

## International Journal of Innovative Research in Science, Engineering and Technology

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# Seismic Design of Multistorey RCC-Building with Dampers Using ETABS

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**ABSTRACT:** The basic principles of design for vertical and lateral loads (wind & seismic) are the same for low, medium or high rise building. But a building gets high both vertical & lateral loads become controlling factors. The vertical loads increase in direct proportion to the floor area and number of floors. In contrast to this, the effect of lateral loads on a building is not linear and increase rapidly with increase in height. Due to these lateral loads, moments on steel components will be very high. By providing viscous dampers these moments can be reduced.

In the present analysis, a residential building with 20 floors is analyzed with columns, columns with viscous dampers at different locations were for all the 2 cases. The building is analyzed in Zone 3 & Zone 5 with three soils in both static Analysis. Displacement were compared for all the cases. It is observed that the deflection was reduced by providing the Viscous dampers .

**KEYWORDS:** VISCOUS DAMPERS, RCC BUILDING, ETABS

### I. INTRODUCTION

Natural disasters are inevitable and it is not possible to get full control over them. The history of human civilization reveals that man has been combating with natural disasters from its origin but natural disasters like floods, cyclones, earthquakes, volcanic eruptions have various times not only disturbed the normal life pattern but also caused huge losses to life and property and interrupted the process of development. With the technological advancement man tried to combat with these natural disasters through various ways like developing early warning systems for disasters, adopting new prevention measures, proper relief and rescue measures. But unfortunately it is not true for all natural disasters. Earthquakes are one of such disaster that is related with ongoing tectonic process; it suddenly comes for seconds and causes great loss of life and property. So earthquake disaster prevention and reduction strategy is a global concern today. Hazard maps indicating seismic zones in seismic code are revised from time to time which leads to additional base shear demand on existing buildings. Retrofitting reduces the vulnerability of damage of an existing structure during future earthquakes. It aims to strengthen a structure to satisfy the requirements of the current codes for seismic design. In this thesis, a methodology has been proposed for retrofit of existing buildings for additional base shear demand and serviceability requirement using viscoelastic dampers. Seismic zone map in Indian standard IS 1893 Part 1 2002 is being revised from time to time which leads to increase in elastic demands on existing buildings. Base shears for a typical low rise (three storey) and high rise (twenty storey) buildings for zone 2, zone 3, zone 4 and zone 5 for hard soil condition are estimated using seismic coefficient method and time history analysis with spectrum compatible acceleration. Number of viscoelastic dampers and damping ratio required for different cases are worked out and the comparisons are made. The common practice to strengthen existing buildings is to strengthen members and joints with concrete or steel jacketing and to increase the size of the structural members so as to meet the new design requirements. However, it is a time-consuming process and requires demolition of plastering of members, further it may cause pollution to the environment. Considering the above disadvantages, earthquake resistant design and retrofit

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of structures using energy absorption devices have received desirable attention in recent years (Soong and Dargush 1997). Primary objective of adding energy passive dissipators is to enhance the damping of the structure and to bring down the demand on structural members without the help of external power supply and to minimize structural damage. Number of passive energy dissipators are employed in structural design viz., friction dampers, metallic dampers, viscoelastic dampers and dampers made out of smart materials.

## II. RELATED WORK

The plan of multistoried building is 24 x 24 m, here 24 is the length of the plan and 24 is the width of the plan and have a lift section design in the building. There are 6 flats in the ground floor and it is similar in the upper most part of the building and in the entry of the building one hall is have and in that hall we have given a lift section from bottom to upper part of the building.

### Statement of project

#### Salient features

Utility of building	:	Residential complex
No of stories	:	G+9
Type of construction	:	R.C.C framed structure
Types of walls	:	Brick wall

#### Geometry Details

Width of the building	:	24m
Height of building	:	30m
Height of the floor	:	3m

### Size of Structural Members

#### Column Size:

Column sizes from storey one to storey five = 600mm x 300mm  
Column size from storey five to storey ten = 450mm x 300mm

#### Beam sizes

Beams size from storey one to storey five = 450mm x 300mm  
Beams size from storey five to storey ten = 350mm x 230mm

