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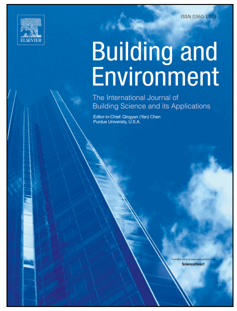

Optimization of glazing systems in non-residential buildings: The role of the optical properties of air-conditioned environments

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OPTIMIZATION OF GLAZING SYSTEMS IN NON-RESIDENTIAL BUILDINGS: THE ROLE OF THE OPTICAL PROPERTIES OF AIR-CONDITIONED ENVIRONMENTS

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ABSTRACT

Highly glazed envelope in non-residential buildings are usually designed to have more access to daylight and to offer better visual comfort. However, large windows allow for the transfer of remarkable heat gains and thermal losses that affect the building energy consumptions. Because the latter represent the majority of operating expenses, in the design phase an appropriate window size and a suitable glass typology have to be identified to achieve energy and economy savings. In this paper, a simplified procedure to determine the optimal glazed system in function of the sensible and latent energy requirements, is proposed. The calculation of the involved energy requirements has been carried out by the quasi-steady procedures described in the international standard ISO 13790, but employing a novel steady-state model to calculate the transmitted solar radiation through windowed surface. An absorption coefficient of the indoor cavity, in fact, was introduced to take into account the fraction of the solar radiation transmitted through the windows that, after mutual internal reflections, escapes outside from the same glazed surfaces. In building envelopes equipped with large glazed surface, this fraction cannot be neglected because it does not become a thermal load for the indoor environment. The same calculations were carried out considering also the air-conditioned volume as “black” to the transmitted solar radiation in order to evaluate the weight of the cavity absorption coefficient on the choice of the glazed system.

keywords: window, solar gains, optical properties, energy savings, quasi-steady procedure

Nomenclature

A	Surface area [m²]
F	Reduction factor [-]
f	Operation time factor
G	internal water vapor mass flow rate [g_{WV}/h]
g	total solar energy transmittance or solar factor [-] (from EN ISO 410)
h	specific enthalpy [kWh/kg]
I	Incident solar irradiation [kWh/m²] per day
N	Number of days per month[-]
q	secondary heat flux coefficient [-]
Q	Energy demand [kWh]
T	temperature [°C]
t	time constant [h]
U	thermal transmittance [W/m²K]