Design of RCC Structure Using Dampers in All the Seismic Zones

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ABSTARCT

The structures considered here are high-rise residential buildings (G + 11) located at various earthquake zones and wind speeds of approximately 50m/s.The size of the building plan is 30mx25m. Design made at three specific earthquake zones III, IV, V. These structures are made up of beams and columns constructed of RCC. The height of each floor is 3m on standard floors, the height of the bottom floor is 2m and the total height of the building is 32m.

In addition to the loads due to the effects of gravity, the magnitude of the earthquake should be considered when designing buildings in earthquake zones. The philosophy in the general earthquake construction is that the structures should be designed to withstand lateral loads associated with wind and earthquakes by its elasticity only, and the structure is allowed to deteriorate but not collapse while carrying the load on the side of moderate or severe earthquakes. These structures must be strong enough to prevent a major displacement and acceleration in order to maintain their functions in the service of the structure.

Dampers allow the structure to dissipate earthquake energy. This, in turn, produces significant savings as building components can be made to save costs. By doing so, the building is able to withstand earthquakes without causing significant damage to its structure.

1. INTRODUCTION

In addition to the loads due to the effects of gravity, the magnitude of the earthquake should be considered when designing buildings in earthquake zones. The philosophy in the general earthquake construction is that the structure is designed to withstand side loads associated with wind and small earthquakes by its elasticity only, and the structure is allowed to deteriorate but not collapse while carrying the load on the side of moderate or severe earthquakes. As a result, plastic hinges on buildings must be developed to use earthquake power when the building is under intense vibration. Design methods based on this philosophy are welcome to respond to the needs of economic considerations and health safety. However, the development of plastic badges depends on the maximum modification and high height of the structure. When the building is in good working condition, there is a great deal of damage. Otherwise, other important structures such as hospitals and fire stations should remain operational after a major earthquake, the above-mentioned design philosophy (health safety) may not be appropriate. These structures must be strong enough to prevent a major and rapid earthquake in order to maintain their functions while in the service of the structure.

In this study, these models are employed under three seismic zones and modeling the actual dynamic behavior of dampers installed at in the numerical model of a practical high-rise Reinforced cement concrete building

1.1 Loading, Analysis, and Design

Once the modelling is completed, ETABS automatically generates and provides coding-based loading conditions, earthquake power, wind, Users can specify an unlimited number of download cases and combinations.

The ability to analyze and then provide advanced non-linear methods for static-pushover placement and dynamic feedback. Strong considerations may include modelling, response recognition, or time history analysis. P-delta effect of geometric nonlinearity.

Given the specificity of the cover, the design features will automatically add materials and systems, design reinforcement schemes, and otherwise improve the structure according to the desired operational steps.

2. Literature Review

Structural Analysis Using Strange Relays In Earthquake-V 1abhishek Kumar Maurya, 2v.K. Singh et al., Nowadays a large number of buildings tend to be prone to earthquakes and this has highlighted the fact of ignorance in the construction of high-rise buildings and has raised concerns about the need for earthquake-resistant structures. This paper learns about a reinforced multi-storey structure and their vibration parameters. It also deals with comparisons between seismic behaviour of a fixed structure without a constraint in the proposed structure where the dampers are connected at different locations namely Middle and Corners. The G + 11 building analysis was performed to determine the difference in response to the fixed RC structure without a buffer and a structure fitted with a viscous damper at various locations. Time history analysis is used and performed by ETABS 2016. After capturing the earthquake event in India (Sikkim) -Nepal-Border Region became

Consideration Story Drift, Story Displacement and Mode times some parameters under the dynamic load of this building -RC read on this paper

Xiaoli Wu, 1,2 Wei Guo, 1,2 Ping Hu, 3 Dan Bu, 4 Xu Xie, 5 and Jao Hu 1,2 et al. In this paper, we consider the approximate earthquake, the seismic activity of the system to construct a ground-breaking structure and the effect of the failure of the mitigation system. Subsequently, the impact of damper failure is investigated, suggesting that damper failure will significantly affect the seismic performance of the building program, particularly in the construction-SCD system. Subsequently, by introducing near-magnitude earthquakes, errors of various heart rate parameters, such as pulse velocity amplitude, pulse duration, and number of critical pulses, are studied. It shows that the pulse velocity amplitude and pulse time are clearly affected by seismic activity, while the number of critical pulses does not provide a small effect.

