A hybrid online test combined with general-purpose finite element software

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1. Introduction

The hybrid online test method proposed in this paper, combined with a general-purpose finite element software, using substructure technique, gains the advantages of analyzing the full scale model with various loading and boundary conditions from finite element software, and has a capability of tracing the actual behavior of the tested structure.

2. Method Devised

In the system, the simulated structure is divided into several substructures. Some substructures are analyzed by a general-purpose finite element software: ABAQUS, and the others are to be tested physically. Compatibility between the substructures is satisfied to ensure correct responses. A control program is devised to solve the equations of motion using a simplified dynamic model, exchange data with the numerical analyzed parts, and control the physical experiments. Another program is used to control the numerical part, exchange data with the control program, and communicate with ABAQUS. The union of numerical parts and experimental parts forms a detailed static model.

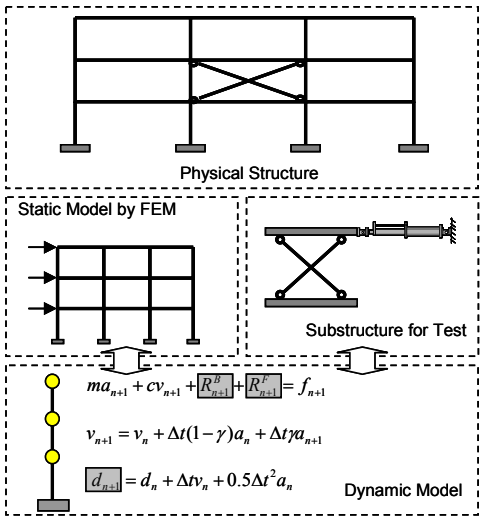

Fig. 1 Outline of proposed system framework

3. Experiment by Proposed System

The proposed system is applied for an eight-story base-isolated structure. The structure is divided into a super structure and a base structure. The super structure is a planer frame that can be simulated numerically, while the behavior of the base structure including isolators is complicated, particularly when collision against retaining wall takes place. The behavior of this portion is best simulated by a physical test.

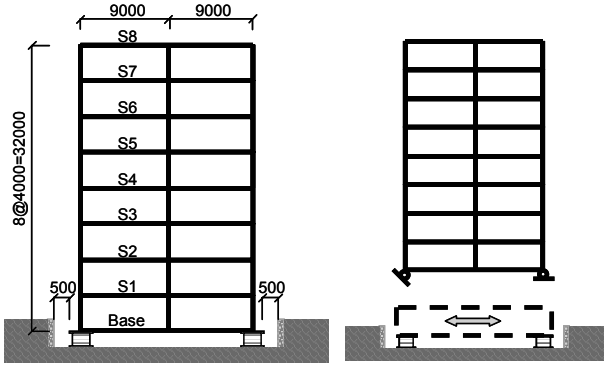

Fig. 2 Eight-story base-isolated structure

The ground motion record of fn-tkt with a scale of 2.0 was adopted to ensure the deformation of base level large enough to collide against the retaining wall. The duration is 15 s and the time interval is 0.01 s. The experiment result validates the proposed system.

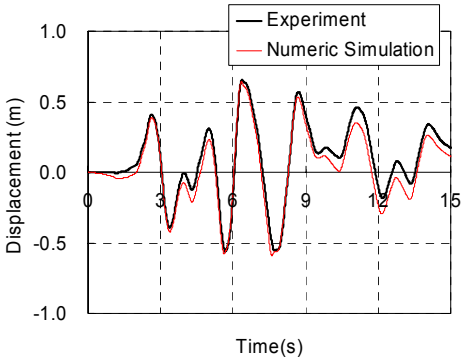

Fig. 3 Displacement response of base level

4. Time Efficiency

Parallelism of the analytical substructure and experimental substructure makes the proposed system work effectively. The 15 second simulation took 7.9 hours in total. Analytical part consumes more time than experiment in most steps. ABAQUS restart requires more time with the time elapse, because it has to read data from all previous steps.