

SEISMIC POUNDING OF MULTISTOREYED BUILDINGS

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Abstract

The investigations made to past and present earthquake technological have shown that during earthquake, the building structures are vulnerable to severe damages. The adjacent buildings collide and collapse during moderate to strong ground vibrations caused by earthquakes. Actually, the separation distance of many buildings is inadequate to accommodate their relative motions, so building vibrate out of phase and collapse. Among the possible structural damages the seismic induced pounding has been commonly observed phenomenon. In this paper, a systematic study regarding pounding of building response as well as seismic hazard mitigation practices like effect of different separation distances and effect of addition of shear walls are investigated in ETABS nonlinear software. The results were obtained in the form of pounding force and joint displacements. As the pounding effect varies inversely with separation distance so by increasing separation distance pounding effect is reduced greatly and hence damage to neighboring buildings is minimized. Also, the provision of shear wall reduces effect of pounding.

Key words: Seismic Pounding, Separation Distance, Mitigation of Seismic Pounding, Adjacent Buildings, Gap Element, Impact, Shear wall.

1. INTRODUCTION

A quake with a magnitude of six is capable of causing severe damage. Several destructive earthquakes have hit India in both historical and recent times. The annual energy release in India and its vicinity is equivalent to an earthquake with magnitude varying from 5.5 to 7.3 [1]. When two structures are close together, it is expected that they will pound against each other. This situation can be easily seen in highly populated cities.

Many studies were made about structural pounding considering single degree of freedom. Pounding is a highly nonlinear phenomenon and a severe load condition that could result in high magnitude and short duration floor acceleration pulses in the form of short duration spikes, which in turn cause greater damage to building contents. [1]. Pounding is critical on the response of the stiff system, especially when the system is highly out-of-phase. Essentially, in-phase systems exhibit displacement amplifications that are much closer to one, independent of model type [2].

The pounding effect can be reduced in two ways:

- 1) By placing elastic materials between adjacent buildings or by introducing structural systems with cast-in-place reinforced concrete (RC) walls [3].
- 2) By providing a safe separation distance between adjacent [4].

1.1 Required Seismic Separation Distance to Avoid Pounding

Clause of Indian Standards clearly given in its code IS 4326 that a Separation distance is to be provided between buildings to avoid collisions during an earthquake. The code is mentioned in following Table 1[5].

Table 1: Seismic pounding gap for different structures

Sl. No.	Type of Construction	Gap Width/Storey, in mm for Design Seismic Coefficient, $\alpha_h \leq 0.1$
1	Rise system or frames with shear walls	15.0
2	Moment resistant reinforced concrete frame	20.0
3	Moment resistant steel frame	30.0

IS1893:2007 Part1 mentioned that, separation should be R times the sum of displacements. R may be replaced by R/2 when two buildings are of same height, where R is response reduction factor (Clause 7.11.1) [6]. As per FEMA: 273-1997, separation distance between adjacent structures shall be less than 4% of the building height and above to avoid pounding, also the equations for calculating gap are

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