Presented at Engineering Mechanics Institute Conference EMI 2015, Stanford University, USA

Resiliency of a Community of Buildings to Fire Following Earthquake

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Cascading multi-hazard events, such as fires following an earthquake, can trigger progressive collapse of structures. In cascading earthquake and fire events, buildings that may have already experienced damage due to a primary earthquake hazard, should cope with a secondary extreme event. This work provides a methodology to evaluate the risk of fire ignitions after an earthquake and building responses in a community. The work has two components: In the first part, a model is developed for predicting the probability of ignition in a building due to an earthquake. This probabilistic model relies on the data from seven significant earthquakes that took place in the U.S. between 1983 and 2014. The main parameters influencing the probability of ignition are found to be the peak ground acceleration, the type of building material, and the main features of the environment in which the buildings are located (i.e. the total square footage and the population density). In the second part of this work, fragility curves are developed for performance of structures under fire, to quantify the probability of exceeding a damage state given a fire scenario. The probabilistic ignition model is implemented in Ergo, a GIS based risk assessment software platform developed at the Mid-America Earthquake Center at UIUC. Ergo provides the probability of ignition after an earthquake for each building in a region of study, and the overall risk for the community. The developed package in Ergo is validated against number of historical fire following earthquake events. For the future work, the developed fragility curves for buildings under fire will be implemented in Ergo to integrate the probability of ignition and possible damage states of the buildings. This research integrates multi-hazard analysis and risk management to plan mitigation and recovery strategies, and to obtain resilient communities.

Keywords: Fire following earthquake, fire ignition, probability, fragility curves, community.