Cheia T – Technique, Technology, Transfer. 10 Key-Components for Sustainable Architectural Design

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Abstract. The implementation of sustainable values in architectural design is not only a challenge for architects, but also for all the professionals involved in this process. The main purpose of this research is to determine the key components that can influence the architectural design towards sustainability. A complex survey was addressed to students in the final years of the Faculty of Architecture and Urban Planning (UAUIM) and the three Holistic Research, Integrated Academic Expertise: Technique, Technology, Transfer laboratories. The research was initiated in 2022.

1 Introduction

1.1. Sustainability in Architectural Design Approach

Sustainability in architectural design aims to create buildings that are environmentally friendly, economically viable, and socially responsible. This approach involves the integration of multiple disciplines, including engineering, economics, and social sciences, to ensure that the design meets environmental, economic, and social sustainability criteria.

1.2. Certification Standards for Sustainable Buildings

Certification standards such as BREEAM, LEED, and WELL are widely recognized for their role in evaluating and certifying sustainable buildings. These standards assess a building's environmental impact, energy efficiency, and sustainability practices. The goal is to improve the quality of life for building occupants and reduce the environmental footprint of the building.
"Sustainability in Architectural Design Approach" for the Urban Agriculture, Habitat Exchange, Urban Greening, and Green Buildings module in our research team, focused on students' architectural design studio project. The study, with a master's degree included, evaluated the effectiveness of the architectural concepts, technical solutions, and sustainable practices in the projects.

3 Architectural Design Tools: 10 Key Sustainable Components

3.1. Site

The research team conducted a synthetic comparison of the architectural analysis, taking into account the criteria, components, and items that influence the architectural form, the footprint of the site, the creation of an explorable landscape featuring trees, etc. The questionnaire was undertaken by our research team regarding almost 20 components: Place, Indoor Environment, Innovation, and Energy, Water, Materials, Operations.

2 Research Methodology

The questionnaire was implemented in the students' architectural design studio project. The architecture of the scale was designed to be seven and a half meters in height and was maintained buildings for the faculty of architecture, UAUI.

3.2. Inclusive Design

Inclusive Design, Transport, Waste, Water, Materials, Operations involved the technical solutions presented in the code of Design for Greater Efficiency, Energy, Water, Materials, Operations. The questionnaire allows the students to answer that the footprint of the site was maintained buildings for the faculty of architecture, UAUI.

The questionnaire included the code of Design for Greater Efficiency, Energy, Water, Materials, Operations of the students in two projects. The research team conducted a synthetic comparison of the architectural analysis, taking into account the criteria, components, and items that influence the architectural form, the footprint of the site, the creation of an explorable landscape featuring trees, etc. The questionnaire was undertaken by our research team regarding almost 20 components: Place, Indoor Environment, Innovation, and Energy, Water, Materials, Operations.

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3.3. Air

Students also suggested incorporating Braille information into handrails, door handles, and other objects, as well as using auditory cues such as terraces, balconies, loggias, entrances, passages, or facade shapes, solar collectors, or light tubes for acoustic comfort. Some respondents also mentioned noise pollution and other pollutants being excluded from the site.

3.4. Water

Students also recommended integrating devices that activate the senses such as anti-slip surfaces into floors and pavements, as well as providing solutions for rainwater systems, such as gutters, downpipes, and rainwater retention basins. Other respondents also mentioned configurations of separate structures on the site or roof for ventilation and avoiding direct sunlight.

3.5. Sun & Light

The use of sun protection, such as canopies or pergolas, glazed interior partitions to glazed windows or exterior doors, and materials with sustainable properties was also recommended. Students also suggested using solar protection, mainly through the placement of trees, shrubs, and other vegetal elements on the site, through the placement of trees, shrubs, and other vegetal elements on the site, through the strategic orientation of water surfaces to reflect facade design features such as sliding panels or raised exterior flat roofs, cross ventilation, ventilated roofs, slotted ventilated roofs, or hydroponic crops. Some respondents also mentioned the use of vertical planes of the facade, bay windows, sun protection, and ventilation, cooling, heating, or facade shapes, solar collectors, or light tubes for acoustic comfort. Some respondents also mentioned noise pollution and other pollutants being excluded from the site.

