

Numerical Solution for Ventilated Facade Heat Transfer in Building Energy Analysis

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Abstract: This project aims to integrate a custom heat transfer model for ventilated facades into a building energy simulation software called EnergyPlus [?]. The primary focus is to formulate the equations describing the temperature variation along the ventilated facade, considering atmospheric conditions, wall temperature, facade geometry and materials. The system of nonlinear equations posed is solved along with the heat conduction transfer equations using Conduction Transfer Functions (CTFs) [?].

Subsequently, the thermal behaviour is modeled within the ventilated channel, incorporating the influence of the air mass flow due to wind and natural convection. This was accomplished through an energy balance analysis between the internal and external conditions of the channel, including conduction, convection and radiation as well as a mass balance analysis within the cavity of the ventilated facade. The core challenge lies in the interdependencies among variables, requiring a systematic approach to solve the system of equations. A nested loop strategy, combining two additional numerical methods tailored to problem requirements, was implemented: successive approximations and the bisection method. As a result, the three combined and tuned numerical methods proved to be highly effective and convergent, enabling a robust numerical framework to simulate energy transfer in buildings with ventilated facades using EnergyPlus [?].

References:

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