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Seismic Retrofit of Tall Building Structure with Viscous, Visco-Elastic, Visco-Plastic Damper

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Abstract : Increasingly, a large number of new and existing tall buildings are required to improve their resilient performance against strong winds and earthquakes to minimize direct, as well as indirect damages to society. Those advent stationary functions of tall building structures in metropolitan regions can be severely hazardous, in socio-economic terms, which also increase the requirement of advanced seismic performance. To achieve these progressive requirements, the seismic reinforcement for some old, conventional buildings have become enormously costly. The methods of increasing the buildings' resilience against wind or earthquake loads have also become more advanced. Up to now, vibration control devices, such as the passive damper system, is still regarded as an effective and an easy-to-install option, in improving the seismic resilience of buildings at affordable prices. The main purpose of this paper is to examine 1) the optimization of the shape of visco plastic brace damper (VPBD) system which is one of hybrid damper system so that it can maximize its energy dissipation capacity in tall buildings against wind and earthquake. 2) the verification of the seismic performance of the visco plastic brace damper system in tall buildings; up to forty-storey high steel frame buildings, by comparing the results of Non-Linear Response History Analysis (NLRHA), with and without a damper system. The most significant contribution of this research is to introduce the optimized hybrid damper system that is adequate for high rise buildings. The efficiency of this visco plastic brace damper system and the advantages of its use in tall buildings can be verified since tall buildings tend to be affected by wind load at its normal state and also by earthquake load after yielding of steel plates. The modeling of the prototype tall building will be conducted using the Opensees software. Three types of modeling were used to verify the performance of the damper (MRF, MRF with visco-elastic, MRF with visco-plastic model) 22-set seismic records used and the scaling procedure was followed according to the FEMA code. It is shown that MRF with viscous, visco-elastic damper, it is superior effective to reduce inelastic deformation such as roof displacement, maximum story drift, roof velocity compared to the MRF only.

Keywords : tall steel building, seismic retrofit, viscous, viscoelastic damper, performance based design, resilience based design
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