MSC IN SUSTAINABLE ARCHITECTURE: TOWARDS A ZERO EMISSION BUILT ENVIRONMENT

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Summary
An international interdisciplinary MSc programme in Sustainable Architecture starts in autumn 2010 at NTNU, the Norwegian University of Science and Technology in Trondheim, Norway. The 2-year curriculum focuses on the achievement of a zero emission built environment, and is based on a long tradition of MSc courses in environmental project design at NTNU. It is executed in co-operation with the Research Centre for Zero Emission Buildings at NTNU, involving education and research institutions; producers of materials and products for the building industry; contractors, consultants, architects; trade organisations; public administration; public and private construction and property management; and users. The paper describes learning outcomes and course structures of the MSc, including its interdisciplinary students and staff in architecture and engineering.

Keywords: design process, integrated design, interdisciplinary, zero-carbon, lifecycle

1 Education for a zero emission built environment

Architecture and the built environment exert a large influence on GHG emissions through building design, land use planning and transportation, consumption and lifestyle, and life-cycle management of natural resources. Building professionals can therefore play an important role in leading society towards more sustainable use of resources and in building resilience towards climate change [1; 2; 3; 4; 5]. At the same time, such reduction in GHG emissions and resource use need to be developed with a corresponding increase in quality in the built environment in order to be sustainable in a long term perspective [6; 7].

How should we educate building professionals to fulfil their role in society as change agents for the future? The international interdisciplinary MSc in sustainable architecture at NTNU aims to provide architecture and engineering students with the professional knowledge and skills to deal with climate change and resource scarcity in the built environment [8]. Each year, 20 students are accepted to the programme; in addition, the staff co-operates closely with traditional architecture and engineering curricula, the building sector, and the Research Centre for Zero Emission Buildings to create a maximum scope for the topic of sustainable architecture in all sectors [9; 10].

2 Learning outcomes

The MSc learning outcomes are loosely based upon EU Directive 2005/36/EC Article 46 for architectural education, but with environmental sustainability at the core of the profession. There are two distinct focus areas: the design project, and the design process.
2.1 Design project

The students will develop the ability to create low-carbon building projects that satisfy aesthetic, technical and social requirements:

- An understanding of the role of architecture and the built environment in creating a physical framework for a low-carbon society: the interaction between people, buildings and the environment on different levels of scale and time.
- An adequate 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 ability to synthesise complex requirements of building function, structure, and physics into a holistic design in order to provide health, comfort and well-being.

2.2 Design process

The students will develop the knowledge and skills needed to plan, execute, and manage a building project in co-operation with an interdisciplinary design team and stakeholders:

- 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, organisations, 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.

3 Course structure

The 2-year programme consists of three consecutive semesters with project and theory courses, followed by a fourth semester during which the MSc thesis is to be written:

- Semester 1: Climate and built form (project 15 credits); Climate and built form (theory 7.5 credits); Concepts and strategies related to energy efficient, sustainable and zero emission buildings and built environment (theory 7.5 credits);
- Semester 2: Integrated energy design (project 15 credits); Energy systems and services and their integration in architectural design (theory 7.5 credits); Sustainable building materials and components (theory 7.5 credits);
- Semester 3: Design of zero emission buildings (project 15 credits); Use and operation of zero emission buildings (theory 7.5 credits); Elective Course (theory 7.5 credits – to be agreed upon with supervisor and course coordinator);
- Semester 4: MSc thesis (30 credits)
3.1 Semester 1: Climate and built form

The main topic of this semester is climate and built form, embedded in a combined project and theory course. Local site and climate, cultural context as well as building physics and human comfort are factors the students need to integrate in their design project, inspired by lectures, exercises and group discussions. The students work in interdisciplinary groups, and are graded on the quality of their project as well as a written theory exam.

An additional theory course considers the broader scope of sustainable architecture, ranging from understanding its history to a discussion of the most up-to-date concepts of zero-emission buildings and built environment. The course covers various levels of scale in climate change and resource scarcity, including building and neighbourhood design, land use, green infrastructure, traffic, and urban storm-water management. Also policy and economic challenges posed by innovative building strategies in society are included. The students are evaluated by means of an individual research essay.

3.2 Semester 2: Integrated energy design

A combined design and theory course on integrated energy design aims to train the students in the interdisciplinary procedures necessary to ensure a successful integration of energy systems in architecture to provide a good indoor climate in a resource-efficient manner. The project training is supported by lectures, exercises and workshops on building systems and services, integrated design methodology, evaluation tools and user behaviour. Challenges related to new and existing buildings are discussed. The courses are taught in co-operation with the Faculty of Engineering Sciences and Technology at NTNU. The students’ grades are based on their project work as well as a written theory exam.

An additional theory course, taught in co-operation with the Industrial Ecology Programme and the Faculty of Natural Sciences and Technology, concerns building materials, their correspondent construction methods, and their consequences on GHG emissions during the building’s life cycle. The students learn how to specify construction materials in a brief, how to compare materials’ performance using different criteria, and how to critically analyse product information. They also receive an introduction to environmental labelling of building materials and their effect on the building users’ health and indoor climate, and learn how to use these criteria to select the appropriate materials for their project. The students are evaluated by means of an individual research essay.

3.3 Semester 3: Zero emission building

The third semester offers the students a combined design and theory course on the use and management of zero emission buildings, in co-operation with the Faculties of Arts and Humanities, and Engineering Science and Technology. It includes environmental management of the construction site and building project, as well as user participation in the design and operation of low-energy architecture. It includes environmental classification tools are discussed along with quality control and documentation methodology. Contracting alternatives are investigated for their effect on the overall environmental and economic performance of the project. In addition, the students design a project that integrates these strategies into high-quality architecture.

In addition, the students choose an elective course in dialogue with the staff, in order to prepare themselves for their MSc thesis. The elective course may for example be related to environmental policy, economics, project management, or user participation.
3.4 Semester 4: MSc thesis

During their fourth semester, the students finish their final thesis project, the scope and topic of which is adapted to their individual professional background and interest.

4 Conclusion

Architecture and the built environment create a physical framework for a future zero-emission society. Building professional can contribute considerably to this development by means of projects on the building, neighbourhood and urban level that create high quality for society and its citizens, while dealing with challenges of climate change and resource scarcity. More architecture for less CO₂.

References


