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A Study on the Failure Modes of Steel Moment Frame in Post-Earthquake Fire Using Coupled Mechanical-Thermal Analysis

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Abstract : Post-earthquake fire is considered as a major threat in seismic areas. After an earthquake, fire is possible in structures. In this research, the effect of post-earthquake fire on steel moment frames with and without fireproofing coating is investigated. For this purpose, finite element method is employed. For the verification of finite element results, the results of an experimental study carried out by previous researchers are used, and the predicted FE results are compared with the test results, and good agreement is observed. After ensuring the accuracy of the predictions of finite element models, the effect of post-earthquake fire on the frames is investigated taking into account the parameters including the presence or absence of fire protection, frame design assumptions, earthquake type and different fire scenario. Ordinary fire and post-earthquake fire effect on the frames is also studied. The plastic hinges induced by earthquake in the structure are determined in the beam to the column connection and in panel zone. These areas should be accurately considered when providing fireproofing coatings. The results of the study show that the occurrence of fire beside corner columns is the most damaging scenario that results in progressive collapse of structure. It was also concluded that the behavior of structure in fire after a strong ground motion is significantly different from that in a normal fire.

Keywords : post earthquake fire, moment frame, finite element simulation, coupled temperature-displacement analysis, fire scenario
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