Consolidated Testing – Framework for thermo-mechanical modelling

Patrick Schulthess, ETH Zurich, Stefano-Franscini-Platz 5, 8093 Zürich, Switzerland, *schulthess@ibk.baug.ethz.ch*

Martin Neuenschwander, ETH Zurich, Stefano-Franscini-Platz 5, 8093 Zürich, Switzerland, *neuenschwander@ibk.baug.ethz.ch*

Markus Knobloch, Ruhr-Universität Bochum, Universitätsstrasse 150, 44801 Bochum, Germany, *stahlbau@ruhr-uni-bochum.de*

Mario Fontana, ETH Zurich, Stefano-Franscini-Platz 5, 8093 Zürich, Switzerland, *fontana@ibk.baug.ethz.ch*

This paper presents a framework for thermo-mechanical modelling in structural fire engineering. The presented approach enables analyzing global structural fire behavior by taking advantage of the possibilities of advanced numerical modelling in combination with physical sub-modelling. Additionally, it facilitates considering complex temperature- dependent interactions between structural components, like load redistribution, change of structural system, failure of individual components. Furthermore, it allows taking into account specific material properties in fire like temperature induced material non-linearity, strain rate effects and thermal strains.

The key parameters for the development of the proposed consolidated framework for structural fire engineering were first studied with a hybrid model featuring a numerical sub-model. This technique allowed including state-of-the art knowledge in structural fire engineering and former experimental research on material and component behavior under fire conditions performed at ETH Zurich. The results of this preliminary study indicate that consolidated thermo-mechanical modelling should account for thermal strains and strain rate effects. Based on these findings a benchmark problem for advanced thermo-mechanical consolidated modelling was developed. This benchmark problem enables the validation of the framework for consolidated fire testing and design by a full-scale experimental study.