4. SUSTAINABLE ENERGY PROGRAM

Program leader: **Prof. Dr. Ferenc Kalmár DSc**

The general aim of the program

The main goal of the program is expanding the basic- and applied research related to environmental conscious energy systems taking into account the international trends. The emphasized goal is to review of innovative and efficient energy supply and energy distribution solutions, presentation of recent knowledge and development of new methods improving the energy efficiency. This energy engineering program through the integration of solar radiation and geothermal energy sources in modern energy systems is tightly related to geosciences.
This training makes possible the development of new, complex and innovative architectural and building service engineering solutions minimizing the energy use of buildings or settlements.

Research fields of the program: building service engineering, the energy supply of settlements, building energy, integration of renewable energy sources in traditional energy systems, analysis, and utilization of innovative (super) insulation materials.

Role of already performed research in the program

The Sustainable energetics was founded in 2010 as a sub-program of Landscape protection and Climate program. The topics of already performed research works were chosen accordingly. The work of researchers attending the program is broad but energy efficiency is always in the focus. The research work performed in the Sustainable energetics program is related to the physical properties of building elements, building materials, the energy efficiency of heating, cooling, ventilation, air-conditioning and domestic hot water systems, optimization of operation of building service systems, utilization of renewable energy sources, modelling of building energy systems. Considering as one integrated system the built- and the natural environment, the sustainable energy supply of settlements and reduction of environmental pollution improving the efficiency of energy systems are in the focus of our program as well.

Key research topics

- analysis of thermophysical parameters of traditional and new insulation materials
- thermophysical properties of aerogel
- thermotechnical analysis of vacuum panels
- energy optimization of heating systems
- energy analysis of buildings' thermal insulation

- degree-day analysis
- buildings' heat load analysis
- energy analysis of cooling systems (with mechanical compressors and with thermochemical compressors)
- energy analysis of ventilation systems
- development of personalized ventilation systems
- turbulence analysis of occupational zone in mechanically ventilated buildings
- thermal comfort
-utilization of renewable energy sources
-modelling of energy systems with finite volume method

Key points of the program

Building energy

The research related to energy use in buildings, improvement of energy performance and identification of energy-saving possibilities is extremely important since out of 40% of the total energy consumption is realized in this sector. The energy demand of buildings is influenced by the climatic conditions and relief, thus even in small geographical areas, significant differences can be observed. Construction of nearly zero-energy houses is possible by applying appropriate architectural solutions and integrating efficiently the renewable energy sources. Using innovative solutions for building structures, the energy use of existing buildings can be reduced substantially. Utilization of modern so-called super insulating materials the strict thermos-physical requirements might be easily fulfilled. These materials are aerogel, ceramic paintings, vacuum panels or insulating materials with graphite admixture. These materials are not used on a large scale, so a series of investigations have to be done to identify the sensitivity of different physical properties of these materials in function of different environmental parameters. Nowadays, energy analysis is done using different simulation tools. Using the WINWATT, CASAnova, TRNSYS, ENERGY+, REVIT and ANSYS software researchers can easily do a series of investigations.

Building service systems

Providing a healthy indoor environment to occupants in buildings is indispensable. Developing new, innovative conceptions for heating, ventilation, air conditioning and domestic hot water systems important energy savings might be realized. Optimization of operation processes of building service systems, development of new, efficient equipment, energy analysis of heat transfer processes and hydraulics, energy and thermal comfort measurements, diagnostics of HVAC systems are important research areas of the program.

Urban energy systems

In the case of a settlement, besides the energy consumption and energy-saving possibilities, the available renewable energy sources have to be investigated. Minimizing the energy demand and integrating efficiently the renewable energy sources in the energy supply system of a settlement the energy dependency and the environmental pollution caused by the utilization of fossil fuels might be reduced substantially. Economic analysis has to be done at the same time, and life cycle analysis might offer the optimal solution for the energy supply of a settlement.

Research related to the utilization of renewable energy sources

Low enthalpy geothermal energy sources are available in different Hungarian regions and might be used efficiently for heating. The aims of the research related to the use of geothermal energy are related to the exploitation of heat content of thermal waters and utilization of heat pumps in the energy supply of settlements and buildings. Solar energy might be used for passive heating in buildings, preparation of domestic hot water, electricity production but even for cooling systems. Such systems might be implemented only after a complex energy-economic analysis to identify the most efficient solution which leads to the lowers environment pollution.

Courses of the program

- Building energy (Dr. Ferenc Kalmár)
- Comfort analysis of closed spaces (Dr. Ferenc Kalmár)
- Thermophysical properties of insulating materials (Dr. Ákos Lakatos)
- Energy conscious buildings (Dr .Imre Csáky)
- Energy analysis of ventilation and air conditioning systems (Dr. Imre Csáky)
- Modelling of energy processes (Dr. Ferenc Szodrai)
- Energy analysis of DHW systems (Dr. Tünde Kalmár)