PASSIVE, ACTIVE AND HYBRID CONTROL OF STRUCTURAL VIBRATIONS DURING EARTHQUAKES

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The passive and active vibration control of structures for their seismic protection was reviewed. Different base-isolation devices including laminated rubber bearing, and various frictional systems for aseismic design were described. It was shown that the acceleration transmitted to compact stiff structures during an earthquake can be significantly reduced by using appropriately designed base-isolation systems. Sample responses of some generic buildings with and without base-isolation systems subject to different seismic excitations were described and the effectiveness of various isolation system for protecting the structure and structural contents were discussed.

Stochastic approach for response analysis of base-isolated structures was also described. Particular attention was given to the performance of a high damping rubber bearing (HD-LRB) and a number of frictional base isolation systems for protecting the structures and the structural contents. A generic nonuniform shear beam structural model was used, and the generalized nonstationary Kanai-Tajimi model for the El Centro 1940 earthquake was considered as the stochastic excitation. The technique of equivalent linearization is utilized and the mean-square response statistics of secondary systems and primary structure were evaluated. Statistically estimated peak responses of the secondary system and the primary structure were evaluated and the results are compared with the response spectra for the actual earthquake accelerogram.

Comparison of the stochastic responses for base-isolated structures and the fixed-base structure was also carried out. It was shown that the mean-square, as well as the peak acceleration and deflection responses of the structure were significantly reduced with the use of the base-isolation systems without generating large base displacements.

The recent development on preview active control of structural vibrations during earthquakes was also discussed and the methodology for active and hybrid preview control was described. Sample examples were presented and the potential of the new preview control approach was pointed out.