Research Project Highlight

Post-earthquake Fire Performance of Industrial Facilities

Project # 1139-NCTREF

Principal Investigator
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Research Team

Start-End Dates:
8/1/2018-8/1/2019

Abstract
This project is a seed project that will produce results necessary for a much larger scope project on performance-based earthquake and fire engineering. The scope of the project includes evaluation and investigation of the post-earthquake fire performance of industrial facilities. The investigation will use OpenSees. Previous researchers have demonstrated good results using OpenSees for multi-hazard evaluation of buildings. Post-earthquake fires tend to cause more damage than the earthquake itself. In the case of the 1906 San Francisco and the 1923 Tokyo earthquake, 80% of the damage was caused by post-earthquake fires. A variety of ground accelerations will be used and combined design fire scenarios developed using performance-based fire engineering approaches. The varying ground accelerations will cause varying degrees of damage to the building during the earthquake phase of the simulations. Varying ground accelerations will allow the researchers to quantify how much additional damage is caused by the fire versus the earthquake ground motion. This work will integrate seismological, multi-hazard, and socio-economical aspects of earthquake and fire engineering to improve emergency management and the resilience of communities. Cities on the west coast of the United States are quantifying the economic impacts of post-earthquake fires on their communities. The proposed research project would work with practitioners to communicate the results and develop retrofit strategies that improve the performance of buildings in post-earthquake fires and are able to be implemented by contractors.

Deliverables
A PEER report and several conference and journal papers describing the analyses and results.

Research Impact
The losses from post-earthquake fires can be comparable to those experienced only from earthquakes. Typical building design allows for plastic deformation of the building and does not require fire suppression systems to be operable after an earthquake. This type of design approach leaves many structures vulnerable to post-earthquake fires without the capability of operational automatic fire suppression systems. In addition, if a building has already experienced plastic deformations, the structure is already weakened and potentially has residual deformations when the fire initiates. As both the earthquake and fire engineering fields move toward performance-based fire engineering approaches,

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more buildings may be designed to have operational fire suppression systems post-earthquake and limited plastic deformation of the structural system; however, there are still many vulnerable existing buildings in high seismic regions that have not designed with performance-based engineering practices in mind. This work has direct impact on the structural engineering and emergency management practice. Through evaluation of industrial facilities in post-earthquake fires, this project will identify the vulnerable components of these facilities and targeted improvements that can be made. The results of this research can provide important information regarding emergency management of cities and communities. By identifying types of structures vulnerable to collapse or partial collapse in post-earthquake fires, communities can realistically plan for their recovery after a disaster. The results of this research project would be the foundation for a much larger project that uses OpenSees to evaluate critical transportation infrastructure for post-earthquake fires. The results of the research would contribute to both the performance-based earthquake engineering and performance-based fire engineering design methodologies.

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