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Seismic Assessment of Non-Structural Component Using Floor Design Spectrum

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Abstract : Experiences in the past earthquakes have clearly demonstrated the necessity of seismic design and assessment of Non-Structural Components (NSCs) particularly in post-disaster structures such as hospitals, power plants, etc. as they have to be permanently functional and operational. Meeting this objective is contingent upon having proper seismic performance of both structural and non-structural components. Proper seismic design, analysis, and assessment of NSCs can be attained through generation of Floor Design Spectrum (FDS) in a similar fashion as target spectrum for structural components. This paper presents the developed methodology to generate FDS directly from corresponding Uniform Hazard Spectrum (UHS) (i.e. design spectra for structural components). The methodology is based on the experimental and numerical analysis of a database of 27 real Reinforced Concrete (RC) buildings which are located in Montreal, Canada. The buildings were tested by Ambient Vibration Measurements (AVM) and their dynamic properties have been extracted and used as part of the approach. Database comprises 12 low-rises, 10 medium-rises, and 5 high-rises and they are mostly designated as post-disaster\emergency shelters by the city of Montreal. The buildings are subjected to 20 compatible seismic records to UHS of Montreal and Floor Response Spectra (FRS) are developed for every floors in two horizontal direction considering four different damping ratios of NSCs (i.e. 2, 5, 10, and 20 % viscous damping). Generated FRS (approximately 132’000 curves) are statistically studied and the methodology is proposed to generate the FDS directly from corresponding UHS. The approach is capable of generating the FDS for any selection of floor level and damping ratio of NSCs. It captures the effect of: dynamic interaction between primary (structural) and secondary (NSCs) systems, higher and torsional modes of primary structure. These are important improvements of this approach compared to conventional methods and code recommendations. Application of the proposed approach are represented here through two real case-study buildings: one low-rise building and one medium-rise. The proposed approach can be used as practical and robust tool for seismic assessment and design of NSCs especially in existing post-disaster structures.

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