

## **Insight into the derivation of empirical fragility approaches: a contribution towards the updated Italian seismic risk assessment**

Recent analysis made worldwide have revealed a steady increase in impacts due to natural hazard-related disasters on the economic, social, health, cultural and environmental sectors (UNDRR, 2020: The human cost of disasters), probably ascribable to the increasing exposure of people and assets in all countries faster than vulnerability has decreased (Sendai Framework for Disaster Risk Reduction 2015–2030). Italy is one of the European countries characterized by the highest seismic risk, due to the considerable contribution played by each component, i.e. seismic hazard, vulnerability (as a consequence of the strong criticalities of existing assets) and exposure (because of the high population density and of the valuable historical, artistic and monumental heritage).

Against this background, a steady interest among researchers in the topic of seismic fragility assessment has produced an abundant published literature in last years. This course provides a state-of-the-art review of the main approaches on this topic, specifically for those empirically derived. The main criticalities in their derivation are detailed discussed, focusing on the reliability of data ensuing from coverage and response error and the main solutions addressed to tackle them are also presented. The debate will entail the parameters used for ground motion characterization, the functional forms and the different methodological approaches adopted for their derivation. The course also examines the open challenges and identifies opportunities for future development in the field, in determining the efficiency and sufficiency of empirical fragility curves using different intensity measures, or the effect of the propagation of uncertainty in intensity measures definition in the results.

A final discussion will present the results of recent studies, obtained through the integration of both empirical and mechanical approaches, for update the vulnerability model implemented in the new version of the platform used for Italian seismic risk assessment (IRMA) promoted by the Department of Civil Protection in response to the specific requirement of the Sendai Framework for Disaster Risk Reduction 2015–2030.

**Keywords:** *fragility curves, vulnerability model, residential RC buildings; masonry buildings; post-earthquake damage data; seismic design; gravitational design; shakemap;*