3.6. Sound

Students also recommended using auditory cues such as terraces, balconies, loggias, entrances, passages, or facade shapes, solar collectors, or light tubes for acoustic comfort. Some respondents also mentioned noise pollution and other pollutants being excluded from the site.

3.7. Materials

The use of sun protection, such as canopies or pergolas, glazed interior partitions to glazed windows or exterior doors, and materials with sustainable properties was also recommended. Students also suggested using solar protection, mainly through the placement of trees, shrubs, and other vegetal elements on the site, through the placement of trees, shrubs, and other vegetal elements on the site, through the strategic orientation of water surfaces to reflect facade design features such as sliding panels or raised exterior flat roofs, cross ventilation, ventilated roofs, slotted ventilated roofs, or hydroponic crops. Some respondents also mentioned the use of vertical planes of the facade, bay windows, sun protection, and ventilation, cooling, heating, or facade shapes, solar collectors, or light tubes for acoustic comfort. Some respondents also mentioned noise pollution and other pollutants being excluded from the site.

3.8. Waste
3.9. Energy

Approximately 40% of the respondents mentioned solar panels / photovoltaic systems as solutions that could be integrated on the façade, inside, or on a façade. Some respondents emphasized the possibility of using existing buildings to integrate photovoltaic systems, while others expressed concern about the impact of these systems on the building's aesthetics.

Another potential limitation of this research is that it does not take into account the different needs and preferences of students from different universities. For example, some students may be more interested in sustainable waste management, while others may prefer interventions on existing buildings.

4 Limitations of the Research

Our research team is currently conducting a second sample of students from the Faculty of Architecture, UAUIM, that have recently completed their diploma project or thesis. These students were asked to rate their level of interest in specific program of study competences on a scale from very small to very large. The results of this study will provide a more comprehensive understanding of the attitudes of students in the field of sustainability and the challenges they face in their daily work.

5 Preliminary Results

Almost 40% of the respondents declared that they would like to attend seminars / technical or curricular activities to strengthen the validity of their current knowledge. These activities could be held in the Faculty of Architecture, UAUIM, and would be consistent with the specific program of study in different universities or institutions.

The least frequently chosen answer was “I do not know” when asked if they would like to attend seminars / technical or curricular activities to strengthen their current knowledge. This suggests that students are actively seeking opportunities to deepen their knowledge and improve their abilities.

Some students emphasized the need for more opportunities to practice sports and participate in community activities. The respondents also highlighted the importance of fostering health, nutrition, and physical activity, which are key components of a healthy and sustainable lifestyle.

In conclusion, the preliminary results of our study suggest that students are interested in attending seminars / technical or curricular activities to strengthen their current knowledge, and that there is a need for more opportunities to practice sports and participate in community activities. Our research team is currently working on a comprehensive study that will provide a more detailed understanding of the attitudes of students in the field of sustainability and the challenges they face in their daily work.
The follow...s solutions in the project.

Fig. 1. Illustrates...solutions in the project.

Fig. 2. Illustrates...solutions in the project.

Fig. 3. Illustrates...solutions in the project.

Fig. 4. Illustrates...solutions in the project.
On a scale from 1 to 7 (1 meaning “completely irrelevant” and 7 “extremely relevant”) a significant part of the respondents (73.3%) approved that specific examples of the type provided in the questionnaire are very and extremely relevant for their future diploma projects. None of the students ticked the “completely irrelevant” or “very irrelevant” options.

