

Seismic Response of Structure Using a Three Degree of Freedom Shake Table

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Abstract : Earthquakes are the biggest threat to the civil engineering structures as every year it cost billions of dollars and thousands of deaths, around the world. There are various experimental techniques such as pseudo-dynamic tests - nonlinear structural dynamic technique, real time pseudo dynamic test and shaking table test method that can be employed to verify the seismic performance of structures. Shake table is a device that is used for shaking structural models or building components which are mounted on it. It is a device that simulates a seismic event using existing seismic data and nearly truly reproducing earthquake inputs. This paper deals with the use of shaking table test method to check the response of structure subjected to earthquake. The various types of shake table are vertical shake table, horizontal shake table, servo hydraulic shake table and servo electric shake table. The goal of this experiment is to perform seismic analysis of a civil engineering structure with the help of 3 degree of freedom (i.e. in X Y Z direction) shake table. Three (3) DOF shaking table is a useful experimental apparatus as it imitates a real time desired acceleration vibration signal for evaluating and assessing the seismic performance of structure. This study proceeds with the proper designing and erection of 3 DOF shake table by trial and error method. The table is designed to have a capacity up to 981 Newton. Further, to study the seismic response of a steel industrial building, a proportionately scaled down model is fabricated and tested on the shake table. The accelerometer is mounted on the model, which is used for recording the data. The experimental results obtained are further validated with the results obtained from software. It is found that model can be used to determine how the structure behaves in response to an applied earthquake motion, but the model cannot be used for direct numerical conclusions (such as of stiffness, deflection, etc.) as many uncertainties involved while scaling a small-scale model. The model shows modal forms and gives the rough deflection values. The experimental results demonstrate shake table as the most effective and the best of all methods available for seismic assessment of structure.

Keywords : accelerometer, three degree of freedom shake table, seismic analysis, steel industrial shed

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