# Assessment of Alternative Seismic Design Provisions for Diaphragms per ASCE/SEI 7-22

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ABSTRACT

Based on evidence that seismic inertial forces generated in the floor system can lead to inelastic and potentially non-ductile responses of floor diaphragms, there is a need to validate seismic design provisions for floor diaphragms and to assess how these provisions consider the effects of higher modes on the peak floor accelerations. This presentation disseminates the outcomes from the evaluation of the Alternative Design Provisions for Diaphragms per ASCE/SEI 7-22 Section 12.10. Measured acceleration strong-motion data from instrumented building stations monitored by the California Strong Motion Instrumentation Program are considered. The building stations comprise various numbers of stories and types of seismic force-resisting systems. The design acceleration coefficients computed for each building station using the design provisions are compared with peak floor accelerations measured by the building stations. The peak floor accelerations are computed at the center of rigidity. The location of the center of rigidity is estimated using the measured strong-motion data based on a method proposed by Safak and Celebi (1990). The period of the first translational mode of each building station is estimated as a function of the seismic force-resisting system, building station height, and peak ground velocity using the simplified equations presented by Xiang et al. (2020). The properties of vibration for the second and third translational modes are estimated using the analytical expressions presented by Miranda and Taghavi (2005). Design-based intensity-dependent acceleration coefficients are computed as a modified version of the design acceleration coefficients to consider the earthquake-intensity level of the measured ground motions and the level of inelastic responses to which the building stations were subjected. The magnitude and amplification over the height of the design-based intensity-dependent acceleration coefficients are compared with those of the peak floor accelerations using two comparison metrics. The higher-mode effects are assessed by comparing the spectral acceleration amplification factors of the building stations. The design-based intensity-dependent acceleration coefficients based on ASCE/SEI 7-22 Section 12.10.3 reasonably predict the peak floor accelerations if the spectral response accelerations are reasonably estimated. These modified acceleration coefficients can capture the increased peak floor accelerations caused by either the higher-mode spectral response accelerations or the higher-mode response contribution characteristic of the dynamic properties of the building stations.

REFERENCES:

Miranda, E., Taghavi, S. (2005). Approximate Floor Acceleration Demands in Multistory Buildings. I: Formulation. Journal of Structural Engineering 131, 203–211. https://doi.org/10.1061/(ASCE)0733-9445(2005)131:2(203).

Safak, E., and Celebi, M (1990). Method to Estimate Center of Rigidity Using Vibration Recordings. Journal of Structural Engineering 116, no. 1: 85–97. https://doi.org/10.1061/(ASCE)0733-9445(1990)116:1(85).

Xiang, Y., Harris, A., Naeim, F., Zareian, F. (2020). Evaluation of natural periods and modal damping ratios for seismic design of building structures. Earthquake Spectra 36(2), 629-646. https://doi.org/10.1177/8755293019900776.