AN INVESTIGATION ON THE UPLIFT FORCES IN BUILDINGS EQUIPPED WITH OPRCB ISOLATORS

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Keywords: Uplift Forces, Empirical Formula, Time History Analysis, Nonlinear Regression, Near Fault Earthquakes

ABSTRACT

Recent studies on Orthogonal Pairs of Rollers on Concave Beds (OPRCB), as a somehow new isolating system, show that these isolators are weak subjected to uplift. In this paper a set of regular 3-, 6-, and 9-story steel buildings, with dual moment frames and chevron bracing system, installed on OPRCB isolators, have been considered subjected to near-fault earthquakes with moderate to high vertical accelerations. The buildings were analyzed subjected to 19 three-component records of selected near-fault earthquakes. By using nonlinear regression analysis, empirical formula was derived for predicting the uplift forces, based on six main parameters, including PGA values in three directions, the structure's volume, and its aspect ratios in two directions. To check the accuracy of the proposed formula another building with different parameters was analyzed and the values of axial forces at the level of isolators were compared to the corresponding values obtained by the proposed formula. The relatively high Index of Agreement between the predicted and observed results and low values of error indices indicate the good performance and accuracy of the proposed formulas.

INTRODUCTION

In spite of the remarkable effects of vibration isolating systems on the seismic behavior of structures, uplift (e.g. in sliding bearings) and tension forces (e.g. in bonded rubber bearings) during near-fault excitations are contingent (Roussis and Constantinou, 2006a). Based on the available references it seems that the first studies with regard to the effect of uplift on seismic isolators go back to late 80s. As one of the first studies Kelly et al. (1987) worked on the evaluation and strengthening of isolators against uplift or tensile forces. In order to resist against uplift in elastomeric bearings, an uplift restraint device has been proposed and tested (Kelly et al., 1987). The feasibility of base isolation for structures subjected to column uplift during earthquake on a reinforced concrete structure with a height-to-width ratio (r) of 1.23 and on a braced steel frame with r of 1.59 have been studied experimentally (Griffith et al., 1988; Griffith et al., 1988).

An experimental and analytical study has been performed to evaluate the feasibility of using a Teflon sliding bearing with uplift restraint devices for a six-story structure (with a *r* of 4.5) (Nagarajaiah et al., 1992). Furthermore, an analytical study on isolated structures with the friction pendulum system has been