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Evaluation of Equivalent Static Analysis Method for Seismic Design of Non-Structural Elements

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Abstract. In this study, the equivalent static approach, which is the most popular but largely empirical, for seismic design of non-structural elements (NSEs) is critically evaluated in order to seek the possibility of its improvement. To this end, the advanced analytical methods as well as the equivalent static methods in ASCE 7 and Eurocode 8 are first reviewed. The inaccuracy of the equivalent static approach resulting from the negligence of the fundamental period of supporting structures is clearly illustrated using elementary structural dynamics. Based on numerical dynamic analysis of 3-dimensional building models, it is also shown that the magnitude and distribution of the maximum floor acceleration can significantly be affected by the supporting structural characteristics such as fundamental period, higher modes, nonlinearity, and torsion. Up-to-date database of instrumented buildings does not well corroborate the magnitude and profile of the maximum floor acceleration specified by the current equivalent static approach. The current equivalent static approach needs to be improved such that some of the key influential structural parameters be selectively included within the limit of practicality.

Keywords: Seismic design, Non-structural elements, Equivalent static method, Dynamic method, Floor acceleration, Torsional amplification.

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