SPONSE
International Association for the Seismic Performance of Non-Structural Elements

4th International Workshop on the Seismic Performance of Non-Structural Elements (SPONSE)

Estimating Consistent Relative Displacement and Absolute Acceleration Floor Response Spectra in Elastic Buildings

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Abstract. The need to properly design non-structural elements to withstand earthquakes has become an important objective within the earthquake engineering community. In the performance-based seismic design framework, the achievement of adequate performance objectives, for increasing seismic intensities, is not only related to the performance of structural members but also to the behaviour of non-structural elements. Recently, a direct displacement-based design methodology for the seismic design of non-structural elements was developed. A crucial aspect of this design methodology for non-structural elements is the definition of the seismic demand as a relative displacement floor response spectrum. This paper presents a simple procedure for estimating relative displacement floor response spectra for building structures responding in the elastic range. Relative displacement and absolute acceleration floor response spectra were computed for a reinforced concrete moment resisting frame via dynamic time history analyses and were compared with floor response spectra predicted by means of a recent methodology available in the literature. It was observed that this methodology was able to predict well absolute acceleration floor response spectra but was inconsistent in its prediction of relative displacement floor response spectra for non-structural periods longer than the natural period of the supporting structure. Accordingly, a correction procedure to predict consistent relative displacement and absolute acceleration floor response spectra was implemented. This new procedure allows predicting the relative displacement floor response spectrum by constraining its ordinates at very long non-structural periods to the expected peak absolute displacement of the floor. The resulting acceleration and relative displacement response spectra are then consistently related by the well-known pseudo-spectra relationship over the entire non-structural period range.

Keywords: Floor response spectra, Non-structural elements, Seismic demand non-structural elements.

DOI 10.7414/4sponse.ID.4