

# Passive Thermal Control for Window Insulation

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## Abstract

A definite requirement of the building envelope is to separate the natural environment from the indoor environment. Energy is one component of the environment that we sometimes wish to capture, harness, or reject. How can these actions be best performed to yield passive benefits such as solar heating or shading?

This research focuses on control of thermal radiation energy, and the role windows play as transfer medium between indoor and outdoor environments. A novel concept for passively controlling solar thermal energy input, and building thermal energy output with the use of operable insulation is explored during the heating season.

This is done through a combination of finite element mathematical modeling using COMSOL Multiphysics® software (Heat Transfer Module), field performance testing, and theoretical design/modeling for validation of this concept. Modeling and field testing revealed an energy imbalance attributed to unpredictable solar gains and spectrally dependent emissivity of materials. Simulation results of the concept reveal improvements that translate to reduced heating load requirements over the tested normal static, or less commonly used daily-cycle systems.