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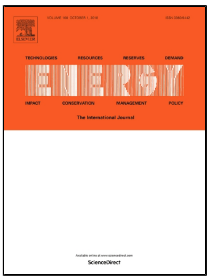

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Linking design and operation performance analysis through model calibration: Parametric assessment on a Passive House building

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Abstract

Efficient buildings are an essential component of sustainability and energy transitions, which represent today a techno-economic and socio-economic problem. New paradigms are emerging both for new and existing buildings (e.g. NZEBs) and passive design strategies are becoming increasingly common. However, the adoption of these strategies in mild climates has to be carefully evaluated to prevent overheating in intermediate seasons and increasing cooling loads in summer, considering also climate change scenarios. Additionally, optimistic assumptions about building technology performance are often considered and the variability of occupant comfort preferences and behaviour is generally neglected in the design phase. The research presented aims at verifying the suitability of a simple, robust and scalable calibration approach (based on multivariate linear regression) to link design and operational performance analysis transparently, using a Passive House case study building. First, the original baseline design configuration is compared with a larger spectrum of data generated by means of parametric simulation, following a Design of Experiment (DOE) approach. After that, regression models are trained first on simulation data and then progressively calibrated on measured data during a three year monitoring period. The two fundamental objectives are evaluating the robustness of design phase performance analysis through parametric simulation (i.e. detecting potentially critical assumptions) and maintaining a continuity with operation phase performance analysis (i.e. exploiting the feed-back from measured data).

Keywords: Parametric modelling; behavioural modelling; building performance simulation; Passive House; performance monitoring; multivariate regression.

Highlights:

- Buildings are a relevant element in sustainability transition policies.
- Rigorous schemes for energy efficiency are important tools for designers.
- Robustness of performance estimates has to be considered in design phase.
- Design and operational performance analysis have to be linked transparently.
- Automated model calibration is necessary to ensure long-term performance monitoring.

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