Modelling Complex Fenestration Systems in TRNSYS – a Comparison between a Simplified and a Detailed Thermal Model

- Energy demand, thermal and visual comfort analysis of Complex Fenestration Systems (CFS) with TRNSYS
- Integrated and coupled energy and daylighting simulation
- Comparative case study of two calculation models characterizing the thermal behavior of a shading device

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Abstract

This work compares two calculation models for the CFS performance simulation within the software TRNSYS: the first is the standard model for fenestration systems adapted to work also with CFS; the second is a more detailed model, which is currently released as prototype. While the standard model uses a simplified approach based on the shading factor, the new model follows the standard ISO 15099 which is based on the radiosity method and takes into account the Bidirectional Scattering Distribution Function (BSDF) for the shortwave solar radiation. The aim is to assess whether a more detailed model leads to perceptibly different results and thus is worth the effort.

Starting from a refurbishment project of a shopping mall in Italy, the two approaches are compared by evaluating ideal energy demand, thermal comfort and visual comfort on an hourly basis. A single thermal zone is used. The west façade of the zone is fully glazed. Double windows with solar control and external venetian blinds with variable slat angle compose the CFS.

Besides the comparison of the two calculation models, two different control strategies for the shading device are investigated. The first control aims at maintaining visual comfort. The second control aims at improving the thermal comfort and reducing the energy demand.

In order to consider the effects of the CFS on the visual comfort, we developed a novel TRNSYS Type called “TypeDLT”. The Type can perform climate-based daylighting simulations using the Radiance engine and implements the “three-phase method” to compute the indoor illuminance

values at each simulation time-step. It takes as input the BSDF data for each state of the CFS, determined by the slat angle of the blinds, and the weather file from the TRNSYS model. A user-defined strategy controls the shading state according to specified performance targets (e.g. desired comfort temperature or illuminance), thus allowing the simulation of an automatic shading control.

Key words: complex fenestration system, thermal modelling, BSDF, TRNSYS, coupled daylighting and energy simulation, thermal and visual comfort

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