Carolina TOVAR 1 and Oscar A. LÓPEZ 2 et al., The objectives of this paper are: i) to know the variation in placement and the number of dampings affect the seismic response of the framework, and ii) to study the simplified method of analyzing non-artificial draft structures, to read how a simplified traffic error is influenced by the placement of dampers. To achieve these goals, five-storey two-storey minute flats have been used for basic ground time under earthquakes.. The results showed that the installation of dampers greatly influenced the structural response

3. NECESSITY OF THE WORK

Civil engineering structures are designed to withstand different types of loads. Often the effects of dynamic loads on a building are not considered. This negligence of dynamic energy is sometimes the cause of disaster, especially in the event of an earthquake and severe wind activity in a building. This has created a growing interest and need for an earthquake-resistant structure. The greater the strength of the structure the more plastic deformities do not fall, the more the only is the collapse and the power loss. This causes a decrease in the damage due to force of the active earthquake. Generally without a collapse, the above is the only downfall that comes with the energy distribution.

To study the structural design of the building and its necessity using advanced analysis tool when carrying out structural seismic response assessment. The following are the necessities of the work

- Assess the response to building construction under earthquakes and suggest appropriate remedial and strengthening measures. This was done to restore the earthquake damaged structure to its intended service while maintaining the code required for earthquake resistance.
- Exploring and designing earthquake-resistant solutions for existing buildings.
- Designing new structure facilities using building materials, systems, or other materials using the Fluid Viscous Dampers system can have a significant impact on reducing earthquake responses.
- Assessing the design of buildings to the specific needs of the owner
- Investigate the strength of an earthquake resistance for each object

4. OBECTIVES OF THE STUDY

- To develop an analytical model for different structural systems.
- To carry out design analysis and design of the considered building using ETABS.
- To check the analysis results of ETABS for lateral stability as per IS code provisions for seismic and wind loads
- To provide a brief description to various components of members.
- Identify critical regions where deformations are expected to be high and focus on the detailing
- Perform a dynamic analysis of the load-bearing structures subjected to lateral loads
- To examine, how the variation in placement and number of damping affects the earthquake response of the structure
- To evaluate the effectiveness of viscous fluid dampers in reducing earthquake-responsive structural systems.

5. SCOPE OF THE PRESENT STUDY

The structures taken into consideration here are (G+11) storey residential building located in different seismic zones and wind velocity considered is 50m/s. The plan dimension of the building is 30mx25m. The design carried out in three specific seismic zones III, IV,V. The structure is designed with beams and columns made up of RCC. Height of each storey is 3m in typical storeys, bottom storey height is 2m and the total height of the building is 32m.The main objective of this present study is to evaluate the effectiveness of viscous fluid dampers in reducing earthquake response structural systems.

The purpose of this study was to examine the effect of the fluid viscous dampers on the behaviour of high rise structures due to seismic activity. Design and analysis are performed using ETABS software

6. ASSUMPTIONS OF THE WORK

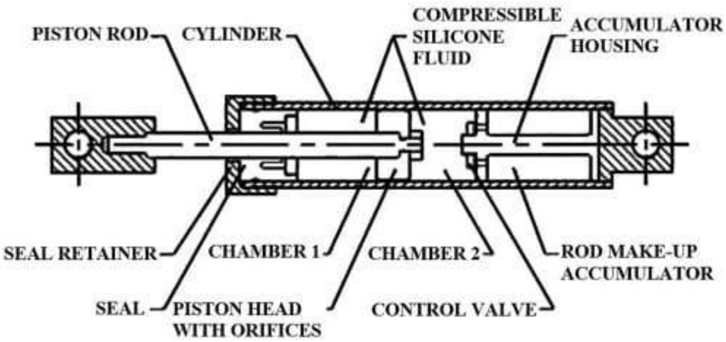
Certain assumptions have been made before the dissertation problem was initiated. They are as follows:

- The condition of the soil is considered to be of medium type.
- The wind forces and its effects on the buildings are considered as per IS 875-1987 (part3)
- The earthquake forces and its effects on buildings are considered as per IS 1893-2002.
- The type of building considered is residential building

