Reducing Cooling Load of Buildings in the Tropical Climate through Window Glazing: A Model to Model Comparison

Arindam Dutta, Akash Samanta

www.elsevier.com/locate/jobe

PII: S2352-7102(17)30502-8
DOI: https://doi.org/10.1016/j.jobe.2017.12.005
Reference: JOBE377

To appear in: *Journal of Building Engineering*

Received date: 22 August 2017
Revised date: 4 December 2017
Accepted date: 9 December 2017

Cite this article as: Arindam Dutta and Akash Samanta, Reducing Cooling Load of Buildings in the Tropical Climate through Window Glazing: A Model to Model Comparison, *Journal of Building Engineering,* https://doi.org/10.1016/j.jobe.2017.12.005

Reducing Cooling Load of Buildings in the Tropical Climate through Window Glazing: A Model to Model Comparison

Arindam Dutta, Akash Samanta*
Indian Institute of Social Welfare and Business Management, Kolkata, India
**Corresponding Author's Email:arindamdutta190@hotmail.com*

Abstract

The comparison studies among various building simulation models are always the research interest for various researchers though most of them are based on a general overview. Here we compared two popular building simulation models TRNSYS & eQUEST for a multizone building to judge the relative accuracy of the models. The base case building having 1465.8 m^2 area is situated in a tropical climate zone of India. Both the models were validated with actual and simulated annual energy consumption data of the case building and a model to model comparison has also been performed. The RMSE values for both TRNSYS & eQUEST were found varying between 2.1% to 12.5% and the Relative Error was found varying -19.6% to 18.0% respectively. It was also found that TRNSYS predict more accurately the total energy consumption of building than eQUEST in this case study. However the main aim of this paper is to quantify the energy saving potential of five different type of single and double glazing glasses especially in case of tropical climate condition through two types of simulation models. Five different types of commercially available window glasses were designed using LBNL-Window7 simulation tool and validated with lab tested results. The percentage reduction of electrical energy consumption due to retrofitting of five types window glasses have also been presented separately for both the simulation models. Both the models revealed that SHGC is more dominating factor than U-value to reduce cooling load of building energy.

Keywords: TRNSYS17, eQUEST, Glazing, Electrical Energy Consumption, Relative Heat Gain, Spectrophotometer, HVAC

1. Introduction:

Building sector is the second largest primary energy consumer in India which consumes more than 30% of India's total electrical power. Very recently Government of India planned to build 100 "smart cities" with an immediate effect in order to extend better infrastructure and employment opportunities to the peoples of India which will lead to increase the build-space by five-fold within 2030. It has been estimated that by 2030 more than 60% of commercial buildings will be equipped with air-conditioner [1]. Over the past 60 years researchers have developed various energy simulation models such as mono-zone models, multi-room models, zonal models, Computational Fluid Dynamics (CFD) models and multi-zone models to reduce building energy consumption through whole building simulation program. Energy simulation tool such as EnergyPlus, Espr, TRNSYS etc. are powerful software program to predict energy performance of building (heating, cooling, artificial lighting etc.) [2]. EnergyPlus was developed by U.S. Department of Energy which is a newest generation simulation program, adds hundreds of new modeling features to building modeling simulation. EnergyPlus makes it possible to model more complex multizone building, however detailed and complex modeling make it much slower and time consuming [3]. ESPr is a general-purpose simulation environment, which supports an in-depth appraisal of the factors which influence the energy and environmental performance of buildings. ESPr was developed by the "Energy Systems Research Unit" of the "University of Strathclyde in Glasgow (ESRU)". The complex relationships between a building's form, fabric, air flow, plant control and integration of daylight utilization, natural ventilation can also be explored using ESPr. However, specialist features of the simulation tool require in-depth specific subject knowledge. The software also lacks the extensive databases associated with commercial tools and its interface also not much user friendly [4]. Henninger[5] explored the testing of EnergyPlus building energy simulation software using the IEA HVAC BESTEST E100–E200 series of tests. HVAC BESTEST is a series of steady-state tests for a single-zone DX cooling system. Korolijaa et al. [6] examined the relationship of building heating and cooling load and subsequent energy