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# A case study of the role of earthquake displacement spectra in assessing physical vulnerability of buildings

M. Bostenaru Dan (1)

(1) ROSE School, Istituto Universitario di Studi Superiori di Pavia (mbostenaru@roseschool.it)

The physical vulnerability of buildings is well assessed by displacement spectra. Therefore their shapes need a further study, which was initiated in this paper. Considered were the displacement spectra for the intermediate depth far-field earthquake in Vrancea (1977) and the near field shallow depth one in Erzincan (1992). Surprisingly, both were characterised by long-period pulses with small duration, which explains and was reflected in the destructiveness of the motions on flexible structures. The models of motions in forward and/or backward pulses or as sinusoides previously done were reviewed, as well as studies on the dependence of magnitude and site conditions of the shape of the horizontal displacement response. The analytical expressions for the displacement spectra derived by Faccioli (2004) were calibrated for the earthquakes considered, using the parameters suggested, the velocity pulse half duration and the peak ground consideration, and proved to be consistent in the computations, despite the difference in the seismic source models. Although the source mechanism must have been different, the effects on structures of the two earthquakes were similar, due to astonishingly similar (by a dampling factor of 5%) displacement spectra shapes. Similar were the deep and alluvial soil conditions. For the comparison reinforced concrete frame structures were considered. Most of destruction was documented in literature for buildings with more than 4 storeys, which is consistent with the deformation based verification carried out. Since displacement spectra prove to be a good vulnerability assessment mean, it can only be emphasised that microzonation studies taking that as a base, as they have been recently put forward, have a high potential.

Reference: E. Faccioli, R. Paolucci and J. Rey, Displacement spectra for long periods, Earthquake Spectra 20(2) (2004) 347-376.