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Enhancing design outcomes and thinking in architectural design by evaluating the results of innovative exercises in relation to climatology

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ABSTRACT

Climatology, sustainability, environmental design is viewed as distinct areas of architecture and it is in dire need for one to see it as a single entity. Building energy efficiency and ecologically friendly designs have long been taught as primary concepts in architectural education. Additionally, students lack an integrated design process because disciplines are fragmented and the implementation of the subject matter is not fully integrated in the design process.

As aspiring architects, they must raise awareness and produce moral design principles that take the needs of the environment into consideration. Thus, it is increasingly important to create creative exercises and introduce tools related to environmentally responsive designs starting in the second year of the curriculum. Doing so will foster critical thinking in students and improve the design outcomes from the beginning of their architectural journey.

In order to improve student learning outcomes and engagement, the study will also examine the strategies currently being employed by SB Patil College of Architecture and other architectural colleges to integrate climatology and sustainability into the architecture design process. This will be accomplished using case studies and surveys.

The research intends to explore and investigate the efficacy of integrating innovative exercises linked to climatology and as a pedagogical tool in enhancing Architecture Design.

Keywords: Innovative teaching methods1, Environmental responsive designs2, Critical thinking3 and design outcomes4.

1. INTRODUCTION

"Buildings are accounted for around half of worldwide energy consumptions, significantly contributing to global warming and the alteration of natural ecosystems, as proved by reports" [1] and India is fourth-largest global emitter of carbon dioxide.

"Years of warnings about the impacts of climate change have become a reality, if we do not rapidly cut emissions in line with the Paris Agreement, we will be in deeper trouble" Inger Andersen, Executive Director of the United Nations Environment Programme (UNEP).[2]

According to the 2022 Global Status Report for Buildings and Construction [3], energy consumption and CO2 emissions in the building and construction sector have recovered from the Covid-19 epidemic to reach an all-time high. In 2021, the sector was responsible for more over 34% of the energy consumption and almost 37% of the energy- and process-related CO2 emissions. According to a research published by the World Resources Institute, by the year

2050, carbon emissions from buildings are expected to be nil. However, as things stand, not even 1% of all buildings can help achieve the zero-carbon target, highlighting a rising gap between the sector's climate performance and the route to full decarbonization in 2050.

Since the building industry is the most important sector of any country, the question of how the aim may be attained still remains.

To achieve these reductions,

- The sector must enhance the energy efficiency of buildings, lower the carbon footprint of building materials.
- Multiply policy promises alongside action.
- To raise investment in energy efficiency in order to reduce overall emissions.

To ensure that India is well prepared to transition to a clean energy economy, it needs to review its economic growth indicators in a holistic fashion. Workforce development is perhaps one of the most critical indicators for economic growth. It not only depends on the number of employed workers but also on the skills that they apply and how these skills evolve with the changing context. Education, a strong building block of and can play a key role in imparting appropriate and

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significant role in disseminating relevant and modern knowledge through ongoing curriculum improvement. To ensure that India is well prepared to transition to a clean energy economy, it needs to review its economic growth indicators in a holistic fashion. Workforce development is perhaps one of the most critical indicators for economic growth. It not only depends on the number of employed workers but also on the skills that they apply and how these skills evolve with the changing context. Education, a strong building block of workforce development,

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Architecture schools are a hidden source of possible climate action because they are settings where students can coexist with highly skilled professionals, which enable students to gradually develop higher order thinking skills to comprehend complicated, system-scale issues like climate change. The existing architectural curriculum ignores the potential of instructional tactics to promote climate awareness, which fosters a sense of stagnation. Due to the fragmented nature of lecture courses and the incomplete integration of course material into the design process, students lack an integrated design approach. Climate change issues may only receive cursory or minimal attention in architectural education without this pedagogical reform.

2. CURRENT ARCHITECTURAL EDUCATION SCENARIO

A distinctive feature of architectural education. is the emphasis on design studios, where students acquire and perfect their architectural design skills and are obliged to integrate the knowledge learned from theoretical courses into the design solutions. Climate responsive design concepts and principals are taught in theory but there is lack in integrating these into designs studios, thus becoming vital to train aspiring architects how to incorporate these concepts into their design solutions in order to minimize or lessen environmental damage brought on by construction projects.

