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PROSPECTIVE TESTING OF GROUND SHAKING SCENARIOS IN ITALY

A reliable and comprehensive characterization of expected seismic ground shaking, eventually including the related time information, is essential in order to develop effective mitigation strategies and increase earthquake preparedness. Forecasting earthquakes and related ground shaking, however is not an easy task and it implies a careful application of statistics to data sets of limited size and different accuracy. Nowadays it is well recognized by the engineering community that standard hazard indicator estimates (e.g. seismic PGA) alone are not sufficient for the adequate design, mainly for special buildings and infrastructures. Moreover, any effective tool for SHA must demonstrate its capability in anticipating the ground shaking related with large earthquake occurrences, a result that can be attained only through rigorous verification and validation process.

A scenario-based Neo-Deterministic approach to Seismic Hazard Assessment (NDSHA) is available nowadays, which considers a wide range of possible seismic sources (including the largest deterministically or historically defined credible earthquake, MCE) as the starting point for deriving scenarios by means of full waveforms modeling, either at national and local scale. The method does not make use of attenuation relations and naturally supplies realistic time series of ground shaking, including reliable estimates of ground displacement readily applicable to seismic isolation techniques. The NDSHA procedure permits to incorporate, as they become available, new geophysical and geological data, leading to the natural definition of a set of scenarios of expected ground shaking at the bedrock. At the local scale, further investigations can be performed taking into account the local soil conditions, in order to compute the seismic input (realistic synthetic seismograms) for engineering analysis of relevant structures, such as historical and strategic buildings. The standard NDSHA has been already applied in several regions worldwide, including a number of local scale studies accounting

for two-dimensional and three-dimensional lateral heterogeneities in anelastic media.

Based on the neo-deterministic approach, an operational integrated procedure for seismic hazard assessment has been developed that allows for the definition of time dependent scenarios of ground shaking, through the routine updating of earthquake predictions, performed by means of the algorithms CN and M8S. The integrated NDSHA procedure for seismic input definition, which is currently applied to the Italian territory, combines different pattern recognition techniques, designed for the space-time identification of strong earthquakes, with algorithms for the realistic modeling of ground motion. Accordingly, a set of deterministic scenarios of ground motion at bedrock, which refers to the time interval when a strong event is likely to occur within the alerted area, can be defined by means of full waveform modeling, both at regional and local scale. CN and M8S predictions, as well as the related time-dependent ground motion scenarios associated with the alarmed areas, are routinely updated every two months since 2006.

The prospective application of the time-dependent NDSHA approach provides information that can be useful in assigning priorities for timely mitigation actions and, at the same time, allows for a rigorous prospective testing and validation of the proposed methodology. A broad spectrum of interrelated actions can be undertaken for mitigation of earthquake impact on cultural heritage, including temporary safety measures, planning of interventions and retrofitting. The operational issues related with prospective testing and validation of the time-dependent NDSHA scenarios are discussed, illustrating the results obtained for the recent strong earthquakes in Italy.