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International
Journal
Of Modern Engineering Research (IJMER)

Seismic Pounding Effect in Framed Structures

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ABSTRACT: *Pounding between adjacent structures is commonly observed phenomenon during major earthquakes which may cause both architectural and structural damages. To satisfy the functional requirements, the adjacent buildings are constructed with equal and unequal heights, which may cause great damage to structures during earthquakes. To mitigate the amount of damage from pounding, the most simplest and effective way is to provide minimum separation distance.*

To study the effect of structural pounding, a case study has been done on different setback ratios (Area & Height) and to investigate the minimum seismic pounding gap between two adjacent structures by using GAP joint element & non- linear time history analysis.

Keywords: *SAP v.14, setback structures, Seismic analysis, gap element*

I. INTRODUCTION

Structures are built very close to each other in metropolitan areas where the cost of land is very high. Due to closeness of the structures, they collide with each other when subjected to earthquake or any vibration. This collision of buildings or different parts of the building during any vibration is called pounding which may cause either architectural and structural damage or collapse of the whole structure. This may happen not only in buildings but also in bridges and towers which are constructed close to each other. Although some modern codes have included seismic separation requirement for adjacent structures, large areas of cities in seismically active regions were built before such requirements were introduced. Many investigations have been carried out on pounding damage caused by previous earthquakes. Pounding damage was observed during the 1985 Mexico earthquake, the 1988 Sequenay earthquake in Canada, the 1992 Cairo earthquake, the 1994 Northridge earthquake, the 1995 Kobe earthquake and 1999 Kocaeli earthquake. Significant pounding was observed at sites over 90 km from the epicentre thus indicating the possible catastrophic damage that may occur during future earthquakes having closer epicentres.

II. BUILDING MODELING

For this study 21 story building with a 3m height of each story, Different building geometries Area & Height were taken for the study. These building geometries represent varying degree of irregularity. In 2 D frame structure nine different categories of buildings, ranging 4 bays (in X direction) a bay width 4m and 21 bays in Y direction. In SAP 14 software. three different gap element are provided in building.

TABLE 1

Sr. no.	Description	Specification
1	Number of stories	G+20
2	Building height	63m
3	Bay width in x- direction	4m
4	Size of beam	0.45mx0.45m
5	Size of column	0.45mx0.60m
6	Grade of concrete & steel	M20 & Fe415

TABLE 2

Sr. no.	Along plan area (RA)	Along height (RH)	Gap width (m)
1	RA=25	RH=16/5, 11/10, 6/15	0.05, 0.10, 0.15
2	RA=50	RH=16/5, 11/10, 6/15	0.05, 0.10, 0.15
3	RA=75	RH=16/5, 11/10, 6/15	0.05, 0.10, 0.15

