

Developing and Shake Table Testing of Semi-Active Hydraulic Damper as Active Interaction Control Device

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Abstract : Semi-active control system for structure under excitation of earthquake provides with the characteristics of being adaptable and requiring low energy. DSHD (Displacement Semi-Active Hydraulic Damper) was developed by our research team. Shake table test results of this DSHD installed in full scale test structure demonstrated that this device brought its energy-dissipating performance into full play for test structure under excitation of earthquake. The objective of this research is to develop a new AIC (Active Interaction Control Device) and apply shake table test to perform its dissipation of energy capability. This new proposed AIC is converting an improved DSHD (Displacement Semi-Active Hydraulic Damper) to AIC with the addition of an accumulator. The main concept of this energy-dissipating AIC is to apply the interaction function of affiliated structure (sub-structure) and protected structure (main structure) to transfer the input seismic force into sub-structure to reduce the structural deformation of main structure. This concept is tested using full-scale multi-degree of freedoms test structure, installed with this proposed AIC subjected to external forces of various magnitudes, for examining the shock absorption influence of predictive control, stiffness of sub-structure, synchronous control, non-synchronous control and insufficient control position. The test results confirm: (1) this developed device is capable of diminishing the structural displacement and acceleration response effectively; (2) the shock absorption of low precision of semi-active control method did twice as much seismic proof efficacy as that of passive control method; (3) active control method may not exert a negative influence of amplifying acceleration response of structure; (4) this AIC comes into being time-delay problem. It is the same problem of ordinary active control method. The proposed predictive control method can overcome this defect; (5) condition switch is an important characteristics of control type. The test results show that synchronism control is very easy to control and avoid stirring high frequency response. This laboratory results confirm that the device developed in this research is capable of applying the mutual interaction between the subordinate structure and the main structure to be protected is capable of transforming the quake energy applied to the main structure to the subordinate structure so that the objective of minimizing the deformation of main structural can be achieved.

Keywords : DSHD (Displacement Semi-Active Hydraulic Damper), AIC (Active Interaction Control Device), shake table test, full scale structure test, sub-structure, main-structure

Conference Title : ICACSE 2015 : International Conference on Architectural, Civil and Structural Engineering

Conference Location : Zurich, Switzerland

Conference Dates : July 29-30, 2015