

Development of a long-stroke MR damper for a building with tuned masses

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Abstract

This article deals with the development of a long-stroke MR-damper aimed to control, by reacting on a tuned mass (TM), the earthquake performance of an existing 21-story office building located in Santiago, Chile. The ± 1 m stroke MR-damper was designed using the nominal response of the building equipped with two 160 ton pendular masses tuned to the fundamental lateral vibration mode of the structure. An extended physical on-off controller, a special current driver, a new real-time structural displacement sensor, and an MR-damper force sensor were all developed for this application. The physical damper and control were experimentally validated using a suite of cyclic and seismic signals. The real-time displacement sensor developed was validated by first using a scaled down building prototype subjected to shaking table tests, and then a real-scale free vibration test on the sensor installed horizontally at the foundation level of a building. It is concluded that the proposed TM and MR-damper solution is technically feasible, and for an equivalent key performance index also defined herein, more economical than a solution based on passive viscous dampers.