Damper systems are designed and constructed to protect the each member of the structure, and to control structural damage, and to protect residents from damage by detecting seismic forces and to reduce deformities in the structure. The following are the types of dampers

6.1. Viscous Dampers

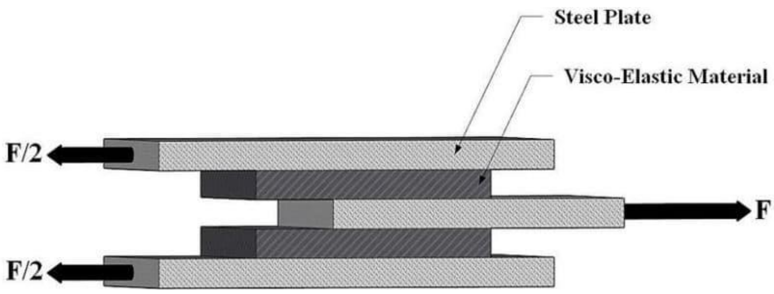
In viscous dampers, seismic forces are absorbed by the silicone-based fluid passing through the piston-cylinder configuration. Viscous dampers are used in the tallest buildings in high seismic zones. It can operate at higher temperatures from 40 ° C to 70 ° C. A viscous damper reduces vibration caused by strong winds and earthquakes.



6.1. Viscous Dampers

6.2. Viscoelastic Dampers

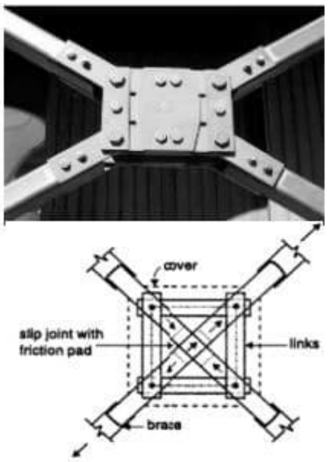
Viscoelastic dampers are simple elastomer in combination with metal parts. This type of damper dissipates the mechanical energy by converting it into heat. Factors such as temperature and loading system affect the performance and consequently the performance of the damper system.



6.2. Viscoelastic Dampers

6.3. Friction Dampers

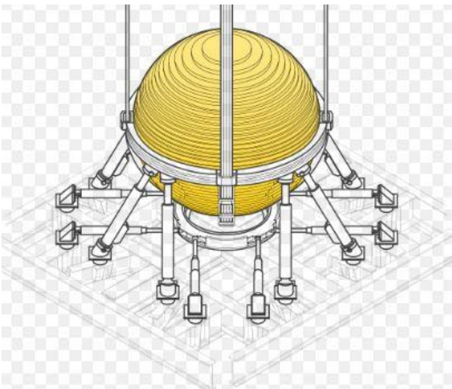
Typically, a friction damper consists of several metal plates that slide against each other on opposite sides. The metal plates are separated by strands of cross-object material. The damper dissipates energy by applying a collision between the colliding surface. It is also possible to build spaces from materials other than metal.



6.3. Friction Dampers

6.4. Tuned Mass Damper

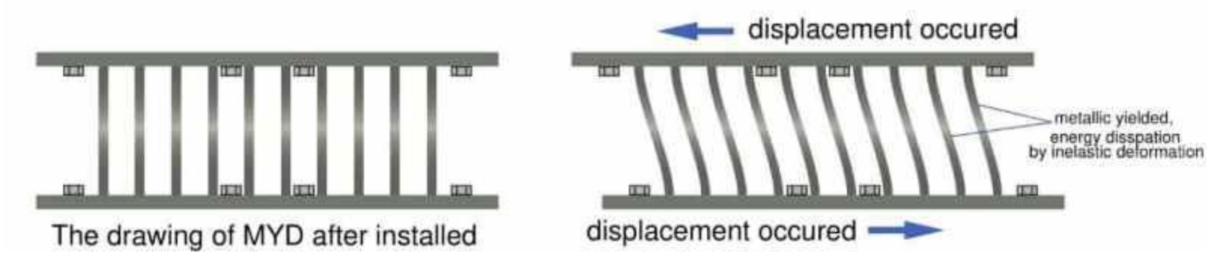
The Tuned Mass Damper (TMD), also known as vibrato dampers or vibrator absorbers, is an idle control device installed in the building to reduce the vibration to an acceptable level whenever strong lateral forces such as earthquakes or strong winds are blown. The use of a mass tuned damper can prevent discomfort, damage, or direct structural failure. They are often used in high-rise structures, automobiles.



