



Manufacturing and Performance of an Economical 1-D Shake Table

Aamar Danish ^{a*}, Naveed Ahmad ^b, M. Usama Salim ^a

^a Cyprus International University, Nicosia 99010, Northern Cyprus.

^b University of Engineering & Technology, Taxila 47080, Pakistan.

Received 24 May 2019; Accepted 22 August 2019

Abstract

The researchers and engineers encountered many problems to precisely replicate earthquake waves. Earthquakes are one of the nature's worst catastrophes and are still unpredictable. Statistical research has shown that the earthquakes have increased in frequency in recent years and have become a major concern for the world especially for those countries which are located on the fault lines such as Japan, Bangladesh and Pakistan. So, it was imperative to devise a mechanism to check earthquake response and apply some necessary mitigations for the safety of humanity. After many years of research an indispensable testing apparatus was designed named as Shake Table. This apparatus is extensively used in earthquake research centers globally because it is the best available apparatus to replicate the earthquakes imposed dynamic effects on structures. A uni-axial shaking table was designed, manufactured and installed in University of Engineering & Technology Taxila, Pakistan which is operated on 3 HP servo motor coupled with encoder, motion controller and supported on HSB mechanical linear drive. The system was assembled in a simple way with care to endure sufficient replication of given (recorded) motion by shake table system. This paper focuses on the designing, manufacturing and performance of an economical analytical model of 1-D shake table incorporating conjunction of structural dynamics and linear control theory.

Keywords: Designed and Manufactured; Dynamic Effects; Earthquake Waves; Linear Control Theory; Replicate; Shake Table.

1. Introduction

There are many specialties of civil engineering among which earthquake engineering is a new addition. The sole purpose of this addition was to design, test and construct earthquake resistant structures. After each strong seismic event, the knowledge on the earthquake response of structures is greatly increased by the observation and analysis of behavior of the different types of constructions. The new developments in construction industry are being rapidly incorporated in the relevant codes through the revisions that are almost carried out after some massive earthquake such as [1]:

1. Earthquake of 8.2 magnitude in Tangshan, Hebei that took lives of 655,000 people in 1976;
2. Kanto, Japan earthquake of magnitude 7.9 (Richter Scale) in 1923 took lives of 140,000 and left millions homeless;
3. In Ashgabat, USSR an earthquake occurred of magnitude 7.3 and claimed lives of 110,000 people.

Earthquake waves are the energy waves generated by an abrupt breaking of subsurface rock. These waves travel through earth and cause some serious damage to our infrastructures and structures. These waves are of two type's body waves and surface waves as shown in Figure 1. Body waves are released at the focus (hypocentre) and moves in all directions through Earth body. These waves move towards surface and after striking the Earth surface they generate new

* Corresponding author: aamardanish@gmail.com

 <http://dx.doi.org/10.28991/cej-2019-03091390>



© 2019 by the authors. Licensee C.E.J, Tehran, Iran. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC-BY) license (<http://creativecommons.org/licenses/by/4.0/>).