

Simulation-Based Evaluation of Indoor Air Quality and Comfort Control in Non-Residential Buildings

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Abstract : Simulation of thermal and electrical building performance more and more becomes part of an integrative planning process. Increasing requirements on energy efficiency, the integration of volatile renewable energy, smart control and storage management often cause tremendous challenges for building engineers and architects. This mainly affects commercial or non-residential buildings. Their energy consumption characteristics significantly distinguish from residential ones. This work focuses on the many-objective optimization problem indoor air quality and comfort, especially in non-residential buildings. Based on a brief description of intermediate dependencies between different requirements on indoor air treatment it extends existing Modelica-based building physics models with additional system states to adequately represent indoor air conditions. Interfaces to corresponding HVAC (heating, ventilation, and air conditioning) system and control models enable closed-loop analyzes of occupants' requirements and energy efficiency as well as profitability aspects. A complex application scenario of a nearly-zero-energy school building shows advantages of presented evaluation process for engineers and architects. This way, clear identification of air quality requirements in individual rooms together with realistic model-based description of occupants' behavior helps to optimize HVAC system already in early design stages. Building planning processes can be highly improved and accelerated by increasing integration of advanced simulation methods. Those methods mainly provide suitable answers on engineers' and architects' questions regarding more exuberant and complex variety of suitable energy supply solutions.

Keywords : indoor air quality, dynamic simulation, energy efficient control, non-residential buildings

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