**Slab Thickness:** 110 mm

#### Viscous dampers on each elevation

Grade of Concrete and Steel: M30; Fe 500 Steel

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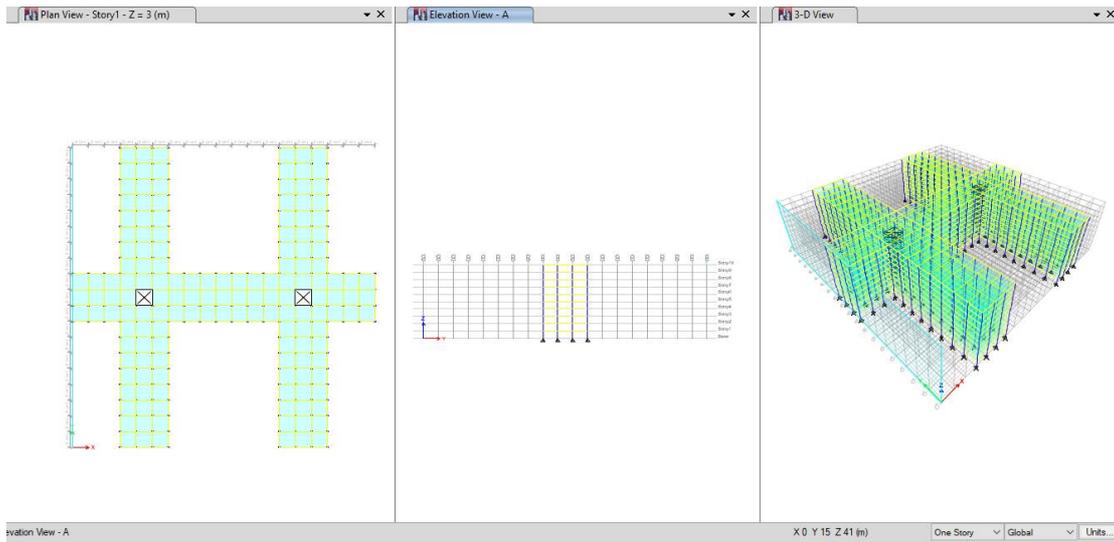


Figure 1: model considered in ETABS

### III. EXPERIMENTAL RESULTS

Case 1: Comparison of displacement in static analysis in zone 3& zone 5 in soil 1,2,3

Table 1 : Displacement comparison values in zone 3 soil 1 in static analysis

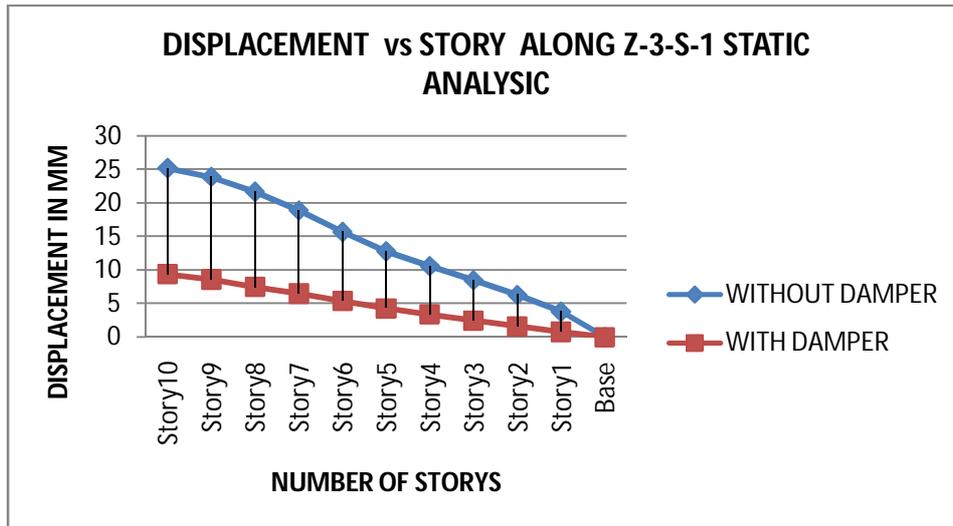
STORYS	WITHOUT DAMPERS	WITH DAMPERS
Story10	25.2	9.4
Story9	23.9	8.6
Story8	21.7	7.5
Story7	18.9	6.5
Story6	15.7	5.4
Story5	12.8	4.3
Story4	10.6	3.4
Story3	8.5	2.5
Story2	6.3	1.6
Story1	3.8	0.8
Base	0	0

