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Engineering seismic demand in the 2012 Emilia sequence: preliminary analysis and model compatibility assessment

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Abstract

The Emilia 2012 sequence featured seven events of moment magnitude (M) >5, five of which occurred between May 20 and May 29, 2012. These earthquakes were structurally damaging over a wide area. The damage included partial or total collapse of industrial precast reinforced-concrete structures, historical masonry, and mainly nonstructural damage to reinforced-concrete buildings; see Section 8 (Data and sharing resources) for damage report repository. These structural typologies are, in principle, sensitive to different ground-motion intensity measures. For example, loss of support requires significant displacement demand at relatively long periods, while infilling damage is due to the ground-motion amplitude at higher frequencies, and masonry structures are comparatively more sensitive to the cyclic content of ground shaking. Moreover, because events were concentrated in time and space, it can be argued that the cumulative effects of the sequence contributed to the damage. As the current seismic code [C.S.LL.PP. 2008] uses a seismic hazard map [Stucchi et al. 2011] to determine the seismic actions for structural design, when a strong earthquake occurs, probabilistic estimates are understandably questioned for their consistency with respect to the observed ground motion. While it is easy to show that in terms of frequency of exceedance of intensity measures, the hazard can hardly be validated via the records of a single earthquake [e.g., Iervolino 2012], on the other hand, it can certainly be verified whether the observations are compatible or atypical with respect to what is predicted by the tools used in best-practice hazard studies. These issues mostly motivated the preliminary analysis briefly presented in this report; i.e., to investigate the engineering seismic demand (peak and cyclic) and to compare this with the prediction models. Both elastic and inelastic demands were considered. Indeed, the inelastic demands are more important from the structural engineering point of view. […]

Keywords

Spectra; Ground motion; Intensity measures

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References

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