3. SURVEY

In order to evaluate the current architecture curriculum a survey was conducted among 2-4th year design faculties and students across architectural institutions in India. A questionnaire was sent based on climate responsiveness in design studio to faculties. Out of which 75 responses were received on how climate and related variables were taken into account in architectural design studios and whether they were given weightage in the final designs assessment. The following charts shows the outcome of the study undertaken.

3.1. Survey participants by type of respondent

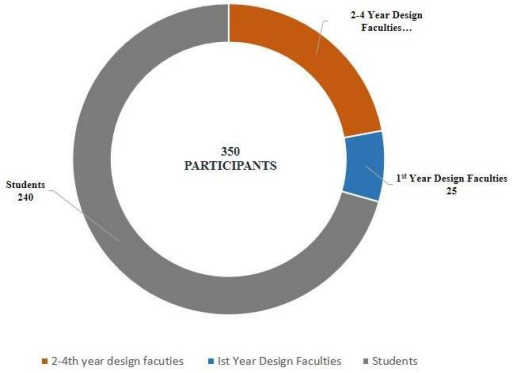

Fig . 1 Summary of survey participants by type of respondent

A total of 350 participants completed the online survey, which was distributed to all architecture colleges in India. Out of the 85 academic respondents, 75 identified as 2-4th year design faculties, 25 as 1st year design faculties. 120 undergraduate students responded to the survey.

3.2. Can architects contribute to tackling climate change?

Fig . 2

3.3. Climatic Parameters

The study revealed that while analyzing a site majority of respondents applied sunpath, windrose,

shading devices and design strategies according to location as a major criteria while very few respondents had used Psychrometric chart and micro conditions of the site along with the above parameters.

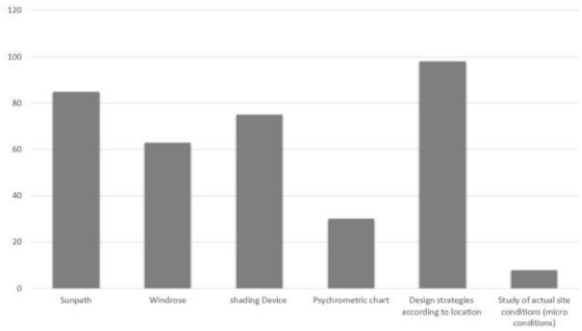

Fig . 3 Climatic Parameters

3.4. Final Assessment based on climate responsive design

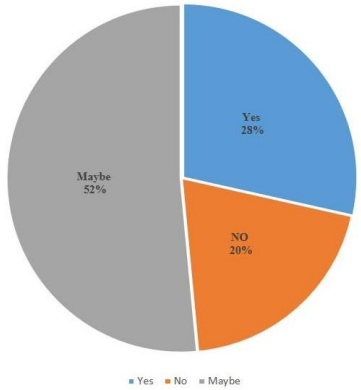

Fig . 4 Final Assessment based on climate responsive design

The responses indicated that the project's brief and the final assessment did not give significant regards to climate-centric designs.

3.5. Tools used to assist students for Climate responsive design

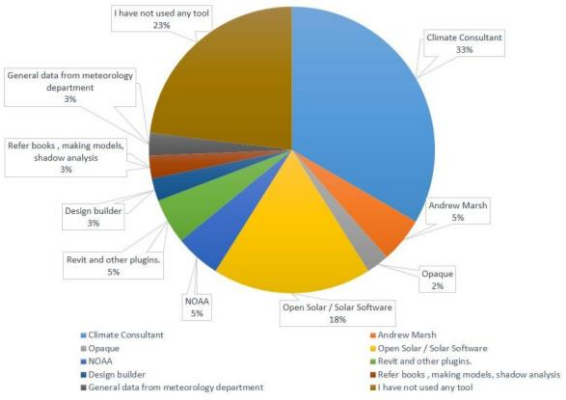

Fig. 5. Tools used to assist students for Climate responsive design

The above figure gives an idea that majority of the faculties use tools and software's in colleges to assist students for achieving climate responsive design solutions, while 23% of the faculties were still not equipped with the tools.

