

Higher-mode response of tall buildings and near-fault pulses

R. Rupakhety* and R. Sigbjörnsson

Earthquake Engineering Research Centre, University of Iceland, Austurvegur 2a, 800 Selfoss, Iceland.

This study investigates the importance of higher modes in the elastic response of tall buildings subjected to near-fault ground motions. Building structures modelled as generic frames are analyzed using a large set of forward-directivity affected pulse-like ground-motion records. It is found that higher modes contribute significantly to peak interstory drifts at the upper portions of the buildings. The importance of higher modes increases as the height of the frame is increased. Maximum interstory drifts are found to depend strongly on the ratio of the fundamental period of the building and the pulse period [1]. When this ratio is close to one, large interstory drifts are experienced by the buildings. Simple pulse models, which are often used in the literature to model near-fault ground motions, are found lacking in estimating interstory drift demands of tall buildings. This is because high-frequency components of ground motion are not accounted for by simple pulse models [2]. An example of this effect is shown in Figure 1 for an 18 story building. On average, pulse models are found to underestimate drift demands by a factor of about 1.4.

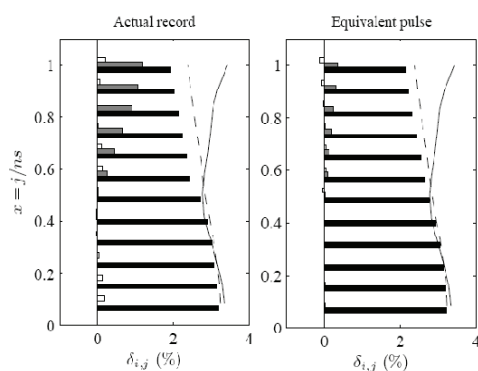


Figure 1: Interstory drift demands (horizontal axis) of an 18-story building plotted against the normalized height (vertical axis) computed by using an actual ground motion (solid curve) record and a corresponding simple pulse model (dashed curve). The horizontal bars of black, gray, and white color represent the contribution of the first three modes of vibration. Comparing the left and the right panels, it can be seen that the response to the pulse model is lacking in higher mode contributions.

References

- [1] Rupakhety R (2010) Contemporary issues in earthquake engineering research. Faculty of Civil and Environmental Engineering, University of Iceland. www.eerc.hi.is/rajesh_rupakhety
- [2] Rupakhety R and Sigbjörnsson R (2010) Can simple pulses adequately represent near-fault ground motions? Journal of earthquake engineering (under review)

*e-mail: rajesh@hi.is url: www.eerc.hi.is