

EDUCATION AND TRAINING IN THE FIELD OF SUSTAINABLE BUILDING DESIGN

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Summary

The responsibility to coming generations for civil engineering education especially in sustainable building design will follow directly from these thoughts. The design, operation and maintenance of sustainable buildings are to be urgent for civil engineering education. Typical building construction, operation and demolition contribute significantly to environmental problems. The aim of sustainable building design is to reduce the negative impact of the buildings on human health and natural environment during whole building life cycle. Sustainable building is a process that requires an integrated and multidisciplinary approach. It is important the cooperation among civil engineers, architects, environmentalists and other experts. The answer on the question why it is necessary to implant the sustainable building design into structural engineering education is based on the fact that human health problems and also indoor and outdoor environment problems are mostly connected with building engineering.

The sustainable building sciences educational activities are particular implement at Technical university of Kosice to Building Engineering study by various ways. The level of professional knowledge in this field depends on the study program. Sustainable building design graduate study contents parts concerning to economic benefit, planning and urban design, materials selection, energy performance, indoor environmental quality, renewable technology, water, sewage and waste management.

We welcome to a new kind of science because it helps us to educate the highly complex problems of many scientific fields. Some basic considerations that may suggest a new view for understanding of relationships between architectural, building and environmental engineering will be presented in the paper.

Keywords: education, sustainability, building design

1 Introduction

The built environment presents us with a major challenge. The construction, fit-out, operation and ultimate demolition of buildings is a huge factor in human impact on the environment both directly (through material and energy consumption and the consequent pollution and waste) and indirectly (through the pressures on often inefficient infrastructure). The built environment also has a crucial impact on the physical and economic health and well-being of individuals, communities and organisations. A good

building is a delight and will enhance a community, enhance our ability to learn or increase our productivity. A poor building will do the opposite. Where buildings and built environments contribute to ill-health, undermine community and create excessive financial liability, they are undesirable and unsustainable.

To meet the challenge we have to enhance quality of life for all by designing healthy buildings and environments fit for individuals and communities both now and in the future. We need to minimize resource throughputs, waste and pollution, and to fulfill our responsibility to protect other species and environments. Buildings and the built environment will therefore increasingly be required to satisfy a number of criteria, including that they should: enhance biodiversity, support communities, use resources effectively, minimize pollution, create healthy environments and manage the process.

The term of sustainable/green building is used for buildings which efficiently used energy, water, and other resources; protected occupant health and improved employee productivity; and reduced waste, pollution and environmental degradation. On the other side typical building construction, use, and demolition, as well as the manufacturing of building materials, contribute significantly to environmental problems. Such problems include climate change, ozone layer depletion, habitat destruction, air and water pollution, water depletion, erosion and flooding, natural resource extraction, and solid waste generation. Sustainable building is a process that requires an integrated and multidisciplinary approach. It is important the cooperation among civil engineers, architects, environmentalists and other experts. Green building strategies are often organized into five categories: site, water, energy, materials and resources, and indoor environmental quality. There are countless environmental benefits associated with minimizing the resource and health impacts. These benefits include preserving natural habitats, watersheds, and ecosystems, preserving biodiversity, protecting air and water quality, reducing greenhouse gas emissions, reducing solid waste, and conserving natural resources, and creating healthier indoor and outdoor environments.

2 Sustainable building design

Extensive research of sustainable building design has been established in Slovak republic mainly during the last five years. Simultaneously, sustainable building design training and education programs have been launched in this field. The main actor in this process has been the research team of Technical University in Košice. Four years ago, the Institute of Building and Environmental Engineering has been established at Civil Engineering Faculty. The institute is center of education and research on architectural and indoor engineering related to environmentally friendly building materials and structures related to green energy and indoor technologies. The reliability, efficiency, quality and safety are continuously observed in the range of energy and mass transfer related to sustainable and green buildings. We do have experiences with NATO science and collaborative projects, COPERNICUS project and FP5 project. Institute of Building and Environmental Engineering has a great cooperation with industry and financial sector. The institute is a member of consortium for green energy and indoor technology research. The consortium was established with the aim of sustainable building research. The consortium has completed low energy experimental building.

The university group consists of 5 professors, 22 researchers and 20 doctoral students and it has a good experience in research of sustainable and architectural design. The green

energy (heat pump, solar panels, photovoltaic cells, and biogas) and indoor technologies are studied in the pre-prepared experimental building. The consortium for green energy and related indoor technology research is interested in participating in EU projects in the field of energizing environmental solutions for the sustainable buildings, smart materials and structures, green energy and related HVAC and indoor technologies. We would like to join the EU group of similar research interest. The main aim of the consortium is to establish the Centre of excellence for green energy and related indoor technologies. The main areas of interest of the Center are:

- sustainable buildings design,
- environmental friendly materials,
- green energy for buildings,
- intelligent HVAC systems,
- smart indoor technologies,
- performance building design,
- building environmental assessment and certification.

3 Sustainable building science programs

This suggests an interdisciplinary approach to the building process and, the requirement for the new educational paradigm, to address the planning, design, construction, operation and maintenance of healthy, comfortable and green buildings. With this objective, the Institute of Building and Environmental Engineering was established on Civil Engineering Faculty of Technical University of Košice. The bachelor, master and doctoral program in sustainable building science is provided nowadays within the program Architectural and Indoor Engineering. Studies involve no charges; therefore, most students continue their studies until master degree. The program focuses its attention to interdisciplinary areas of building, including:

- Building site which focuses on analysis and selection on suitable site, including topography, orientation, passive design of building.
- Building materials which focuses on analysis and selection of green materials, including wood, hems, straws, loams, clay briks.
- Building science which focuses on analysis and control of the physical, chemical and biological phenomena affecting the performance of building materials and building enclosure systems.
- Energy efficiency which deals with analysis, design and control of energy-efficient building and HVAC systems, green energy utilization and intelligent buildings.
- Indoor science which covers the environmental aspects in design, analysis and operation of energy-efficient, environmental-friendly, healthy and comfortable buildings.
- Building environmental assessment which focuses on comprehensive evaluation of building, including site selection and project planning, building materials, indoor environmental quality, energy performance, water and waste management.