In regards of future personal training directions in the field of sustainability, 40.5% of the students were interested in obtaining certificates / specializations, 29.7% declared they would follow LEED / BREEAM / Passive House training courses and 27% answered they intend to work in an entity active in the field of sustainable architectural design. Only a few students intend to work in an entity active in the field of monitoring / certification of sustainable buildings or would like to follow master studies, doctoral studies or in-depth research in the field of sustainability. A significant percent of 37.8% of the students ticked the option “I don’t know / It’s too early for me to make a decision in this direction” and one student wrote that in the future would do “nothing related to architecture”.

It is quite interesting to compare the results shown in Figure 5 to the answers given by RIBA registered architects to the same question in 2020 and 2021.

In 2021 the RIBA study [18] found that 21% of the 613 respondents believe that clients are “leading the way on sustainability,” while only 10% believe contractors are. Most of the polled architects (60%) declared that “design consultants, such as architects, are leading the way” on sustainability. The RIBA survey from autumn 2019 published in 2020 [19] acquired 906 responses for a questionnaire including the same question. The architects' opinions were bolded: 59% of the respondents saw “design consultants, such as architects, as leading the way on sustainability”, while 14% perceived clients as trend setters and 3% said contractors are “leading the way”. None of the British surveys included the option of “central and local public administration”, which gathered almost a quarter of the UAUIM students’ opinions.

### 6 Discussions

- Discuss the “Sustainability in Design” and “Sustainability in Architecture” courses.
- Discuss the impact of sustainability education on student career choices.
- Discuss the effectiveness of the questionnaires in gathering student opinions.
- Discuss the role of private and public institutions in promoting sustainability in architecture.
- Discuss the importance of sustainability education in architectural schools.
- Discuss the need for a more comprehensive approach to sustainability education.
- Discuss the role of professional bodies in promoting sustainability in architecture.
- Discuss the future trends in sustainability education and practice.

**Fig. 4.** Graph showing student interest in sustainability-related training courses.

**Fig. 5.** Graph showing architects' views on leading the way in sustainability.
7 Recommendations & Conclusions

- The architects and teachers should work together to improve the technical project assignments and evaluate students’ projects.
- The participation of students at different stages of project development, such as the initial conception and planning, should be encouraged.
- Students should be supported in the planning of their projects, ensuring that they are aware of their strengths and weaknesses.
- The integration between the faculty’s curriculum and the student’s expectations and experiences should be addressed.
- The feedback from students should be evaluated on a regular basis to improve the design education and practice.
- Students should be encouraged to participate in the evaluation of the students’ performances.
- The examples of sustainable design and technologies should be used instead of examples from other countries.
- The quality and relevance of the research should be demonstrated through practical examples and case studies.
- The technical project assignments should integrate the architectural design exercise, rather than as a disconnected idea.
- The lack of collaboration and awareness of the architectural design exercise should be addressed.

A thorough understanding of the theoretical and practical aspects of sustainability in the architectural design exercise is essential.
As an Associate Professor in Architecture, Oana Mihăescu, Lecturer at the Dep. of Architecture, Faculty of Architecture, UAEIM, along with Adina Ioana Avram (Lecturer, Dep. of Architecture), and Ph.D. candidate in Architecture, Oana Mihăescu, together with Daniel Brzezicki, & Arch. (PhD, candidate in Architectural Design, FFAI), and Prof. Daniel casa, have been working on the CHEIA T project (code UAUIM 2010), Project Director, and the UAUIM Fund for Sustainable Outcomes Guide, an intensive research and educational project aiming to educate architects and engineers on how to apply sustainable knowledge and design in a multidisciplinary and context-sensitive manner.

The total amount of practical application of the sustainable design and construction tactics, for the building industry, and how to participate in exhibitions and seminars, has been a major focus of the research. The results of this research have been presented at several conferences, including the Living Building Challenge, and the Sun Plus project, showcasing the innovative and context-appropriate solutions for sustainable design and construction.

This research allows for the participation of students and academics in architecture and environmental design, and in the field of academic expertise. The evolving norms and standards for the built environment, and the incorporation of sustainable design concepts into the educational curriculum, have been a prominent focus of this research.

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