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Graph 1 Variation of displacement along Z-3-S-1 in static analysis

Table 2 : Displacement comparison values in zone 3 soil 2 in static analysis

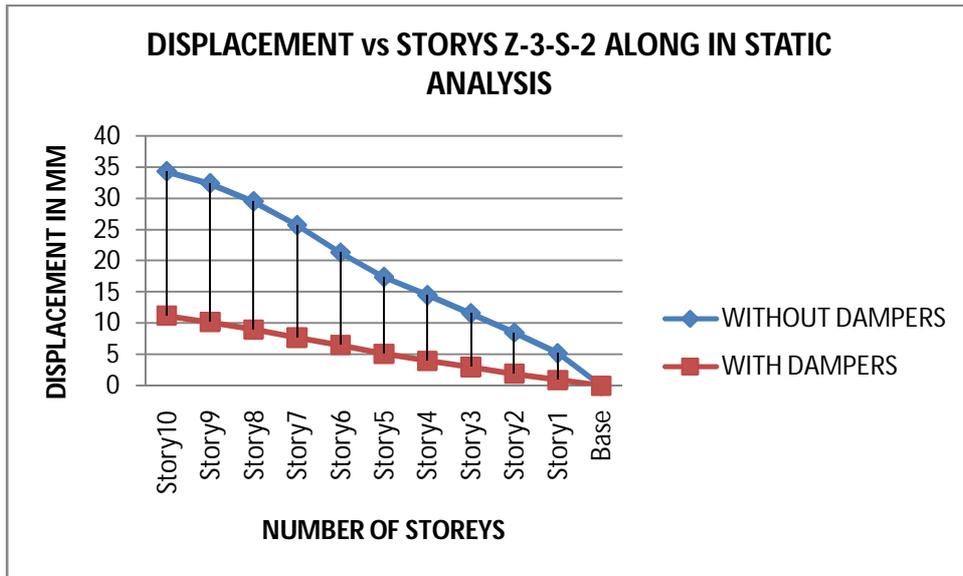
STORYS	WITHOUT DAMPERS	WITH DAMPERS
Story10	34.3	11.2
Story9	32.4	10.2
Story8	29.5	9
Story7	25.7	7.7
Story6	21.3	6.5
Story5	17.4	5.1
Story4	14.5	4
Story3	11.6	3
Story2	8.5	1.9
Story1	5.2	0.9
Base	0	0

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Graph 2 : Variation of displacement along Z-3-S-2 in static analysis

Table 3 Displacement comparison values in zone 3 soil 3 in static analysis

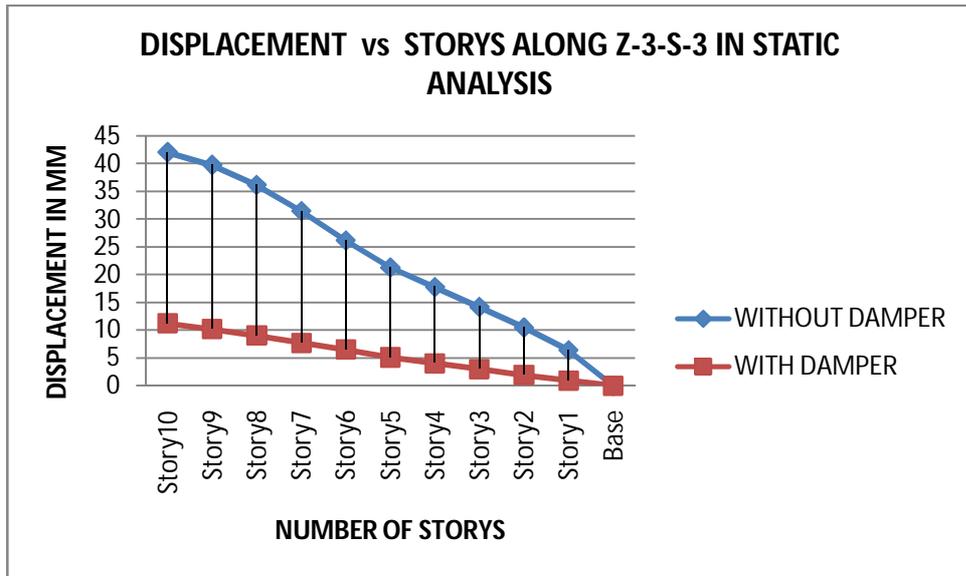
STOYRES	WITHOUT DAMPERS	WITH DAMPERS
Story10	42.1	11.2
Story9	39.8	10.2
Story8	36.2	9
Story7	31.5	7.7
Story6	26.2	6.5
Story5	21.3	5.1
Story4	17.8	4
Story3	14.2	3
Story2	10.5	1.9
Story1	6.4	0.9
Base	0	0