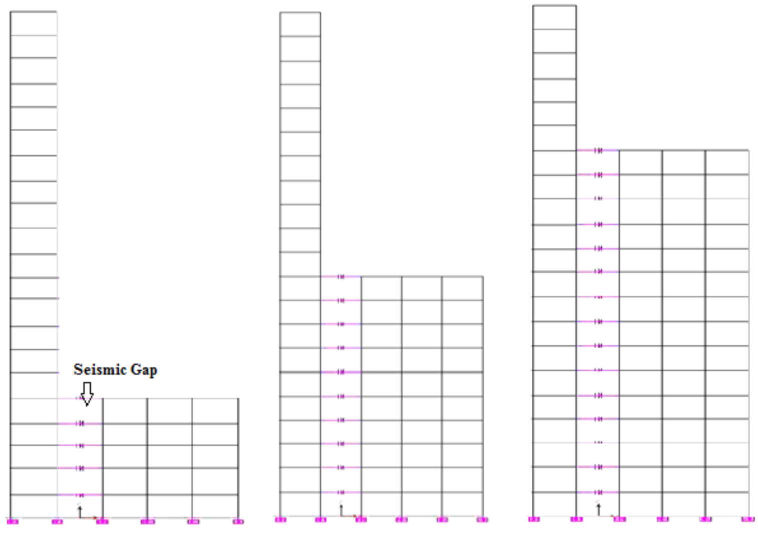

Figure:1 Irregularities In Height i.e. RA=25 and RH=16/5,11/10,6/15

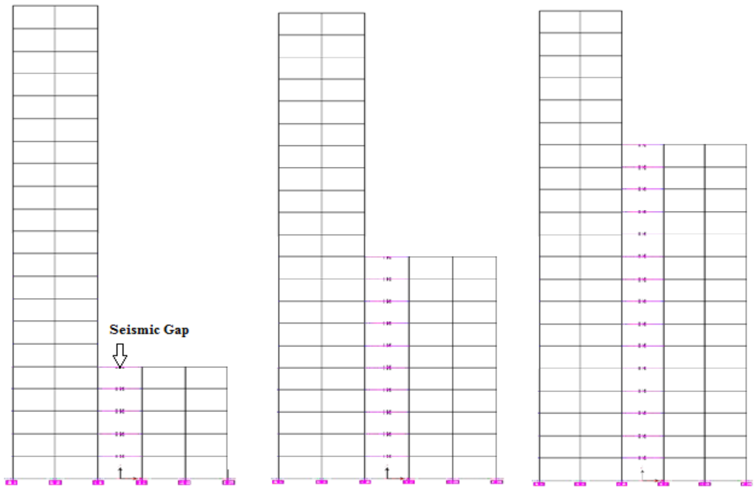

Figure:2 Irregularities In Height i.e. RA=50 and RH=16/5,11/10,6/15

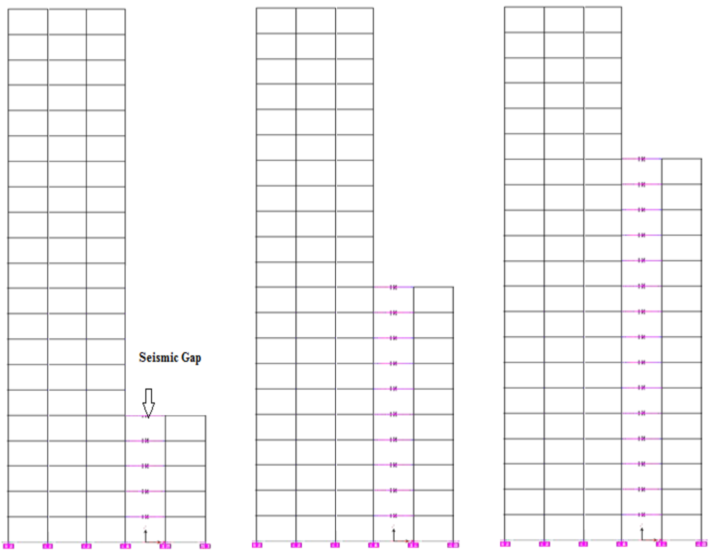

Figure:3 Irregularities In Height i.e. RA=75 and RH=16/5,11/10,6/15

III. RESULTS AND DISCUSSION

For showing variation spectral displacement varies gap width

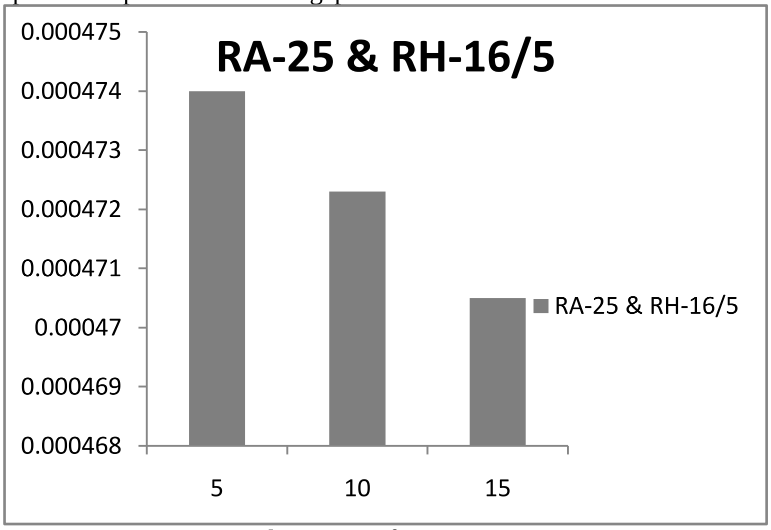

Figure:4 RA=25 and RH=16/5 for gap= 0.05m, 0.10m, 0.15m

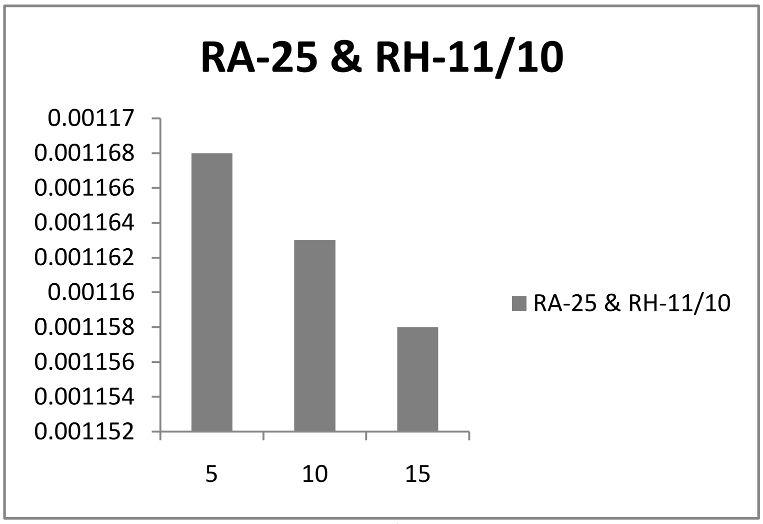

