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Numerical Study on Post-earthquake Fire Behavior of Hollow Tubular Sections Filled with Concrete Under Non-uniform Heating

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Abstract

Following an earthquake, a building's capacity to withstand fire greatly diminishes, while the probability of fire breaking out also significantly increases. It is known that fire in the aftermath of an earthquake can severely damage buildings, but the topic has not been explored extensively. In this numerical study, using ABAQUS, a tool for finite element-based analysis, the effect of post-earthquake fire on the behavior of concrete-filled steel tube (CFST) columns is investigated. The numerical modelling procedure included earthquake analysis, heat transfer analysis, and structural analysis steps. To mimic seismic behavior, a cyclic analysis was performed first, and its output, measured in the form of residual deformations, was then fed into a nonlinear thermal stress analysis performed in a subsequent step. The available literature on large-scale testing of CFST columns under cyclic and thermal loading conditions was used to first verify the accuracy of the simulated numerical model. This was done in order to ensure that the model was accurate. Following that, the validated FE model was utilized to predict the behavior of the CFST column when subjected to multilevel loading scenarios such as fire followed by an earthquake. According to the findings, the column with residual deformation exhibited a lower degree of resistance to fire than the column that had not been damaged.

Keywords: Finite element analysis, Structural fire behavior, Steel-concrete composite columns