Scientific report

STSM Topic: Numerical analysis of steel structures under fire conditions
Short Term Scientific Mission, COST Action TU0904
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Host: Burgess Ian, University of Sheffield
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The main purpose of the STSM was the collaboration of the PhD student with the scientific team of University of Sheffield, concerning the progressive collapse analysis of steel structures under fire conditions. The robust static-dynamic procedure that is developed by the University of Sheffield is a powerful tool for the analysis of structures under fire. This development extends the capability of the Vulcan software for modelling the fire behaviour of steel buildings, taking into account local and global instabilities. The progressive collapse of steel structure under fire is a crucial point of the thesis of the PhD student, since her thesis concerns the behaviour of steel model framed structures under fire conditions after earthquake events.

During the STSM, the PhD student developed a three-dimensional numerical model of a fourth-storey steel building using the code of University of Sheffield. Specifically, three-dimensional beam elements were used in order to simulate the fire behaviour of the steel building. Special consideration was given to the simulation of the connections, in order to take advantage of the full capabilities of the software. The user of the code can simulate the behaviour of the steel joints using special spring-elements that are available. In this way, the joints can be considered as rigid, semi-rigid or pinned, using the appropriate moment-rotation curves. Additionally the user can specify criteria for the failure of the steel connections. At the first stage the steel connections of the fourth-storey steel building are considered to be rigid. The ISO fire curve was used for the analysis. In parallel, the same numerical model was developed using the non-linear finite-element code MSC Marc. It should be noted that the PhD student uses the aforementioned code for the purposes of her thesis. Considering this simulation, the basic assumptions were the same, comparing with the corresponding ones that were used in the analysis with Vulcan software. The numerical simulation was based again on three-dimensional beam elements and the problem was handled through coupled thermo-mechanical analysis. The comparison of the results that are coming from the different codes showed good agreement. The next step, which was not accomplished during the STSM, will be to consider the steel connections of the fourth-storey steel building to be semi-rigid. The cooperation will be continued through e-mail. Parametric analysis will be conducted

in order to to reveal the benefits of the utilization of semi-rigid connections under fire loading and to study the progressive collapse of structures under the same loading. The results of the analysis can be the base for the calibration of the numerical models that are developed through the finite-element code MSC Marc.

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