6.4. Tuned Mass Damper

6.5. Yielding Dampers

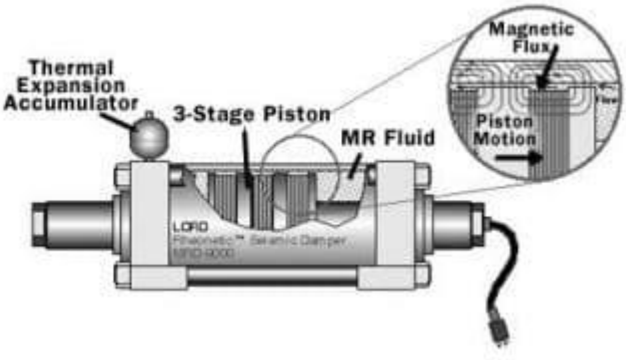
Yielding Dampers is made of easily removed metal or alloy material. It dissipates energy by its flexibility of plastic (allowing metal equipment) which converts vibrating forces and thereby minimizes damage to key structural elements. Providing dampers are economical, efficient, and proven to be a good power distributor.



6.5. Yielding Dampers

6.6. Magnetic Dampers

Magnetic Damper consists of two racks, two pins, a copper disc and magnets. This type of damper is inexpensive and does not depend on temperature. Reducing the magnetic field is not energy and that is why it works well for powerful vibrating vibes that require a little softening



6.6. Magnetic Dampers

7. MODELLING IN ETABS

Table-1 General description and parameters

Parameter Name	Property
Type of building	Residential building
Plan dimension	30mx25m
Total height of the building	32m
Typical story height	3m
Bottom story height	2m
Height of parapet	1.0m
Size of beam	400mmx600mm
Size of column	600mmx750mm
Thickness of slab	150mm
Wind speed	50m/s
Soil condition	Medium soil
Damping ratio	5%
Live load at all floors	3.0 kN/m^2
Grade of concrete	M25
Grade of reinforcing steel	Fe415
Density of concrete	$25kN/m^3$
Density of reinforcement bars	$77kN/m^3$
Code used for RCC design	IS 456:2000

The structure was designed with fluid viscous dampers in every storey in three seismic zones All the models are analyzed to study their seismic performance while considering the parameters such as Story displacement, Story drift and Model period.

