Hosoda M. and Fujita K. (2024), Robust optimal damper placement based on robustness index simultaneously considering variation of elastoplastic design criteria and input level, *Frontiers in Built Environment*, 10:1353827. doi: 10.3389/fbuil.2024.1353827

Abstract Dampers should be installed at appropriate quantities and locations to control building vibrations against excitations such as earthquakes and wind loads. One of the objectives of the structural optimization problem for damper placement is to minimize the initial cost of damper installation to satisfy various structural constraints under a set of input levels and target performance values. However, it is arbitrary what input levels should be used in the design, and it is also necessary to account for various uncertainties in the inputs and structural properties. This study presents a new method for assessing the robustness of building structures with design variables while simultaneously considering various phases of structural performance criteria and input amplitudes. The proposed robustness index is a multidimensional function that can take into account the influence of different input levels on the structural performance. In this paper, the proposed new robustness index is applied to the robust optimal design of the damper placement, where the damping coefficient of the linear oil damper added to the building is uncertain. The worst resonant seismic motion for the building is investigated based on the critical double impulse method and its equivalent onecycle sine wave, which is used as the input seismic motion. By applying the equivalent one-cycle sine wave to the structural response analysis with variations in the input velocity amplitude, the proposed robustness index is effective in comprehensively assessing the relationships between the input velocity amplitude of the seismic motion and the upper response limit of the structure under the variation of the damping coefficient of the oil damper. The comprehensive and efficient evaluation of these relationships enables a more detailed assessment of the influence of uncertainties in design variables on structural performance. In the numerical examples, the optimal damper placement for a 12-story building model is discussed based on the robustness and structural performance of both acceleration and story ductility distribution.

Keywords robust optimal design, damper placement, uncertainty analysis, critical double impulse, oil damper, [info-gap robustness].

\website\IGT\hosoda-fujita2024abs.tex 26.4.2024