

Conceptual Design of a Residential House Based on IDEA 4E - Discussion of the Process of Interdisciplinary Pre-Project Research and Optimal Design Solutions Created as Part of Project-Based Learning

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Abstract : Creating economical, comfortable, and healthy buildings which respect the environment is a necessity resulting from legal regulations, but it is also a response to the expectations of a modern investor. Developing the concept of a residential house based on the 4E and the 2+2+(1) IDEAs is a complex process that requires specialist knowledge of many trades and requires adaptation of comprehensive solutions. IDEA 4E assumes the use of energy-saving, ecological, ergonomics, and economic solutions. In addition, IDEA 2+2+(1) assuming appropriate surface and functional-spatial solutions for a family at different stages of a building's life, i.e. 2, 4, or 5 members, enforces certain flexibility of the designed building, which may change with the number and age of its users. The building should therefore be easy to rearrange or expand. The task defined in this way was carried out by an interdisciplinary team of students of the Silesian University of Technology as part of PBL. The team consisted of 6 undergraduate and graduate students representing the following faculties: 3 students of architecture, 2 civil engineering students, and 1 student of environmental engineering. The work of the team was supported by 3 academic teachers representing the above-mentioned faculties and additional experts. The project was completed in one semester. The article presents the successive stages of the project. At first pre-design studies were carried out. They allowed to define the guidelines for the project. For this purpose, the "Model house" questionnaire was developed. The questions concerned determining the utility needs of a potential family that would live in a model house - specifying the types of rooms, their size, and equipment. A total of 114 people participated in the study. The answers to the questions in the survey helped to build the functional programme of the designed house. Other research consisted in the search for optimal technological and construction solutions and the most appropriate building materials based mainly on recycling. Appropriate HVAC systems responsible for the building's microclimate were also selected, i.e. low, temperature heating, mechanical ventilation, and the use of energy from renewable sources was planned so as to obtain a nearly zero-energy building. Additionally, rainwater retention and its local use were planned. The result of the project was a design of a model residential building that meets the presented assumptions. A 3D VR spatial model of the designed building and its surroundings was also made. The final result was the organization of an exhibition for students and the academic community. Participation in the interdisciplinary project allowed the project team members to better understand the consequences of the adopted solutions for achieving the assumed effect and the need to work out a compromise. The implementation of the project made all its participants aware of the importance of cooperation as well as systematic and clear communication. The need to define milestones and their consistent enforcement is an important element guaranteeing the achievement of the intended end result. The implementation of PBL enables students to acquire competences important in their future professional work.

Keywords : architecture and urban planning, civil engineering, environmental engineering, project-based learning, sustainable building

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