Assessing heating and cooling energy needs in dynamic building simulation

Held by
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Venue: to be defined, according to the number of the students
Date: 16 hours
Thursday, September 10th 2020, 3:00 p.m. - 6:00 p.m.
Thursday, September 17th 2020, 3:00 p.m. - 6:00 p.m.
Thursday, September 24th 2020, 3:00 p.m. - 6:00 p.m.
Thursday, October 1st 2020, 3:00 p.m. - 6:00 p.m.
Thursday, October 8th 2020, 2:30 p.m. - 6:30 p.m.

Abstract

Recently, energy efficiency in buildings has become a popular topic, being the building sector one of the main user of final energy consumptions. Most of energy, in building sector, is used for space heating and cooling purposes. The assessment of the actual energy consumption for heating and cooling purposes, through the procedure of energy audit, is promoted by European Directives as a first step to identify the components, in a building-HVAC system, that are mainly responsible for high consumptions and so that can undergo refurbishment to achieve a higher energy efficiency.
Even if there are different methods to carry out an energy audit of a building, the most complete and accurate procedure is the full dynamic simulation, which evaluate the thermal-energy response of a building on an hourly (or less) time step. The procedure takes into account all the losses and gains of the building (e.g., ventilation and transmission thermal losses, internal gains, solar gains, effects of inertia of the envelope). Also the characteristics of the heating and cooling system (e.g., terminal units, distribution system, effect of different control types, efficiency of the generator) influence the overall efficiency of the building-HVAC system.

In this course, after an introduction about energy audits, two different methods for dynamic simulation in buildings will be presented. The first method aims to describe building envelope through a set of equations, using the indoor air temperature, external temperature, and the temperatures of the opaque walls/windows as "nodes" among which heat exchanges occur. The second method uses TRNSYS 17 software, which is one of the most widespread tool for dynamic simulation of building-energy systems. Finally, some methods for the post-processing of the data obtained through these methodologies will be discussed, aimed at presenting and highlighting the main results through typical plots and indexes.

The course is addressed to PhD students, post-doc researchers and anyone interested in exploring building energy audit through dynamic simulation. The course will include class exercises and live simulations.

Agenda

Day #1

Fundamentals of energy audit and introduction of envelope simulation through equation

- Legislative and regulatory background on energy audit
- Introduction of the building dynamic simulation through set of equations

Day #2

Fundamentals of energy audit and introduction of envelope simulation through equation

- Building dynamic simulation through set of equations: time-dependent profile of air internal temperature
- Building dynamic simulation through set of equations: time-dependent profile of opaque walls temperature (both exterior and interior nodes)

Day #3

Basic features of TRNSYS - TRNBuild

- Examples of dynamic simulation tools available for energy audit
- TRNSYS 17 setup
- Definition of envelope elements in TRNBuild

Day #4

Basic features of TRNSYS – Simulation Studio and case studies

- Definition of external climate and other boundary conditions
- Definition of HVAC system characteristics
- Examples and case studies

Day #5

Post-processing of the data

- Definition and evaluation of typical indexes for energy efficiency
- Creation of typical graphs and plots to represent the most relevant outcomes of the dynamic building simulation