Post-earthquake fire resistance of steel buildings - DTU Orbit (07/12/2018)

Post-earthquake fire resistance of steel buildings
Current design procedures do not account for the concomitant or subsequent occurrence of earthquakes and fires, which has so far been justified by the low probability of occurrence of accidental actions. Nevertheless, fires are often triggered as a consequence of damage caused by the earthquake and are responsible for casualties and major additional damage to buildings and other constructions. Despite a number of research studies on the topic, it is at present unclear as to what extent the occurrence of a previous earthquake could affect the response of a structure to fire.

The response of a moment-resistant steel frame to post-earthquake fires (PEFs) is investigated and compared with the response of the undamaged frame exposed to fire only, by means of numerical analyses performed using a commercial finite element software. The frame considered as a case study is not insulated against fire, but it is designed to comply with the service damage limitation prescribed in EN1998-1 (2004). The nonlinear seismic response to 7 different earthquakes, scaled at the same peak ground acceleration (PGA), is analyzed; then two of these earthquakes are selected for the post-earthquake fire (PEF) computations and a number of critical fire scenarios are identified, based on the vicinity of the fire to the highest permanent deformation induced by the earthquakes. The structural elements involved in each fire scenario are considered to be exposed to a standard fire and the collapse mode and time are determined by means of large deformation analysis.

The comparison of the mode and time of the frame collapse for all the investigated scenarios shows a minor influence of the effect of the two considered earthquakes on the fire resistance of the frame. The current study shows that nonlinear geometric effects do not have a significant effect in the behavior of the building during fire, when the structure is designed to comply with the service damage limit states prescribed in EN1998-1 (2004).

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