Building Energy Modelling

Johann Ott

Hugh Melvin, Marcus Keane*

Disc. of Information Technology

*Disc. of Civil Engineering, IRUSE, Ryan Institute

College of Engineering & Informatics, NUI Galway

Abstract

The Energy Efficiency of the buildings in which we live and work is becoming increasingly scrutinized. A major problem is the amount and subsequent cost of unnecessary energy that buildings consume through heating, cooling, lighting etc. The tools available to evaluate building energy performance are currently inadequate. The objective of this research is to develop a building energy model along with data from a weather station on campus, to predict energy demand. Being able to predict the energy demand of a building will support the analysis of actual energy used and thus assist in identifying wastage and ultimately reducing energy consumption. The Nursing Library extension on campus at NUIG is to serve as the demonstrator building underpinning the energy model. An energy model is currently been developed using the Simulink software package. The main considerations for the model are the thermal characteristics of the building envelope, the building heating and cooling system and the outdoor environment. Simulation results will be compared to actual sensor readings of thermal and power loads in the building.

1. Introduction & Background

With the cost of energy rising there is an increased demand to develop and operate energy efficient buildings. Construction and energy managers are increasingly turning to technology to provide the answers. However, the tools available to evaluate building performance are currently inadequate. One of the major problems is the amount and subsequent cost of unnecessary energy that buildings consume.
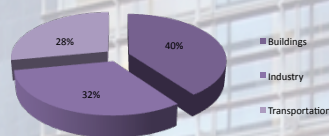
U.S. Energy Consumption 2008

- 40% Buildings
- 32% Industry
- 28% Transportation

Figure 1

"Buildings are responsible for 40% of energy consumption and 36% of EU CO_2 emissions. Energy performance of buildings is key to achieve the EU Climate & Energy objectives, namely the reduction of a 20% of the Greenhouse gases emissions by 2020 and a 20% energy savings by 2020." – European Energy Commission

2. Research Objectives

The objective of this research is to develop a building energy model that will be used together with data collected from an on-site weather station, to predict energy demand. The weather station has recently been installed on the NUIG campus and is been used to provide data for a number of energy related projects on campus. Being able to predict the energy demand of a building will help in the analysis of actual energy used and thus assist in identifying wastage and ultimately reducing the energy consumed. The Nursing Library Extension on campus will provide the basis for the building energy model. This building is fitted with a number of sensors that take readings for temperature and CO_2 levels. The actual thermal and power loads for the building are also measured. Simulation results will be compared to these actual readings.

3. Model Development

An energy model is currently been developed using Simulink, a tool in the MATLAB software package for modelling, simulating and analyzing multidomain dynamic systems. There is a large number of building energy modelling software packages available such as EnergyPlus, DOE-2 and BLAST. Simulink was preferred to these packages due to its adaptability and modularity. The main considerations for the model are the thermal characteristics of the building envelope, the building heating and cooling system and the outdoor environment. Figure 2 shows the block structure of the model. Figure 3 shows some simulation results.
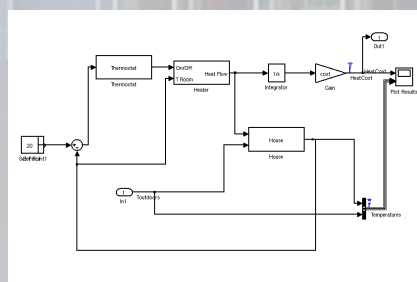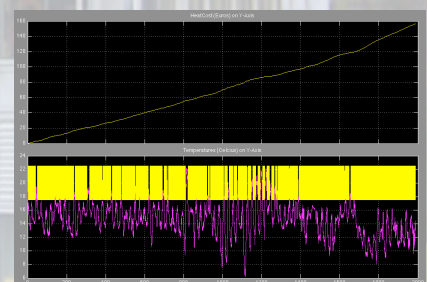

Figure 2

Figure 3

4. References

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IRUSE

NUI Galway
OÉ Gaillimh