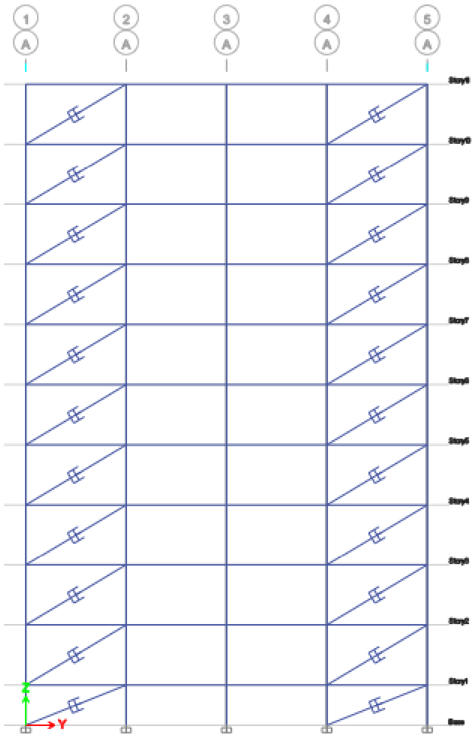


Fig:7

Building with fluid viscous dampers in elevation A

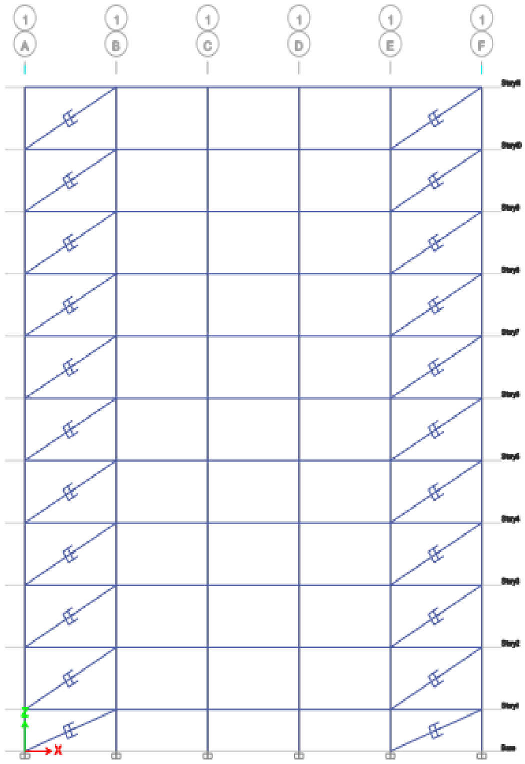


Fig:8

Building with fluid viscous dampers in elevation 1

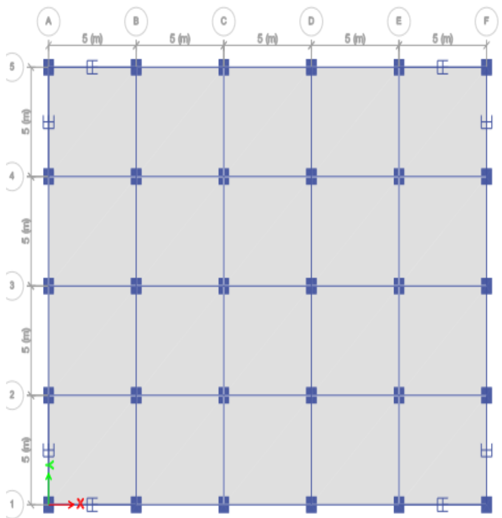


Fig 9: Plan

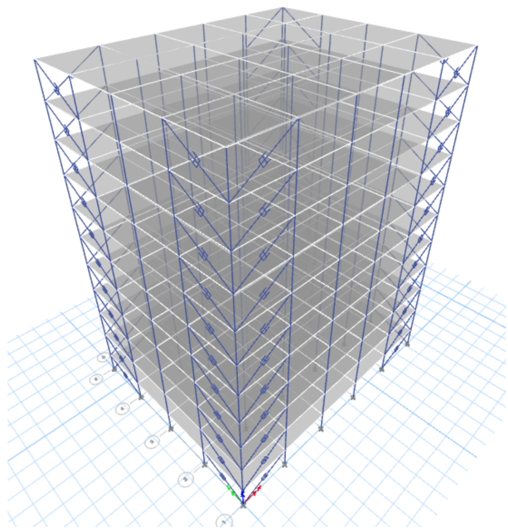


Fig10: 3-D view

8. RESULTS AND DISCUSSION

TABLE: Storey Response ZONE III						
Story	Elevation	Location	X-Dir	X-Dir with dampers	Y-Dir	Y-Dir with dampers
	M		mm	Mm	mm	mm
Story11	32	Top	12.313	11.696	12.353	11.562
Story10	29	Top	11.248	11.131	11.064	11.164
Story9	26	Top	10.554	9.909	10.343	9.945
Story8	23	Top	9.621	8.637	9.398	8.672
Story7	20	Top	8.492	7.318	8.261	7.35
Story6	17	Top	7.212	5.98	6.976	6.007
Story5	14	Top	5.824	4.662	5.587	4.683
Story4	11	Top	4.368	3.406	4.138	3.421
Story3	8	Top	2.89	2.258	2.687	2.267
Story2	5	Top	1.47	1.27	1.329	1.273
Story1	2	Top	0.315	0.494	0.277	0.493
Base	0	Top	0	0	0	0

