FIRST EVALUATION OF THE MASTER PROGRAM IN SUSTAINABLE ARCHITECTURE AT NTNU

Matthias HAASE
Norwegian University of Science and Technology, Department of Architectural Design, History and Technology, Alfred Getz vei 3, Trondheim, Norway, Matthias.haase@ntnu.no
SINTEF Building and Infrastructure, Alfred Getz vei 3, Trondheim, Norway, Matthias.haase@sintef.no

Aoife HOULIHAN WIBERG
Norwegian University of Science and Technology, Department of Architectural Design, History and Technology, Alfred Getz vei 3, Trondheim, Norway, aoife.h.wiberg@ntnu.no

Annemie WYCKMANS
Norwegian University of Science and Technology, Department of Architectural Design, History and Technology, Alfred Getz vei 3, Trondheim, Norway, annemie.wyckmans@ntnu.no

Summary

At the Norwegian University of Science and Technology (NTNU) in Trondheim, an international interdisciplinary MSc program in Sustainable Architecture started in fall 2010. The program is based on long experience with graduate and post-graduate courses in the field, which are now being bundled into one holistic education.

Throughout the two years of the MSc program, a holistic perspective stresses the many architectural expressions and possibilities encompassed within a zero emission built environment. Within each of the theory and project courses, high demands are made towards integrated design strategies to ensure usability and synergy of the design with its surroundings and users. Building simulation is a major part of each semester, enabling the students to couple the design steps with appropriate simulation programs. In addition, the students are continuously trained in interdisciplinary co-operation enabling them to integrate these routines in their professional practice.

The first cohort of master students has now finished the program with the submission and defense of their master thesis.

This paper describes the learning aims, course structures and pedagogical methods of the MSc program. In addition, it focuses on first experiences with respect to the transfer of high-quality research and practice experiences in Norway and abroad. Student outcomes of the first two years were evaluated against the objectives and projected learning outcomes. Lessons learned will be an important asset in the further development of the course content in the coming years.

Keywords: interdisciplinary, architectural design, professional role, lifecycle perspective, zero emission

1 Introduction

At the Norwegian University of Science and Technology (NTNU) in Trondheim, an international interdisciplinary MSc program in Sustainable Architecture started in Fall

2010. The program is based on long experience with graduate and post-graduate courses in the field, which are now being bundled into one holistic education [4].

The MSc program aims to educate building professionals in the use and development of competitive methods and solutions for existing and new buildings that will contribute to lowering GHG emissions related to the production, use, management, and demolition of architecture in a life-cycle perspective [1].

2 Master course

Throughout the two years of the MSc programme, a holistic perspective stresses the many architectural expressions and possibilities encompassed within a zero emission built environment. Within each of the theory and project courses, high demands are made towards integrated design strategies to ensure usability and synergy of the design with its surroundings and users. The students are continuously trained in interdisciplinary co--operation enabling them to integrate these routines in their professional practice.

The curriculum consists of three consecutive semesters with theory and project courses, and a fourth semester during which the participants write their M.Sc. thesis. Throughout the two-year curriculum, a holistic perspective stresses the many architectural expressions and possibilities encompassed within a zero emission built environment. For each consecutive semester, a specific area of focus is selected:

- Semester 1: Climate and built form (project); Climate and built form (theory); Concepts and strategies related to energy efficient, sustainable and zero emission buildings and built environment (theory);
- Semester 2: Integrated energy design (project); Energy systems and services and their integration in architectural design (theory); Sustainable building materials and components (theory);
- Semester 3: Design of zero emission buildings (project); Use and operation of zero emission buildings (theory); Elective Course (theory – to be agreed upon with supervisor and course coordinator);
- Semester 4: Master thesis

Each semester is structured to divide the total of 30 credit points into three courses. Two courses are theory courses with 7.5 credit points each and a project course counting 15 credit points. One of the theory courses is closely linked to the project course while the other theory course is linked to the topic of the semester.

