

## **Retrofitting of Asymmetric Steel Structure Equipped with Tuned Liquid Column Dampers by Nonlinear Finite Element Modeling**

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**Abstract :** One way to improve the performance of structures against of earthquake is passive control which requires no external power source. In this research, tuned liquid column dampers which are among of systems with the capability to transfer energy between various modes of vibration, are used. For the first time, a liquid column damper for vibration control structure is presented. After modeling this structure in design building software and performing the static and dynamic analysis and obtaining the necessary parameters for the design of tuned liquid column damper, the whole structure will be analyzed in finite elements software. The tuned liquid column dampers are installed on the structure and nonlinear time-history analysis is done in two cases of structures; with and without dampers. Finally the seismic behavior of building in the two cases will be examined. In this study the nonlinear time-history analysis on a twelve-story steel structure equipped with damper subject to records of earthquake including Loma Prieta, Northridge, Imperial Valley, Petrolia and Landers was performed. The results of comparing between two cases show that these dampers have reduced lateral displacement and acceleration of levels on average of 10%. Roof displacement and acceleration also reduced respectively 5% and 12%. Due to structural asymmetric in the plan, the maximum displacements of surrounding structures as well as twisting were studied. The results show that the dampers lead to a 10% reduction in the maximum response of structure stories surrounding points. At the same time, placing the dampers, caused to reduce twisting on the floor plan of the structure, Base shear of structure in the different earthquakes also has been reduced on the average of 6%.

**Keywords :** retrofitting, passive control, tuned liquid column damper, finite element analysis

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