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The Influence of Design Complexity of a Building Structure on the Expected Performance

Authors : Ormal Lishi

Abstract : This research presents a computationally efficient probabilistic method to assess the performance of compartmentation walls with similar Fire Resistance Levels (FRL) but varying complexity. Specifically, a masonry brick wall and a light-steel framed (LSF) wall with comparable insulation performance are analyzed. A Monte Carlo technique, employing Latin Hypercube Sampling (LHS), is utilized to quantify uncertainties and determine the probability of failure for both walls exposed to standard and parametric fires, following ISO 834 and Eurocodes guidelines. Results show that the probability of failure for the brick masonry wall under standard fire exposure is estimated at 4.8%, while the LSF wall is 7.6%. These probabilities decrease to 0.4% and 4.8%, respectively, when subjected to parametric fires. Notably, the complex LSF wall exhibits higher variability in predicting time to failure for specific criteria compared to the less complex brick wall, especially at higher temperatures. The proposed approach highlights the need for Probabilistic Risk Assessment (PRA) to accurately evaluate the reliability and safety levels of complex designs.

Keywords : design complexity, probability of failure, monte carlo analysis, compartmentation walls, insulation
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