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EXPERIMENTAL INVESTIGATIONS ON MASONRY BUILDINGS STRENGTHENED USING FERRO-CEMENT OVERLAY UNDER DYNAMIC LOADING

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ABSTRACT

Use of Ferro-cement (Welded Wire Mesh in cement concrete/mortar) 'splints' and 'bandages' is a common method of retrofitting unreinforced masonry (URM) buildings in India. Indian code IS:13935-2009 [22] provides pre-computed amount of reinforcement to be provided in the splints and bandages in URM buildings located in active seismic areas. However, adequacy of this technique is not comprehensively studied so far. In this research paper, behaviour of a half-scale burnt clay brick unreinforced masonry building and another similar building but retrofitted using carried out on 'Shock Table' test facility available at Department of Earthquake Engineering, Indian Institute of Technology Roorkee. In this facility, an impact is applied at the base of the specimen. Short duration impulse types of motion are the main characteristics of shock table. It also has low frequency content and higher base acceleration with respect to real ground motion. The crack pattern, weaker zones and modes of failure with increasing intensity of shaking, have been presented and conclusions are drawn with respect to effectiveness of the used strengthening technique. Equivalent frame models (EFM) of the tested scaled models have been developed in SAP2000 Nonlinear software and the numerical results are compared with the prototype results. The results suggest that the lateral load resistance of the retrofitted building increases considerably, as compared to the URM buildings. The EFMs are able to predict the peak displacement, quite reasonably but fail to predict the response waveform.

KEYWORDS: Unreinforced Brick Masonry; Shock Table Test; Wire-Mesh, Retrofit; Equivalent Frame Model

INTRODUCTION

The adequacy of a retrofitting method can be fully tested either during a real earthquake, or by full scale model testing on a shake-table, simulating the expected ground motion. Non-availability of full/large scale shake-table testing facilities, at many places, necessitates the use of scaled models and simplified testing procedures. These scaled models have been successfully used to compare the dynamic behaviour of URM and strengthened models [Paulson et al. (1) ; Nikolic-Brzev and Arya (2); Tomaževič et al. (3); Ersubasi and Korkmaz (4); Mendes et al. (5)]. In India these scale models have been successfully tested on shock-table facility [Arya (6); Qamaruddin et al. (7); Qamaruddin et al. (8); Agarwal and Thakkar (9); Jagdish et al. (10)]. In the present study, two models of half scale brick masonry, one without any strengthening and the other with strengthening using Ferrocement in splints and bandages, have been tested and apprise with the analytical simulation using macro-modeling approach named "Equivalent Frame Method". The models have been tested for a series of shocks of gradually increasing intensity on Shock-Table facility available at the Department of Earthquake Engineering, IIT Roorkee. Agarwal [11], Masood [12], and Dubey [13] have shown that the shock-table motions are has low frequency content and higher base acceleration. These motions typically have much