

A New Approach to the Preparation of Engineers of Building Energy Efficiency

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Abstract: -The aim of the new curriculum is to raise the engineering competence in the field of energy efficiency to a new qualitative level. In the situation, where assuring and improving energy efficiency is becoming increasingly more important in the world, the need for energy consultants is growing significantly. The knowledge of energy efficiency has a significant potential to affect people's daily life as fully planned energy efficient solutions in the building can reduce costs up to 30% and create a better living environment. The curriculum of energy efficiency of buildings is a modern balanced curriculum, covering more than a 1.5 year completion process of a unique thesis, in which students gain the practical knowledge of an energy specialist.

Key-Words: -Energy efficiency, Curriculum of energy efficiency of buildings, Unique thesis, Growth of knowledge of energy efficiency

1 Introduction

Nowadays training engineers of energy efficiency has become especially important.

The European Parliament and Council Directive 2010/31/EU have imposed extremely high expectations on the buildings in the field of energy efficiency in the member states. Since 2018 all public buildings and since 2020 all new and substantially refurbished buildings must be designed and built as zero energy buildings. This means a substantial reduction in energy consumption compared to that today.

Based on the directive the ministries have started to compile an action plan to fulfill its requirements, the most important part of which is ensuring a competent staff. For that, it is necessary to train new young specialists and retrain the existing specialists.

To solve these problems a master's program curriculum with a novel approach has been developed, where the main goal and direction is to achieve energy usage options, which are technically and economically reasonable. The Building constructions and their use are becoming increasingly complex, which in turn sets challenges for the energy efficiency of buildings.

One of the goals of the new curriculum is to raise the engineer's awareness and competence

in the field of energy efficiency to a new qualitative level.

The curriculum is innovative and requires training specialists, who are ambitious, open-minded and have practical experience in the field.

In a situation where ensuring and improving energy efficiency in various sectors of the economy is becoming increasingly more important in the world, the need for energy consultants of the building is growing both at the state and local levels of the government and the private sector.

The knowledge of energy efficiency affects people's daily living, because fully planned energy efficient solutions in the buildings may reduce costs up to 30% and improve the quality of the living environment.

The importance of the curriculum is emphasized with the following aspects:

A limited range of specific know-how – the theme of energy efficiency in the construction curricula is currently included with only a few credit points, which is clearly insufficient for students to have development skills of planning and investment projects of energy efficiency.

The focus of knowledge transmission in the field is rather on the energy production and distribution issues than energy use. Information

about the opportunities for saving energy and the related issues has to some extent remained in the background. Improving energy efficiency depends on the consumers' own initiative, their knowledge and skills to implement energy saving projects.

The policies on improving energy efficiency are needed to expand its foothold, because in the energy consumption structure a significant impact is carried by a considerable number of small consumers, who are dispersed over the country. The opportunities for saving energy in the country are also distributed quite fragmentally.

The new curriculum has an important role in raising the administrative ability of coordinating energy saving of the local governments and their divisions.

The energy consumption of buildings amounts to 40% of the total energy need in Estonia, in which the energy consumption of apartment buildings and public buildings forms 63%. Thus there is significant potential for energy saving in this field. Legislation in this field imposes obligation on the regional and local level to prepare and constantly update the chapter of energy economy in the development programs and to coordinate energy efficiency activities.

Also the real estate managed by regions, local governments and their agencies represents a significant part of public buildings. These are mostly educational and social facilities, where the demands on the indoor climate, heating, ventilation and lighting systems are high and necessary skills to ensure those with reasonable costs are inadequate.

Many scientists have addressed methodological issues of teaching. According to Martin [1], subject matter experts (SME) are indispensable when developing training courses. "SME's have technical skills and practical knowledge that are necessary to help non-expert students learn. Martin's piece on five important teaching practices that can improve the quality of a training course:

Know Your Students

Write Learning Objectives

Include Practice and Feedback in the Training

Create Simple PowerPoint Slides

Design Test and Evaluation Measures that Promote Transfer.