3.6. Climate responsive design output

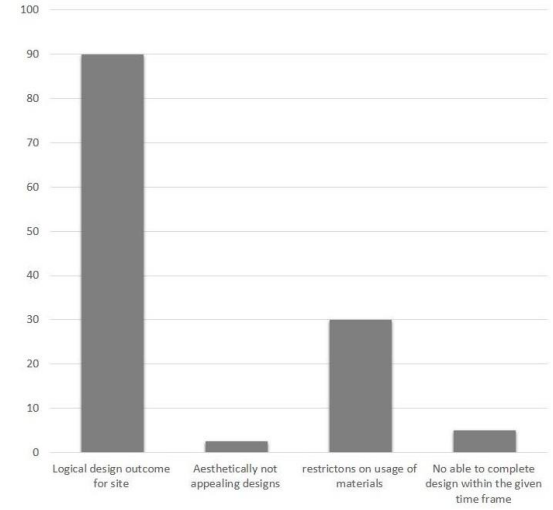

Fig . 6 Climate responsive design output

The qualitative results indicated that when the studio concentrated on climate responsive design solutions, the design outcome was sensible and appropriate for the location, but some felt constrained from adopting the same approach.

3.7. Mandatory application of Climate responsive design in curriculum

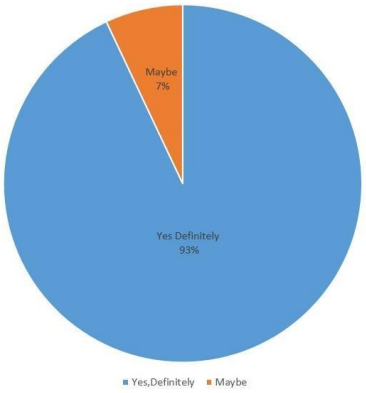

Fig .7 Mandatory application of Climate responsive design in curriculum

Figure 7's distribution demonstrates that majority of the respondents felt the need in updating the curriculum with mandatory implementation of climate responsive design.

3.8. LIMITATIONS AND RESTRICTIONS

A. Limitations faced by faculties and Faculties
Major barriers faced by faculties in implementing climate responsive design is that they perceived themselves as competent but "not an expert" in matters of climate change.
They indicated confidence in their subject knowledge but acknowledged that they lacked specialized knowledge and abilities. This was closely related to new software and technology, as well as to enhanced support systems and access to information sources. It was frequently stated that suitable "road maps" for curricula, learning, and teaching were needed to assist the embedding of new knowledge and the development of confidence in both teachers and students

B. Limitations faced by faculties and students
Only a small percentage of students quickly analyse and relate climate to their design after taking the time to grasp projects and designs geographically. Most of the time, once a design is finalized and the initial design development is complete, climatic factors become juxtaposed or retrofitted and lose their significance.
Students sometimes forgo including climate into design since final assessments do not assign any weight to developing climate-responsive solutions.

4. CASE STUDY

An experiment was conducted in 2 phases with second year students in Architectural Design Studio (AD).
The first phase of experiment was conducted in 1st semester in AD where students were given themes in the design brief out of which one was climate responsive. Few students opted for the climate responsive design, while others opted rest of the themes. The design approach of students whose opted for climate responsive design theme were able to explain and defend their design in a more rational and practical way.
The 2nd phase was conducted in 2nd semester where the brief was structured to be climate responsive. Few students in this exercise chose the notion of form, where climatic variables are juxtaposed or retrofitted which limited the incorporation of climatic aspects in design. As a result, the process was turned around, and students were asked to start over at the concept stage by moving away from form-based design.

4.1. RESULTS AND DISCUSSION

Students provided input at the end of the experiment with students providing comments that the final design outcomes with climate integration were more justified. The students said there was a delay in the approval of initial ideas and that it was challenging to comprehend the tools and put techniques into practice. Additionally, it was challenging for students to depart from form-based thinking. Overall, they claimed that it is simpler for them opt out of creating climate-responsive designs unless the brief makes it mandatory.

5. CONCLUSION

This paper concludes that - environmentally responsive designs should be made mandatory as a part of design brief from second year of the curriculum and should be considered while assessing the design which will in turn foster critical thinking in students and improve the design outcomes from the beginning of student's architectural journey.
Thus, it is increasingly important for the faculty to upgrade themselves and create innovative exercises and teaching methods which will simplify the complexities of analyzing climatic parameters and applying them in design.
The paper concludes with 95% of all respondents "strongly agreeing" that they want to see more teaching about climate responsive design in their degree programs. Qualitative responses indicated that this was seen as potentially beneficial for both students and the professionals as they can be part of the solution for climate change, which in turn reinforced India's mission to decarbonize the building sector by 2050.

6. REFERENCES

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[3] https://globalabc.org/index.php/news/globalabc-releases-2022-global-status-report-buildings-and-construction.