Coupled Fire-structure Simulations for Thin-walled Steel Sandwich Panels: Bolts and Screws, Pyrolysis, and Experimental Verification

Prof Herm Hofmeyer

Associate Professor, Dept of Built Environment, Eindhoven University of Technology, Netherlands

Abstract: Simulations exist for the prediction of the behaviour of building structural systems in fire, including two-way coupled fire-structure interaction. However, they do not include detailed models of the connections, although they may seriously impact the overall structural behaviour. Therefore, this presentation proposes a two-scale method to include bolt and screw connections. For bolt and screw failure modes, load-deformation behaviour and failure predictions of the two-scale method are verified by a detailed system model and Eurocode design rules. The two-scale method is insightful as it contains a functional separation of scales, revealing their relationships, and it is computationally efficient. Furthermore, local small-scale non-convergence (e.g. a screw failing) can be handled without convergence problems in the global-scale structural model. Secondly, a modelling approach is presented to predict the thermodynamical and thermomechanical behaviour of structures with composite material in fire, which takes into account the pyrolysis of the composite material and its effects on the overall structure. Results show that by including pyrolysis, being an endothermic phenomenon, panel failure is postponed. It is also shown that for the case studied, the difference between one-way and two-way coupled simulations (i.e. including the effect of structural behaviour on fire) is less relevant than the inclusion of pyrolysis. Finally, the quality of simulations for combined situations is investigated, i.e. a furnace fire on a set of panels including details and connections, which led to some important findings relating to fire tests and simulations.

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Location: GP-S301   **Contact:** Prof Mahen Mahendran email: m.mahendran@qut.edu.au

Speaker: Hèrm Hofmeyer is an Associate Professor in the Dept of Built Environment at Eindhoven Univ. of Technology. He enthusiastically focuses on two types of research. The first, Computational Structural Design, involves the application of Computer Science to building structures and their design process. Unique developments include automated zoning, iterative structural grammars, stabilization, generation of conformal geometries, simulations of co-evolutionary design processes, and structural and topology optimization. Applying the high standards of Applied Mechanics, these developments are verified with additional implementations, genetic algorithms, & case studies from practice. The second type of research is related to the application and further development of the FE method for structural engineering. Using experimental data and theories, dedicated FE models are developed to obtain in-depth knowledge on structural behaviour.

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