Scientists at the U.S. Department of Energy's Lawrence Berkeley National Laboratory

(Berkeley Lab) are teaming with educators at the Peralta Community College District in Oakland, California to train community college students in the latest techniques of managing buildings for maximum energy efficiency [2]. The program will be for students in community college two-year programs who want to be heating, ventilation, cooling and refrigeration (HVAC&R) technicians, as well as for those in building facilities management programs.

Today's commercial buildings are complex super-systems that rely, not only on the efficient operation of individual equipment components, but also on sub-systems of these components, and on control systems [3].

Interesting curricula are the subject of several articles [4, 5, 6, 7].

2 The structure of the curriculum

The curriculum differs from the former ones in the complex approach to building and its systems that ensure indoor climate. It should be noted that in recent years, this approach is increasingly more applied around the world.

The curriculum consists of five teaching modules:

- The general and initial training module 17 ECTS
- The basic training modules 32 ECTS
 - Buildings and indoor climate
 - Electricity and energy
- The special training module
 - Designing buildings, engineering systems 32 ECTS
- Practice and free training modules 9 ECTS
- The thesis 30 ECTS
- Total 120 ECTS

The traditional initial courses in thermal engineering, electrical engineering, pumps and fans, energy engineering, intelligent buildings, buildings physics, buildings, indoor climate, sustainable energetics, corrosion control are about learning the engineering systems of the building (heating, ventilation, the heat supply of buildings, local boiler houses, air conditioning and cooling), as well as the renovation aspects (renovation of buildings, renovation of utilities).

The disciplines directly related to energy efficiency in buildings are:

- Planning of buildings and design of facades
- Energy efficiency and economic evaluation, planning and management
- Electric lighting, electric power and safety of buildings
- Modeling the thermal behavior of buildings

The process of completing the thesis is quite unique in Estonia. Every student gets one building to investigate in the second month (e.g. an existing office building or school building), a supervisor is assigned. Doing the thesis starts with getting acquainted with the technical documents. Then the indoor climate of the building is monitored in the course of one year (registering the indoor temperature and relative humidity during one year, the level of the CO₂ concentration is checked randomly, for schools in all classrooms), particle concentration analysis is done when needed.

Heating and ventilation systems are monitored: determining the performance of the heating system, checking the quality of air in the rooms and the work of the ventilation systems and if the air flow rates are as planned.

The quality of the envelope is checked with thermo cameras.

Data about the energy consumption during 1 to 3 years is obtained (heat for heating, heat for hot water, power consumption (lighting and equipment separately)), renovation work, which has been done, is determined.

Knowledge of energetic auditing and conducting audits is acquired during the studies. Students get acquainted with the energetic auditing methodology of buildings developed and patented in Estonia.

During the studies 1 to 2 simulation programs are learnt. Building plans are digitized.

A building model is compiled to carry out simulations. Simulations of the energy consumption and indoor climate of the building are conducted based on the heating and electricity consumption and the indoor climate data. Comparisons are made of various options. Technical and economic evaluation is given for the methods of increasing energy efficiency.

The student obtains certain experience in conducting research, which is vital to a future specialist in the field of energy efficiency of buildings.

An extensive program of compiling teaching materials has begun, the following books have been compiled (in the chronological order):

- Hot water in buildings
- Energy technology
- Corrosion protection
- Planning and design of the facades of buildings
- Renovation of buildings
- Heating of buildings
- Local boiler houses

Also visualizing tools will be provided and foreign teachers are involved in the learning process.

3 Conclusion

Training engineers of energy efficiency has become especially important. One of the goals of the new curriculum is to raise the engineer's awareness and competence in the field of energy efficiency to a new qualitative level.

The aim of the new curriculum is to raise the engineering competence in the field of energy efficiency to a new qualitative level. In a situation, where assuring and improving energy efficiency is becoming increasingly more important in the world, the need for energy consultants is clearly growing. The knowledge of energy efficiency has a significant potential to affect people's daily living as fully planned energy efficient solutions in buildings can reduce costs up to 30% and improve the living environment considerably.

The curriculum of the energy efficiency of buildings is a modern balanced curriculum, during which students gain the practical knowledge of an energy specialist.

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