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Graph 3 Variation of displacement along Z-3-S-3 in static analysis

Table 4 : Displacement comparison values in zone 5 soil 1 in static analysis

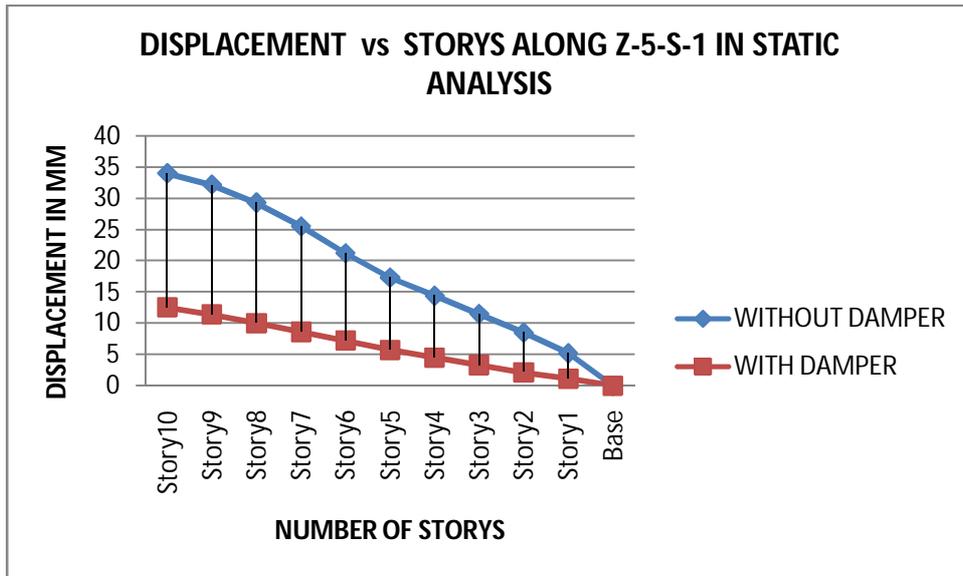
STORYS	WITHOUT DAMPERS	WITH DAMPERS
Story10	34	12.5
Story9	32.2	11.4
Story8	29.3	10
Story7	25.5	8.6
Story6	21.2	7.2
Story5	17.3	5.7
Story4	14.4	4.5
Story3	11.5	3.3
Story2	8.5	2.1
Story1	5.2	1.1
Base	0	0

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Graph 4 Variations of displacement along Z-5-S-1 in static analysis

