

Foreword

Structural Control Benchmark Problem: Smart Base Isolated Building subjected to Near Fault Earthquakes

Many branches of engineering, mathematics, and sciences, have relied on benchmark problems as a standard means to compare different solution techniques. Since 1996, the ASCE Structural Control Committee and Task Group on Benchmark Problems and IASCM have developed a series of benchmark control problems that offer a set of carefully modeled real-world structures in which different control strategies can be implemented, evaluated, and compared using a common set of performance indices. First-, second- and third-generation benchmark problems focusing on response control of seismic and wind-excited buildings, and seismically excited long-span cable stayed bridges have been developed and evaluated.

The IASCM-ASCE task group on structural control benchmark problems has developed a new benchmark study to compare control strategies designed for a base-isolated building subjected to strong near-fault pulse-like ground motions. This special issue focuses on the new smart base-isolated building benchmark problem, specifically on phase I sample controllers for linear isolation system.

Seismic response of base-isolated buildings subjected to near-fault pulse-type ground motions has been the subject of intense debate in the past decade. The primary problem in such cases is the large base displacement in the flexible isolation system. Many new strategies, such as supplemental nonlinear passive dampers, have been suggested as a means to reduce the base displacement. Semiactive dampers and active devices offer an alternative strategy to reduce base displacement while keeping the superstructure response within limits.

The smart base-isolated benchmark problem is aimed at evaluating such control strategies; it includes four parts: part I, definition of the benchmark problem; part II, phase I sample controllers for linear isolation system; part III, phase II sample controller for the bilinear elastomeric isolation system; and part IV, phase II sample controller for sliding isolation system (to be developed). The benchmark structure considered is a three-dimensional eight-story base-isolated building similar to existing buildings in Los Angeles. The superstructure is considered to be linear with lateral-torsional behavior. The developed three-dimensional nonlinear dynamic analysis Matlab/Simulink program can model three different kinds of base isolation systems: linear elastomeric systems with low damping or supplemental high damping; nonlinear sliding or friction systems; bilinear or nonlinear elastomeric systems or any combination thereof. A host of control devices can be considered at the isolation level, but no control devices are allowed in any other level in the superstructure. The control algorithms may be passive, active or semiactive. Participants in this phase I study have proposed different devices, active and semiactive control strategies, evaluated, and reported their results compared with the results of the sample controllers for linear isolation systems. Each research team has adhered to prescribed practical control constraints, and has evaluated the performance of their control designs by prescribed performance indices.

Phase II of the smart base-isolated benchmark problem will address nonlinear isolation systems such as sliding and bilinear elastomeric systems. A forthcoming announcement of a new special issue of the journal will invite participants to focus on this important practical benchmark problem.

SATISH NAGARAJIAH
Rice University, Houston, Texas, U.S.A.