# NONLINEAR INERTIAL COUPLING IN ASYMMETRIC BASE-ISOLATED STRUCTURES

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## ABSTRACT

It has been well proved that seismic base isolation systems, as passive tools of structural control, mitigate the intensity of damage caused by earthquakes. On the other hand, structures are often built in irregular plans, which lead to much more damage under earthquake motions. So, the present research dealt with the dynamic interaction of asymmetric base-isolated structures in a new point of view. The motion equations were presented in two coordinates: one fixed on the building base (inertial or global coordinate) and the other at the torsional isolation level (local coordinate), which led to linear and nonlinear forms of equations, respectively. Two types of structures were defined with different natural frequencies. Responses of both linear and nonlinear models for the two types of structures under harmonic effects were compared while analyzing time history and frequency. Some non-linear phenomena such as saturation and energy transfer between the modes in such structures were observed. Historical response peaks of linear and nonlinear models under real earthquake were compared in terms of various base torsional natural frequencies of the base isolation system in different directions. It can be inferred from the results of the analysis that nonlinear responses can be more critical than linear ones and design prescriptions should be adapted regarding nonlinear effects.

## INTRODUCTION

Severe damage to buildings, as a result of earthquake, is caused by torsional motions due to irregularity. Observations have shown that earthquakes can cause more damage to asymmetric-plan structures than comparable symmetric-plan ones. Today, base isolation of buildings is a conventional approach to earthquake resistance. The prominent goal of this method was to reduce the displacement of the main structure by moving elastomeric bearings installed on the substructures. It has been demonstrated that the base isolation is the common method of damage reduction in asymmetric structures (Kelly and Naeim, 1999).

Many previous works have emphasized the linear model of isolated structures in the global coordinate system. Kilar and Koren (2009) determined the most appropriate distribution of isolators in the asymmetric plan; they observed that, when the center of mass was based on the center of distribution of the base isolation, the torsional effect was reduced in the isolation system. Seguín et al. (2008) studied the earthquake response of isolated structure with lateral-torsional correlation. The results showed that the UBC code did not have accurate estimation of the edge displacement under the static approximation; so, it required precise revision in the mentioned subject. Sharma and Jangid (2009), by utilizing the motion equations of the isolated structure, showed that high initial stiffness in the isolation system could create intense modes in the superstructure and lead to more displacement at the story level. The common point of such studies was in exploiting the dynamics of models because of lateral-torsional coupling in the global coordinate.