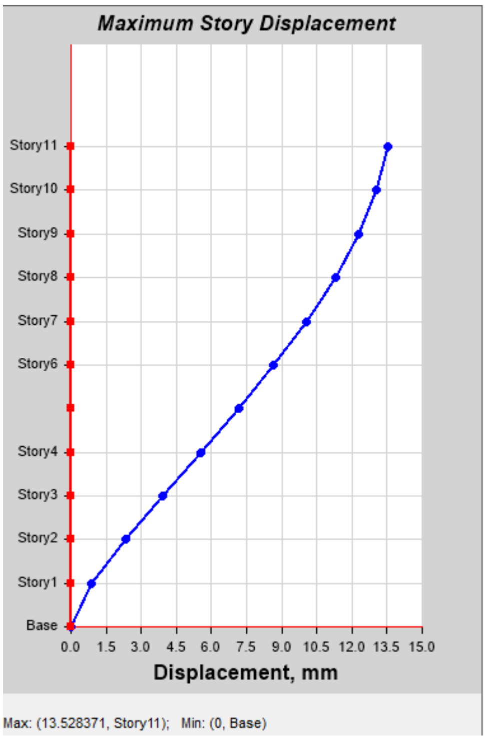


Fig 11: Max Storey Response in X-Direction Without dampers in Zone III

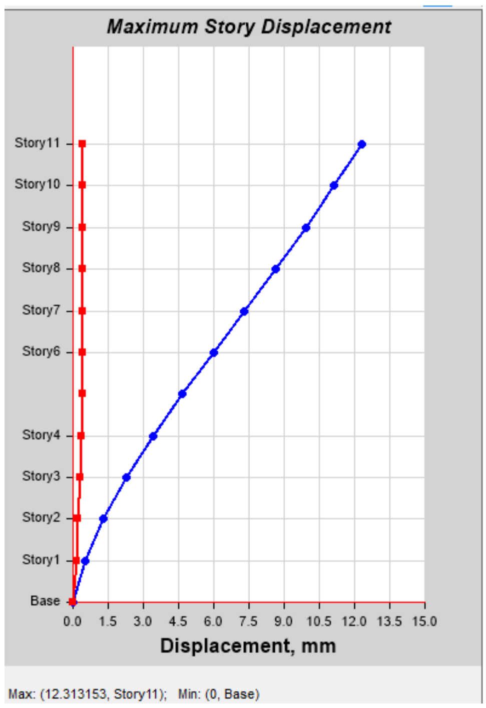


Fig 12: Max Storey Response in X-Direction With dampers Zone III

TABLE: Storey Response ZONE IV						
Story	**Elevation**	**Location**	**X-Dir**	**X-Dir with dampers**	**Y-Dir**	**Y-Dir with dampers**
	m		mm	Mm	mm	mm
Story11	32	Top	23.794	17.544	17.614	17.344
Story10	29	Top	22.107	16.872	15.842	16.596
Story9	26	Top	19.957	15.831	14.033	15.514
Story8	23	Top	17.528	14.432	12.141	14.097
Story7	20	Top	14.897	12.738	10.18	12.392
Story6	17	Top	12.131	10.818	8.202	10.465
Story5	14	Top	9.325	8.735	6.268	8.38
Story4	11	Top	6.594	6.552	4.448	6.207
Story3	8	Top	4.077	4.335	2.82	4.03
Story2	5	Top	1.934	2.204	1.47	1.993
Story1	2	Top	0.557	0.473	0.479	0.416
Base	0	Top	0	0	0	0

