

INTEGRAL DESIGN IN CONTEXT OF THE U.S. DEPARTMENT OF ENERGY SOLAR DECATHLON

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Summary

The paper presents the multidisciplinary project U.S. Department of Energy Solar Decathlon 2013 in the context of integral design approach. On this project the students of architecture, building technology, electrical engineering, structural engineering and building services from the Czech Technical University in Prague participate. Uniting knowledge of different disciplines involved in the building design process is the most promising way to pursue sustainable design solutions.

In order to meet new design challenges for the sustainability of the built environment it is necessary to apply such methods, that bring more diversity and knowledge already in the conceptual design phase. This is possible only by integrating all design professions from the beginning of the design process and transforming the team's knowledge into the creation of new architectural concepts.

Keywords: energy-efficient housing, integral design, Solar Decathlon

1 Integral design in the context of the U.S. Department of Energy Solar Decathlon

1.1 Integrated vs Integral Design

Human activity is creating an enormous pressure on the environment. As built environment participates significantly in this state it is obvious, that to reduce the impact of human activities on the environment, change in approach to building design is crucial.

It is my belief, that the traditional design strategies no longer suffice. The current design practice leads only to optimization of what was designed by architect in the beginning of the design process – so called integrated design (Zeiler, 2010). In order to meet new design challenges for the sustainability of the built environment it is necessary to apply such methods, that bring more diversity and knowledge already in the conceptual design phase – the so-called integral design (Zeiler, 2010). This is possible only by cultivating such design methods, that meaningfully integrate all design professions from the beginning and that transform the team's knowledge into the creation of new architectural concepts.

1.2 State of the Art

Key to the sustainable design is holistic approach in which efficiencies begin to amplify one another, which could be described as "virtuous circles of improvement" (Hawthorne 2001). Still, sustainable architecture is mostly created by additive assembly of technical measures,

that are seemingly not influencing each other. This is probably caused by tight design budgets, deadlines and maybe also a lack of skill of the design process participants. The new design methods originated in early sixties (Cross, 2007). They were based on scientific methods and management decision-making techniques from the 1950s. In the 1970s came the rejection of these methods and proposals of methods that were moving away from attempts to optimize towards recognition of satisfactory or appropriate solutions. In the 1980s engineering design methodology of the systematic variety developed strongly. Since the 1990s up to day, design as a discipline of study was established, however there is still no clear directions and many designing models exist. Integral design method is pursued for example by Wim Zeiler and his team on the TU Eindhoven in Netherlands. In his approach, the C-K theory is extensively used. It „defines design as the interplay between two interdependent spaces having different structures and logics. This process generates the co-expansion of two spaces, space of concepts C and space of knowledge K“ (Zeiler, 2010).

The future clearly lies in the complex view on the building design process, where the whole life cycle of the building will be taken into account, in relation to all three pillars of sustainability – social, economic and environmental. This requires a close cooperation of architect, engineers and design process participants already from the beginning of the design process. Most architects/engineers are not yet able to apply this approach. As Christopher Day says in his book *Spirit and Place*: "If we want to apply the holistic approach to the sustainable design process, it requires vision of a wider whole, than what we have before our eyes..." (Day, 2005).

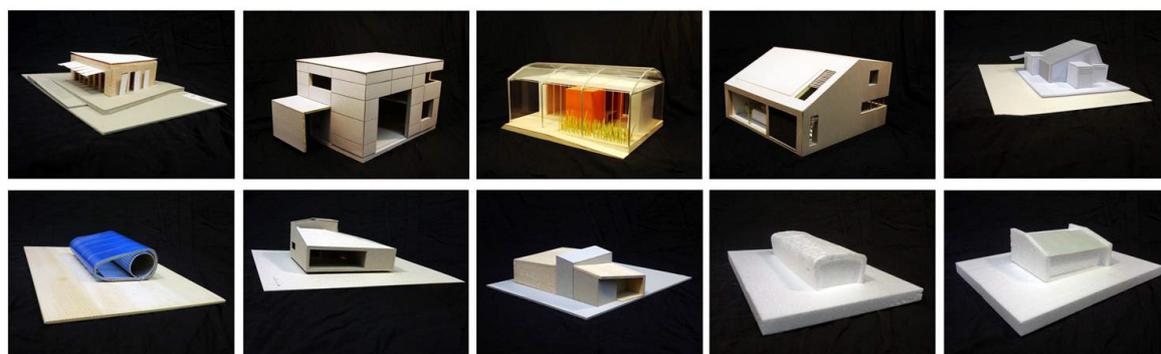


Fig. 1 Different versions of the AIR House concept, at the beginning of the design process. Authors are students of architecture and civil engineering programme.

1.3 Czech Contribution to the U.S. Department of Energy Solar Decathlon

In order to teach the architectural society to apply the integral design process, it is necessary to purposefully implement this issue into the architectural education. The Czech Technical University in Prague (CTU) gained a remarkable opportunity to train the integral design process in reality. As one of two European teams, the CTU team fought its way into the finals of the international student competition U.S. Department of Energy Solar Decathlon.

In Solar Decathlon, 20 selected collegiate teams from all over the world are challenged to design, build and operate energy self-sufficient solar-powered houses. The buildings come into being on university grounds and the finished houses will be presented to the public during a two-weeks display in October 2013, in California. It is the most prestigious university competition in the field of sustainable solar architecture.



Fig. 2 The AIR House concept, with which the team of the Czech Technical University in Prague enters the international competition U.S. Department of Energy Solar Decathlon.

The obvious goal of the competition is to support sustainable and innovative architecture development and to introduce this concept to the general public. From the architectural education point of view, the most important aspect is that it fosters interdisciplinary approach within a multidisciplinary design team setting, among students from different academic disciplines, who otherwise may not work together until they finish their studies and become professionals. Like Olympic decathletes, the students have to be strong in many different disciplines – not only design and architecture, but also engineering, health and safety, promotion, fundraising or project management.

Due to the unique challenges of the Solar Decathlon, the team had to generate new concepts and design solutions that go beyond the usual redesign and optimization of the architect-generated concept. What is desirable is a greater involvement of the various disciplines early in the design process. In order to achieve this goal, creating an egalitarian working environment is a necessity. The design of buildings must not be seen as a creative act of an individual. It must be ensured, that all necessary functions and aspects are addressed already at the beginning of the design process.

2 Conclusions

The U.S. Department of Energy Solar Decathlon is a unique possibility to put integral design approach in practice and to reconsider the common design process, where it is the architect who is seen as responsible for laying down the vision of the building and the engineers are involved too late in the design process. However, it is necessary to say, that this is not only “a matter of the architect coming down from the mountain top, so to speak, it is also a matter of the engineer stepping up and meeting the architect half way” (Savanović, 2009). This is a long term goal. Without this, the true cooperation between the disciplines may prove difficult.

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