Figure:5 RA=25 and RH=11/10 for gap= 0.05m, 0.10m, 0.15m

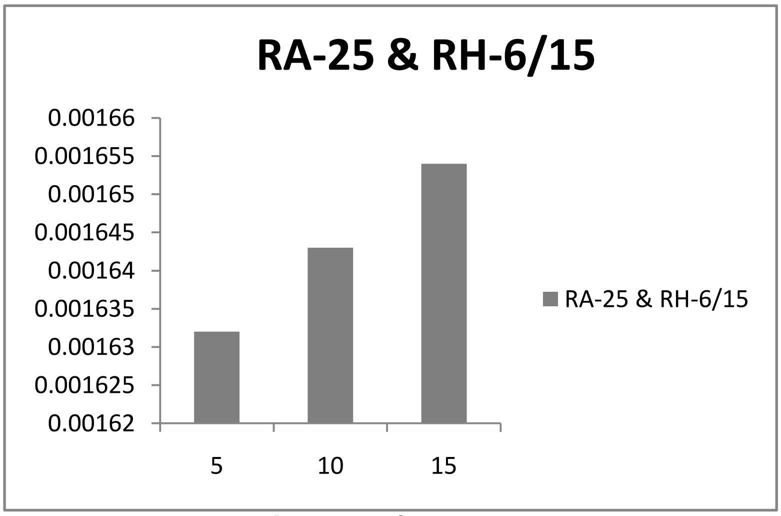

Figure:6 RA=25 and RH=6/15 for gap= 0.05m, 0.10m, 0.15m

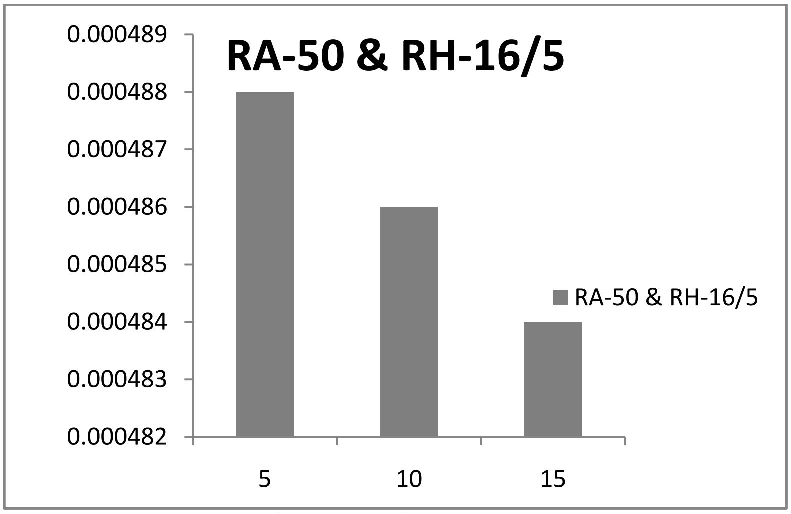

Figure:7 RA=50 and RH=16/5 for gap= 0.05m, 0.10m, 0.15m

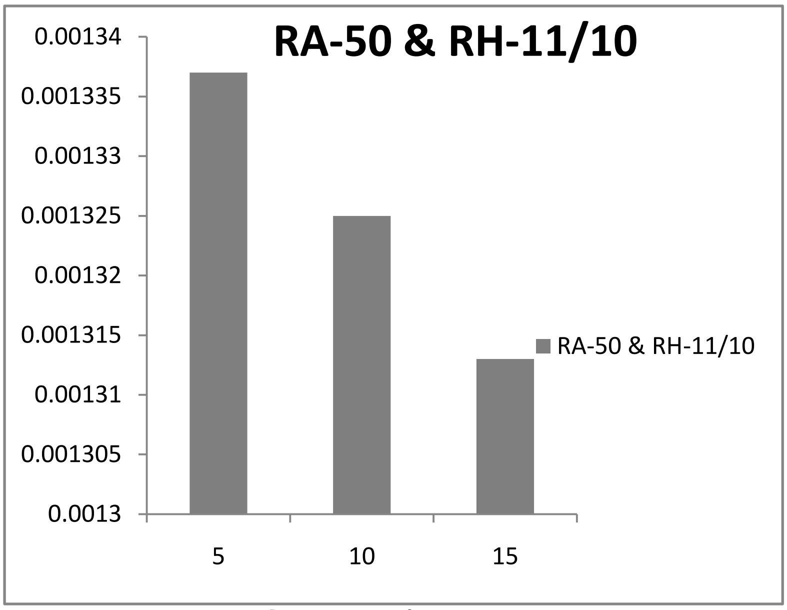

Figure:8 RA=50 and RH=11/10 for gap= 0.05m, 0.10m, 0.15m

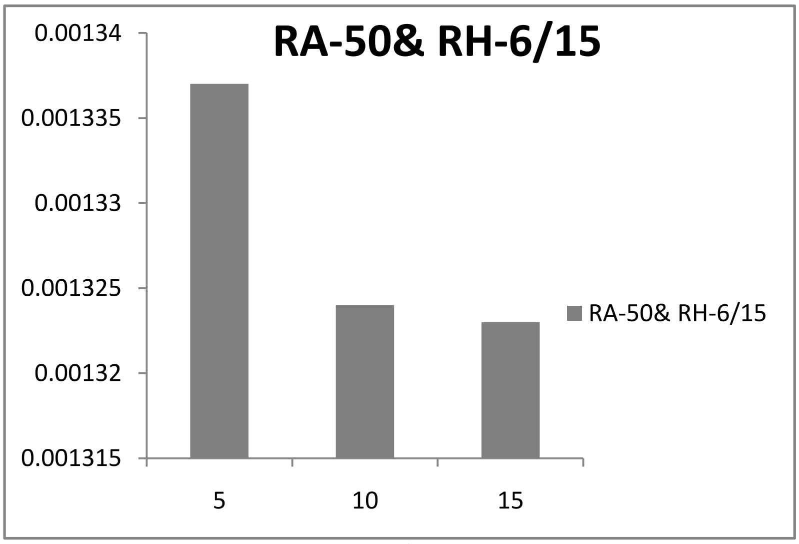

Figure:9 RA=50 and RH=6/15 for gap= 0.05m, 0.10m, 0.15m

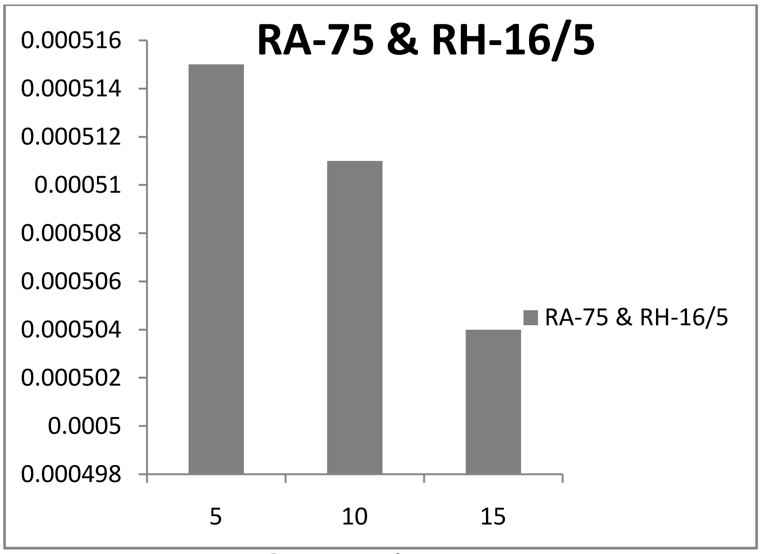

Figure:10 RA=75 and RH=16/5 for gap= 0.05m, 0.10m, 0.15m

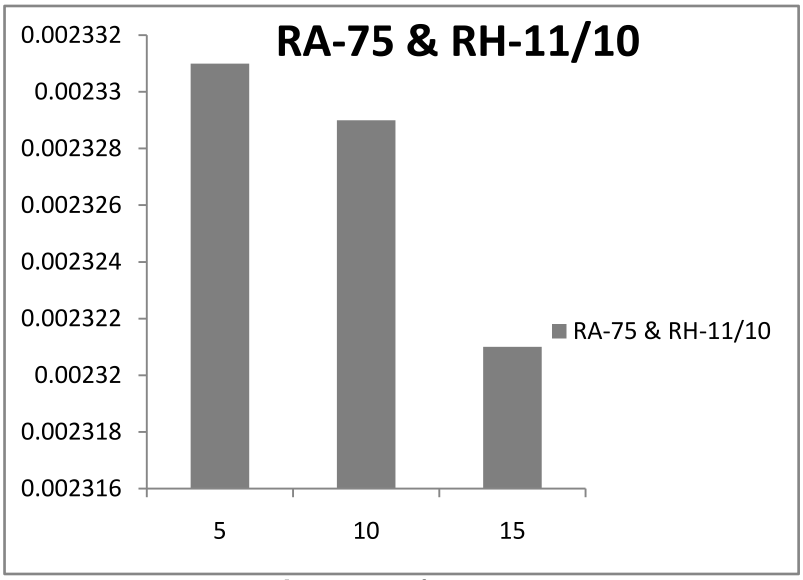

