6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

LINKED SIMULATION FOR FIRE-EXPOSED STRUCTURES USING CFD AND THERMO-MECHANICAL MODELS

S. Šulc[1*], V. Šmilauer[2] and F. Wald[3]

[1] CTU in Prague, Faculty of Civil Engineering, Department of Mechanics, Thakurova 7/2077, 166 29, Prague, CZ, stanislav.sulc@fsv.cvut.cz

[2] CTU in Prague, Faculty of Civil Engineering, Department of Mechanics, Thakurova 7/2077, 166 29, Prague, CZ, vit.smilauer@fsv.cvut.cz

[3] CTU in Prague, Faculty of Civil Engineering, Department of Steel and Timber Structures, Thakurova 7/2077, 166 29, Prague, CZ, wald@fsv.cvut.cz

Keywords: *Thermo-Mechanical Model, Virtual Furnace, Computational Fluid Dynamics, Multiphysics, Fire Resistance, Validation, OOFEM, Fire Dynamics Simulator*

Structural fire assessment creates essential part in design and maintenance of steel, concrete or timber structures. Expensive empirical tests carried out in furnaces with gas burners present traditional approach. This article presents linked computational approach for fire simulation and its effects on structure using adiabatic surface temperature approach.

The simulation solves a weakly-linked problem, consisting of computational fluid dynamics (CFD), heat transfer and mechanical model. The temperature field from the CFD creates Cauchy and radiative boundary conditions for the thermal model. The temperature field from an element is passed further to the mechanical model, which induces thermal strains and modifies material parameters.

CFD model uses Fire Dynamics Simulator (FDS) code [2] and the thermo-mechanical task runs in OOFEM code [1]. Both codes are interconnected with MuPIF's API python library [3], which transfers simulation data, exports them to VTK data formats, and orchestrates simulation runs.

This article also presents a validation of this linked simulation on wood and concrete elements exposed to fire, which confirms good accuracy of the computations, considering all the aleatory impacts and imperfections of the experiment.

REFERENCES

[1] B. Patzák, *OOFEM - an object-oriented simulation tool for advanced modeling of materials and structures*, project homepage URL http://www.oofem.org/, 2018.

[2] NIST, *FDS - Fire Dynamics Simulator*, project homepage URL http://www.pages.nist.gov/fds-smv/, 2018.

[3] B. Patzák, V. Šmilauer, V. Šmilauer, M. Horák and G. Pacquaunt, *Multi-Physics Integration Framework - MuPIF 2.0*, project homepage URL http://mupif.org, 2018.