APPLICATION OF FIRE SAFETY ENGINEERING IN A TALL BUILDING

Iolanda Del Prete

Department of Structures for Engineering and Architecture, University of Naples Federico II, Naples, ITALY

This presentation is devoted to the application of Structural Fire Engineering to a tower, with office use, according to Italian and European Codes. The tower is 101.00m high and has 29-storeys above the ground; the structure has steel beams and columns and a reinforced concrete core.

The aim of fire safety assessment concerns the mechanical resistance and stability in fire situation of the tower. In agreement with Fire Brigades, the performance level assumed for fire safety check of the structure is: “maintaining of the fire resistance requirements, which ensure the lack of partial and/or complete structural collapse, for the entire duration of the fire”. In addition, with reference to the most probable fire scenarios, which involve the effectiveness of active protection systems, a limited structural damage after the fire exposure is also required.

The design fire scenarios are identified applying the concepts of the Fire Risk Assessment, through the event tree approach according to ISO-16732 Guidelines. A fire scenario in an event tree is given by a time-sequence path from the starter condition through a succession of intervening events till to an end-event. Each fire scenario corresponds to a different branch of the event tree, therefore the branches represent all fire scenarios. The main events, which may affect the development of the fire, are taken into account in the risk assessment. In particular, first aid suppression, alarm activation (smoke detectors), sprinklers activation, sprinklers suppression and barrier effectiveness are considered. Moreover, secondary events, such as doors and windows state as well as the location of fire ignition, are implicitly taken into account in the fire model.

The post-flashover fire is modelled by one-zone model and CFD model, applying Ozone (provided by University of Liegi), C-Fast and FDS (provided by NIST) softwares.

In order to evaluate the structural fire safety, Italian and European Codes allow the global structural analysis, the analysis of part of the structure (substructure analysis) and the analysis of a member (single member analysis). In the case study, due to the building’s large size, in order to reduce the computational time, the substructure analysis is adopted. The static scheme of the building allows to define simple substructures, which are able to represent the global structural behaviour. Note that the structural static scheme does not produce significant indirect actions.

The results of the structural analyses under the highest risk fire scenario show that no relevant plastic strains occur in the structure, thanks to passive protection systems, avoiding structural collapse. Moreover, in the most probable fire scenario, characterized by sprinkler activation, the temperatures in the structural members are very low, so that no significant structural damages are achieved.