The following courses are offered in Architectural and Indoor Engineering programs within these areas:

- Building site: Topography, Orientation, Passive design, Air circulation, Residential Density, Distance to Employments, Business Services, Hospitals, Retails

Education and Information

- Building materials: Properties, Environmental characteristic of materials such as Metal, Brick, Stone, Plastic, Wood, Timber, Hemp, Loam, Straw, Glass
- Interior: Surface design, Typology, Color, Lighting
- Building science: Indoor Environment, Building Acoustic, Building Illumination, Fire Control in Buildings, Building and Environment, Sustainable Building Design, Environmental Assessment and Certification of Buildings
- Energy efficiency: Thermal Performance of the Building Envelope, HVAC Systems, Energy Certification of Buildings, Energy and Environmental Impacts, Green Energy for Buildings, Intelligent Buildings, Computer-Aided Building Operation
- Indoor science: Indoor Environment, Indoor climate, Indoor chemicals, Building and Indoor Air Quality, Legal Environmental Issues, Computer-Aided Building Operation

Experiences with the program concerning to sustainable design sciences have generally been quite favorable and the indications are that the package of courses offered in these areas is reasonably successful in exposing students to the related discipline and application. Students, who follow the Sustainable Building Design Science education, have a good knowledge of the sources of the planning, site selection, building management, building materials and structures, indoor pollutants, HVAC systems, sources control, monitoring, energy performance, waste and water management. Therefore, they can systematically investigate the building as a building engineer and propose engineering solutions.

The topics of the doctoral training courses vary annually. Most common are courses in architectural design of buildings with the principles of sustainability, architectural making of interiors and environmental safety of buildings and their environment, green building design, environmental management of green buildings, smart buildings perceived comfort of environment, green energy for clean buildings, etc. Two days during the academic year, special seminars are held for doctoral students at Institute of Building and Environmental Engineering. The PhD students present their results of research with the aim of general discussion. Seminars serve also for motivation and creative working atmosphere. The doctoral students may get inspired by one another, and are driven to intensive research work.

4 Sustainable building design and construction process

The sustainable building design is affected equally by site selection, passive solar design, architectural building design, green energy use, use of environmentally friendly materials and structures. Adequate quality of indoor and outdoor environment requires taking these aspects into consideration during all the stages of the design, construction and use of the building and their surrounding environment. Some of the problems may originate from the buildings themselves, some are caused by actions of the occupants or operation and maintenance of the buildings and surroundings. Because of these multiple origins of the problem, it is important for owners and designers to specify the performance of the building and the construction process so that the building industry can prove through accepted procedures that the buildings meet the agreed performance criteria for health, and unnecessary claims are avoided.

4.1 Design phases

4.1.1 Environmental plan

The pre-construction phase includes preparation of an Environmental Plan including:

- identification of factors with potential influence on the internal and external environments,
- development of procedures for elimination/minimization of environmental hazards and/or negative impacts,
- provision/development of the necessary technologies to meet the environmental objectives.

4.1.2 Design brief

This phase should begin as soon as possible after the first discussions concerning inception of the project. The client's objectives should clearly define issues and criteria important to the owner, to all members of the design team and to future tenants. These criteria would include:

- functional use of the facility,
- occupant safety, health and comfort,
- occupancy requirements,
- quality of materials and construction,
- environmental and energy management goals and requirements.

Conceptual designs should be prepared for passive and active systems of green energy that will fulfill the basic design requirements. The required functional operation of the HVAC and related life-safety systems should be compiled and set out in the system manual. Another important action is the appointment of a commissioning manager, who has to start the development of a commissioning plan, and should form a commissioning team with commissioning specialists.

4.1.3 Design

This phase begins with the preparation of the schematic design documents. The documents delivered during the design phase are:

- performance specification for the green energy systems,
- specification of provisions for maintenance and cleaning,
- the commissioning plan,
- description of all building components (HVAC equipment) and systems,
- contract documents that clearly identify describe and fulfill the design intent.

During this phase, review and accept contract documents for compliance with design intent.

4.2 Construction

The following areas have been identified as having a potential effect on environmental quality:

- dust and particulate matter generated during construction/reconstruction,
- the quality and design of air handling equipment,
- maintenance procedures,
- selection of interior building materials and furnishing (design phase),
- performance of the building protection against influences from soil, e.g. radon,

- emissions from office equipment, e.g. copy machines.

Implementation of a building project which employs new or innovative techniques requires the total cooperation and participation of sub-contractors:

- education of contractors,
- displacement of conventional practices and attitudes,
- introduction of the “Sustainable/Green Building Philosophy”,
- creation of work stations with no objective reasons for complaints of the indoor environmental quality (IEQ),
- trying to avoid a number of common problems during the initial design and construction phase.

5 Conclusions

Sustainable building design science has gained considerable general interest in Slovakia and the need for sustainable science education has become obvious for many professionals, such as civil engineers, HVAC engineers, environmental medicine doctors, and building inspectors. In addition, there is a need of specialists in this field. It has been generally understood that an interdisciplinary approach is required in this education. These efforts have already resulted in better building design education and training. More reliable building investigations have also become possible.

Acknowledgement

The authors are grateful to the Grant Agency of Slovak Republic to support of project No. 1/0188/10, on the base of which the results are presented.

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