3 Objectives

The paper describes the learning aims, course structures and pedagogical methods of the MSc programme. In addition, it focuses on first experiences with respect to the transfer of high-quality research and practice experiences in Norway and abroad. Student outcomes of the first two years were evaluated against the objectives and projected learning outcomes.

4 Learning outcome

During the semester the students developed the ability to create a low-energy building that satisfies aesthetic, technical and social requirements. They gained knowledge of building, neighbourhood and urban design including the interactions between built form, transportation and land use, energy supply and generation, lifestyle and consumption, climate change and resource scarcity. The role of the architect in creating a physical framework for a low-carbon society became clear: the interaction between people, buildings and the environment on different levels of scale and time. In particular, the students gained:

- The ability to synthesize complex requirements of building function, structure, and physics into a holistic design in order to provide health, comfort and well-being.
- A thorough understanding of the changing role and responsibility of building professionals in society. This includes a continuously updated knowledge of and critical attitude towards the industries, organizations, regulations and procedures involved in developing sustainable building projects.
- The knowledge and skills required to transform various performance criteria into a coherent design during the different stages of the life cycle of a building project. This includes the design skills to negotiate stakeholder requirements within the constraints imposed by environmental specifications, cost factors and building regulations.
- An understanding of the investigation, assessment and evaluation required to achieve a low-carbon project, including the ability to develop and follow-up an environmental program that takes into account aesthetics, technical requirements and social factors.

5 Evaluation

The course structure allowed for different types of research and experiments in theory and design. Regular interactive workshops with discussions among peers and with the teaching staff help the students become more conscious of their own knowledge and beliefs. An individual research essay each semester allows the students to develop their own scientific potential. In the design studio, interdisciplinary design teams give the students the opportunity to continually test their own ideas in co-operation with others, and explore their professional, social and cultural behavior. In this manner, the students get familiar with different ways in which to work professionally with the built environment, and get a good foundation to mix and re-combine the different elements into a meaningful whole.

It became obvious that socio-cultural interactions form an important part of the students' learning environment. In order to create well-functioning architecture, the students need to be able to build a thorough knowledge of a project's local climate and site as well as its cultural history. The synthesis of systematic analysis results into the overall architectural expression within the group work in design studio is a social arena. Resulting overall design projects are not purely based on engineering analysis but also form a compromise that takes social and cultural aspects of the project as well as the participants and designers into account.

The integration of these interactions on behavioral simulation poses major modeling and computational challenges that have to be discussed. Its ability to deal with the resulting complexity of scale and diversity of component interactions has gained building simulation a uniquely recognized role in the prediction, assessment and verification of building performance. But as designer limits and scope of accuracy of building simulation is

important to know. E.g. user behavior's influence on energy consumption becomes even more prominent in very low energy buildings. If a designer limits his work to the use of standardized sets of user profiles and operation hours he will always design sub optimized buildings.

6 Conclusions

The M.Sc. in Sustainable Architecture equips the students with extensive knowledge and experience that prepare them for a challenging, rapidly changing profession. There is a dire need for an architectural policy that encompasses the new technological opportunities while improving quality of life and reducing environmental impact. The development of a zero-emission built environment creates a new physical framework for large parts of society, reflecting cultural values, existing structures and the new layers of the future.

Theoretical challenges are plentiful when recognizing that the physical state of a building is the result of the complex interaction of a very large set of physical components. The integration of these interactions on behavioral simulation poses major modeling and computational challenges that have to be discussed. Its ability to deal with the resulting complexity of scale and diversity of component interactions has gained building simulation a uniquely recognized role in the prediction, assessment and verification of building performance. The relationship towards design that extends beyond principles and develops truly integrated design solutions remains unclear. Here, the MSc course will give important input and discuss the issues related to building design.

Acknowledgement

The allocation of resources and expert knowledge from the Zero Emission Buildings research centre are kindly acknowledged.

References

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