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Social Impacts of Emergency Shelter Provision in the aftermath of Earthquakes: Integrating Social Vulnerability in Systemic Seismic Vulnerability Analysis

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For planning of public shelter provisions in the aftermath of earthquakes the expected number of homeless persons and people seeking public shelter is an essential input for emergency managers. Earthquake loss estimation software such as HAZUS calculate displaced populations as a linear function of building damage states (i.e. it is assumed that all people residing in collapsed buildings and 90% of the population residing in extensively damaged multi-family homes are displaced). Poor linkages between damage to physical systems and resultant social consequences remain a significant limitation with existing hazard loss estimation models. A new approach for modeling demand for emergency shelter and housing caused by earthquake damage which integrates social vulnerability into the modeling approaches is presented. The focus here is to obtain shelter demand as a non-linear consequence of building habitability and social vulnerability of the affected population rather than building damage alone. The shelter model simulates households' decision-making and considers physical, socio-economic, climatic and spatial factors in addition to modeled building damage states. Thus a new advancement to shelter estimation methodology is being explored through a systemic seismic vulnerability approach where building vulnerability functions (fragility curves) are adjusted by a set of factors including loss of utilities (water, gas or electricity), climatic conditions and socio-economic characteristics of the building occupants. When combined together these factors provide information on the habitability of a building and can be used as a better determinant in influencing the decision to evacuate than building damage alone.

The modelling framework developed allows for the formal integration of common quantitative approaches used in earthquake loss estimation and social vulnerability models often limited to conceptual frameworks. To operationalize the shelter model, appropriate indicators from the EU Urban Audit Database have been selected using principal component analysis combined with expert judgement. The objective here is development of a flexible data model harmonized with available data in Europe for the selection of sub-city district level indicators for urban-level applications of post-earthquake shelter needs. Vulnerability factors deduced from the EU Urban Audit will be validated by applying the model using data from the M 6.3 earthquake that struck L' Aquila, Italy in April 2009.