Table 5 : Displacement comparison values in zone 5 soil 2 in static analysis

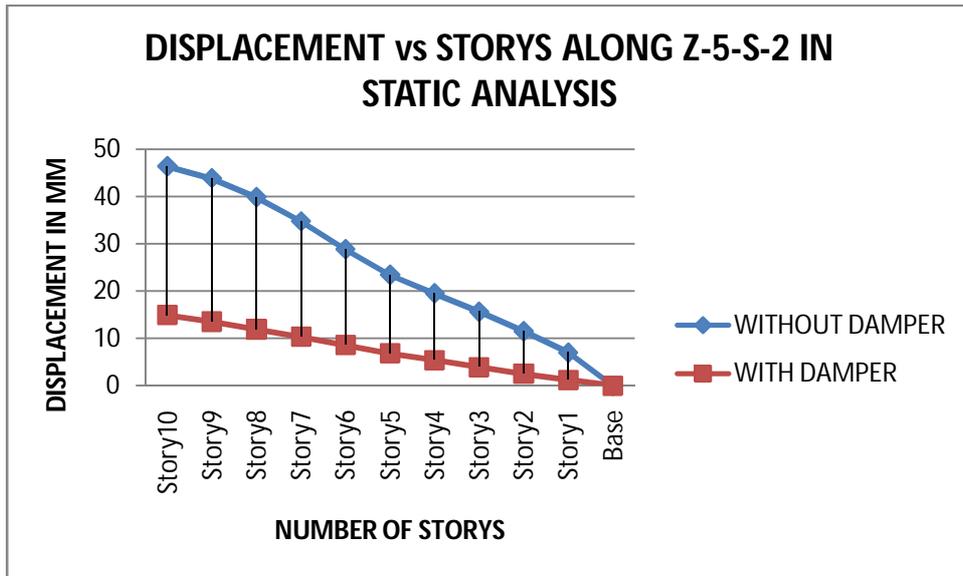
STORYS	WITHOUT DAMPERS	WITH DAMPERS
Story10	46.3	14.9
Story9	43.8	13.5
Story8	39.8	11.9
Story7	34.7	10.3
Story6	28.8	8.6
Story5	23.4	6.8
Story4	19.5	5.4
Story3	15.6	3.9
Story2	11.5	2.5
Story1	7	1.2
Base	0	0

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Graph 5 Variation of displacement along Z-5-S-2 in static analysis

Table 6 Displacement comparison values in zone 5 soil 3 in static analysis

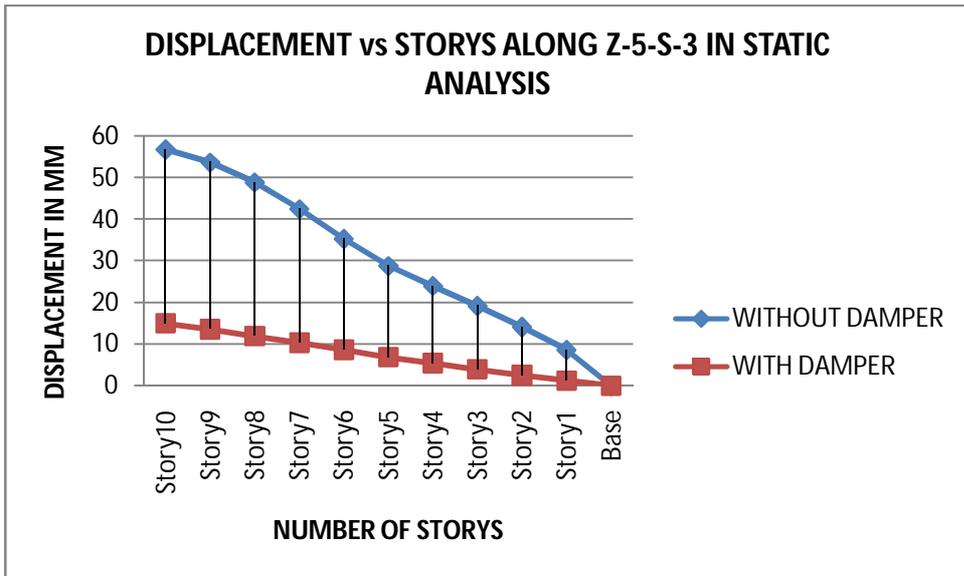
STORIES	WITHOUT DAMPERS	WITH DAMPERS
Story10	56.8	14.9
Story9	53.7	13.5
Story8	48.9	11.9
Story7	42.5	10.3
Story6	35.3	8.6
Story5	28.8	6.8
Story4	24	5.4
Story3	19.2	3.9
Story2	14.1	2.5
Story1	8.6	1.2
Base	0	0

