World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:11, No:04, 2017

A Methodology for Seismic Performance Enhancement of RC Structures Equipped with Friction Energy Dissipation Devices

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Abstract : Friction-based supplemental devices have been extensively used for seismic protection and strengthening of structures, however, the conventional use of these dampers may not necessarily lead to an efficient structural performance. Conventionally designed friction dampers follow a uniform height-wise distribution pattern of slip load values for more practical simplicity. This can lead to localizing structural damage in certain story levels, while the other stories accommodate a negligible amount of relative displacement demand. A practical performance-based optimization methodology is developed to tackle with structural damage localization of RC frame buildings with friction energy dissipation devices under severe earthquakes. The proposed methodology is based on the concept of uniform damage distribution theory. According to this theory, the slip load values of the friction dampers redistribute and shift from stories with lower relative displacement demand to the stories with higher inter-story drifts to narrow down the discrepancy between the structural damage levels in different stories. In this study, the efficacy of the proposed design methodology is evaluated through the seismic performance of five different low to high-rise RC frames equipped with friction wall dampers under six real spectrum-compatible design earthquakes. The results indicate that compared to the conventional design, using the suggested methodology to design friction wall systems can lead to, by average, up to 40% reduction of maximum inter-story drift; and incredibly more uniform height-wise distribution of relative displacement demands under the design earthquakes.

Keywords : friction damper, nonlinear dynamic analysis, RC structures, seismic performance, structural damage
Conference Title : ICCSEE 2017 : International Conference on Civil, Structural and Earthquake Engineering
Conference Location : Boston, United States
Conference Dates : April 24-25, 2017