure 2: Structural Engineer's Perception and Experience Working with Architects (Author).

The findings from the primary interactive survey and the secondary online survey with practising architects and structural engineers shows that each profession has generally a positive respect for each other even though some mutual criticism emerged.

Excluding the perceived weaknesses of each profession the existing positive attitude can be built upon in order to improve the quality of collaboration.

Online Survey - Conducted Among 3rd Year, 4th Year and 5th Year Student Architects: In the online survey, an average of 80% of students from each group agreed that Structural design classes focus more on quantity analysis using mathematical formulae and notations rather than giving practical knowledge. Majority of the students agreed that the structure integration should be considered in the preliminary stage of design process.

Almost 90% of total students agreed that structural design classes will be more effective if it visualizes how the structure elements work and their application rather than imagination.

Majority of 4th year and 5th year batches replied that the structural design learned was not useful during the internship period and they acquired more practical level structural knowledge during internship more than from the college.

Almost all the students found the subject dull and boring and also find it really hard to understand that what is being thought and why is it being taught.

The findings from the survey shows that student architects are having difficulties in integrating structural knowledge into their design studio projects.

Conclusion: The research critically explored the importance of collaboration of architecture and structural engineering in the conceptual design stage. By conducting interviews and surveys with practicing architects and structural engineers shared their insights about the utility of integrating structural engineering concepts in design. Finally, by criticizing the existing situation of structural knowledge in the current architectural education.

The data's about these areas of collaboration are general and detailed studies must be conducted to establish a more comprehensive network of guiding principles. The research can be extended by studying and comparing different college student's opinion about structural design integration with their architecture education. And also incorporating the faculty's opinion will give more effective ways to integrate structural design with education.

Nevertheless, there is a hope that this research will encourage architects and structural engineers to overcome certain problems in their mutual professional integration.

Acknowledgment: Guidance of Associate professor, Ar. Jayadevi Venugopal and Assistant professor, Er. Hashim k Abdul Azeez, are gratefully acknowledged.

References:

1. Daketi Srinivas. "Role of Women in the profession of Architecture." *Human Rights International Research Journal*. ISSN: 2320 – 6942. Volume 1 Issue 1 (2013): 308 – 312.
2. Cengiz Ozmen, Ali Ihsan Unay. "Architect and Structural Engineer Collaboration In Sustainable Structural System Design." *Gazi University Journal of Science GU J Sci* 24(4):919-925 (2011): 920 – 925.
3. N. Hu & G.L. Dai. "From separate to combine –the ever-changing borderline between architectural art and structural art." *Structures and Architecture*. ISBN 978-0-415-49249-2: 1930 – 1938.
4. Srinivas Daketi. "Cultural approach to architecture." *Engineering Sciences International Research Journal*. ISSN 2320-4338. Volume 3 Issue 2 (2015): 89 – 92.
5. Sumana Karanam. "Universal Design for Recreational Open Spaces." *Engineering Sciences International Research Journal*. ISSN: 2330 – 4338. Volume 1 Issue 1 (2013): 14 – 28.
6. A.J. Reis. "The architecture of special structures." *Structures and Architecture*. ISBN 978-0-415-49249-2 (2010): 39 – 52.
7. A. J Macdonald. "The changing relationship between architects and structural engineers." *Structures and Architecture*. ISBN 978-0-415-49249-2 (2010): 62 – 63.
8. J. Martinez Calzon. "Treatment of the form in structural engineering." *Structures and Architecture*. ISBN 978-0-415-49249 (2010): 224 – 228.