Figure:11 RA=75 and RH=11/10 for gap= 0.05m, 0.10m, 0.15m

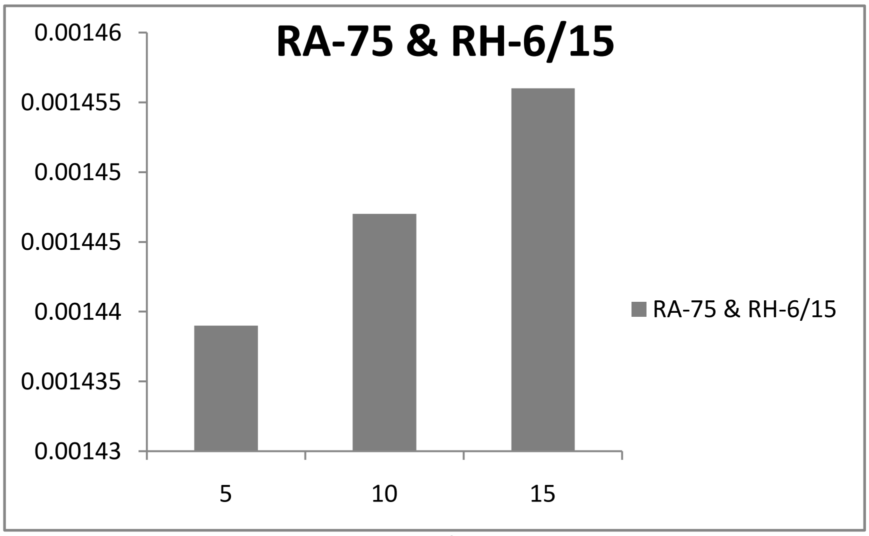

Figure:12 RA=75 and RH=6/15 for gap= 0.05m, 0.10m, 0.15m

Time history results clearly depict the need of seismic gap between adjoining structures. The initial models of RA=25%, RA=75% variation along the height shows the need of seismic gap between the range 5cm to 15cm. whereas for RA=50% and variation along height a seismic gap between 5cm to 10cm is suggested.

IV. CONCLUSIONS

The analytical studies involved design of different building geometries were taken for the study .the building geometries represent varying degree of irregularity or amount of setback.
Following conclusion can be draw from the obtaining result,
1) when RA=25,75 and RH=16/5,11/10 in that case response linearly increases then seismic gap width 15 cm have found to be sufficient. RA=25, 75 and RH=6/15 in that case seismic gap width more than 15 cm is needed.
2) RA=50 and RH=16/5,11/10 is show similar variation in seismic gap width 15 cm have found to be sufficient. But for RA=50 and RH=6/15 the seismic gap width 10 cm is sufficient.

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