[COST] Action TU0904 STSM:
Application of Structural Fire Engineering to steel frame structures

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Scientific report

Some large structures can be very sensitive to localised heating cases and the introduction of large compression forces due to thermal expansion. These additional compression forces can produce buckling of individual space frame members, which can lead to progressive collapse of the structures at relatively low temperatures and therefore much earlier than what is normally assumed. This potential for early and unexpected collapse could expose escaping occupants and fire fighters to unacceptable risks. Therefore, the progressive collapse have to be avoided. In order to check the non-progressive collapse, as some regulation imposes, 3D structural behaviour including the post-local failure stage should be analysed.

During the Short Term Scientific Mission, in London at Buro Happold from August 26th to September 6th under the supervision of Florian Block and Thomas Lowry, the applicant Iolanda Del Prete studied a complex problem of a realistic space frame roof, exposed to uniform and localized heating. This form of construction is frequently used for roof structures of large exhibition halls, which due to their size have often extended travel distances so that evacuation and search and rescue mission are longer than normal. These extended evacuation times are then frequently justified by using performance-based designs combining people flow and smoke modelling assuming the roof structure will not reach the commonly assumed failure temperature of 550°C.

Some calculation models, such as SAFIR and VULCAN, have been compared in order to carry out a benchmark study, titled ***"Structural Fire Engineering Benchmarking of Columns and Space-Frames using VULCAN and SAFIR"***, which will be presented during the next Cost meeting to be held in Aveiro in October 2013.

The benchmark study will be divided into two stage.

In the first stage, a simple problem of columns, exposed to a linear increasing of temperature and uniform heated, analysed through SAFIR and VULCAN, will be shown, in order to establish how good the agreement is for simple cases.

In the second stage, the results of dynamic analysis carried out in SAFIR, with reference to a space frame roof, will be shown.

While the SAFIR dynamic analysis has enable to analyse the structural behaviour after the buckling and so the post-local failure stage, in VULCAN after a frame's buckling is necessary to remove it and restart the analysis. Therefore the main difference between SAFIR and VULCAN, in terms of global resistance time and structural behavior will be shown.

Iolanda Del Prete