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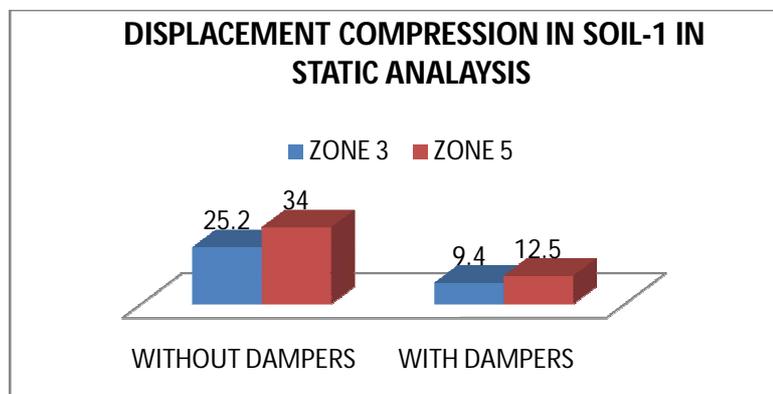


Graph 6 Variation of displacement along Z-5-S-3 in static analysis

Case 2 : Zone wise comparison of displacement along soil 1,2,3

Table 7 Displacement comparison values along soil-1 in Z-3 & Z-5

	SOIL 1	
	WITHOUT DAMPERS	WITH DAMPERS
ZONE 3	25.2	9.4
ZONE 5	34	12.5



Graph 7 :Variation of displacement in Z-3 & Z-5 in soil-I in static analysis

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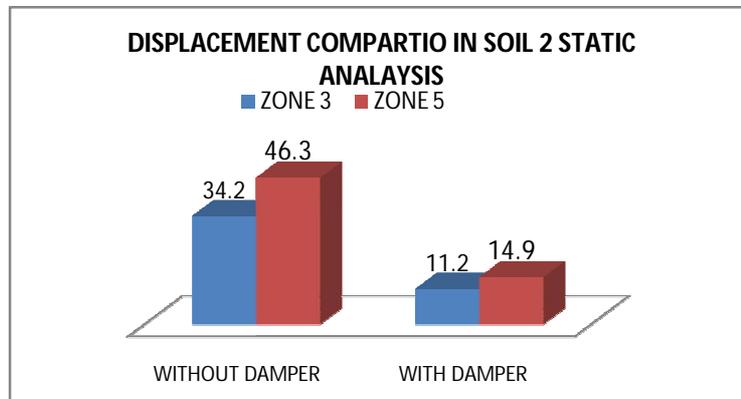
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Table 8 Displacement comparison values along soil-II in Z-3 & Z-5

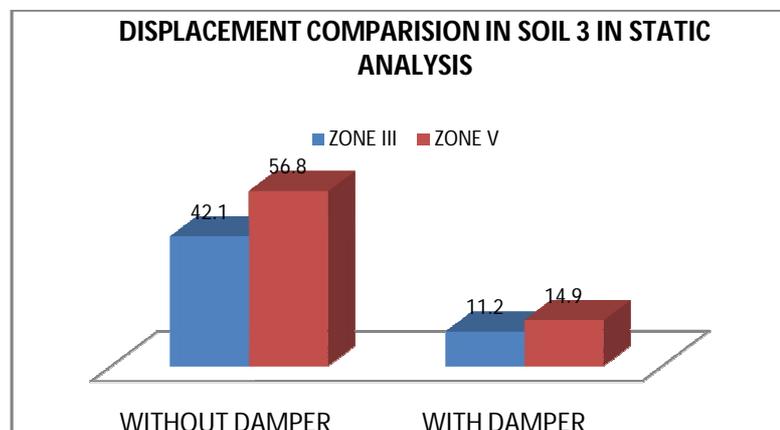
	SOIL 2	
	WITHOUT DAMPER	WITH DAMPER
ZONE 3	34.2	11.2
ZONE 5	46.3	14.9



Graph 8 Variation of displacement in Z-3 & Z-5 in soil-2 in static analysis

Table 9 Displacement compression values along soil-3 in Z-3& Z-5

	SOIL 3	
	WITHOUT DAMPER	WITH DAMPER
ZONE 3	42.1	11.2
ZONE 5	56.8	14.9



Graph 9 Variation of displacement in Z-3 & Z-5 in soil-2 in static analysis

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## IV. CONCLUSION

1. Displacement is compared for two models i.e., with out dampers & with dampers at top storey of a high rise building in zone-2 & zone -5 in each soil it is observed that 50% displacement is reduced when the dampers are provided at each elevation.
2. By providing the dampers the stiffness of the structure is increased and storey shear is decreased with increase in height of structure.

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