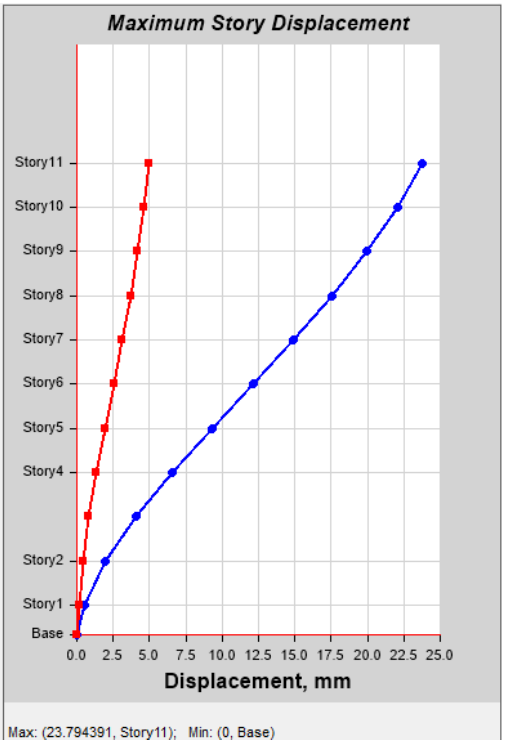


Fig 13: Max Storey Response in X-Direction Without dampers in Zone IV

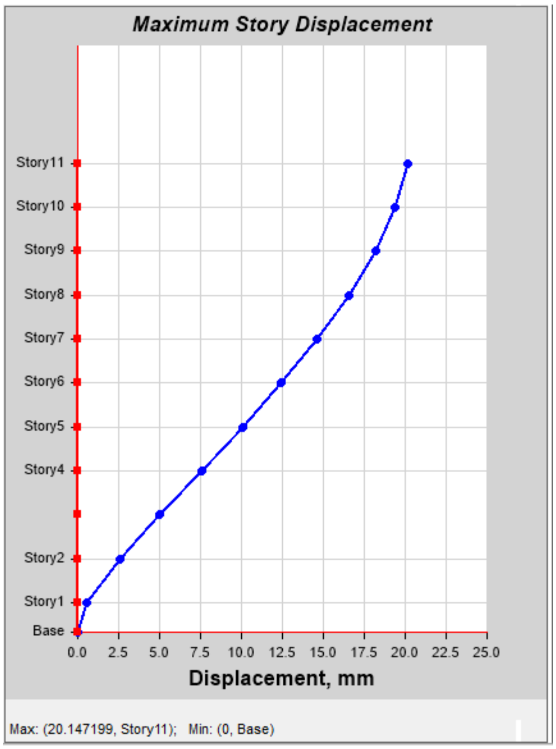


Fig 14:Max Storey Response in X-Direction With dampers Zone IV

TABLE: Storey Response ZONE V						
Story	**Elevation**	**Location**	**X-Dir**	**X-Dir with dampers**	**Y-Dir**	**Y-Dir with dampers**
	m		mm	Mm	mm	mm
Story11	32	Top	26.317	21.301	26.016	21.401
Story10	29	Top	25.308	19.194	24.893	19.274
Story9	26	Top	23.746	16.979	23.272	17.063
Story8	23	Top	21.648	14.695	21.145	14.769
Story7	20	Top	19.108	12.336	18.588	12.399
Story6	17	Top	16.227	9.961	15.697	10.011
Story5	14	Top	13.103	7.641	12.57	7.676
Story4	11	Top	9.827	5.455	9.311	5.475
Story3	8	Top	6.503	3.491	6.045	3.497
Story2	5	Top	3.307	1.847	2.989	1.841
Story1	2	Top	0.709	0.621	0.624	0.609
Base	0	Top	0	0	0	0

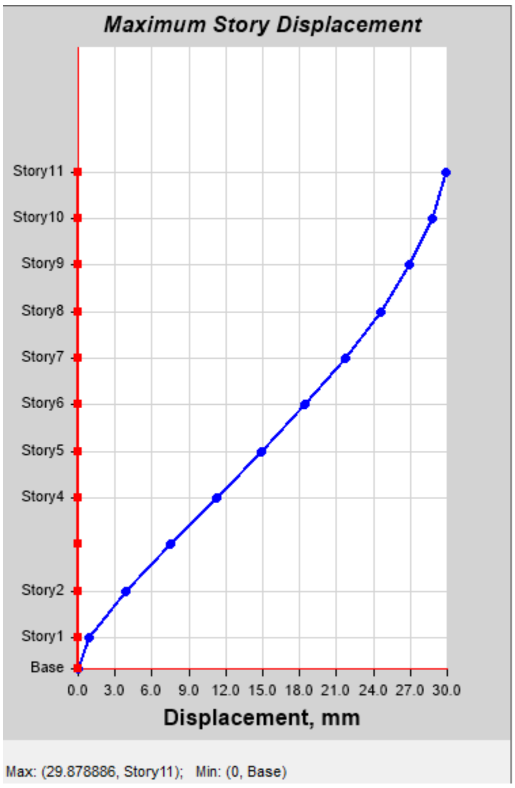


Fig 15: Max Storey Response in X-Direction Without dampers in Zone V

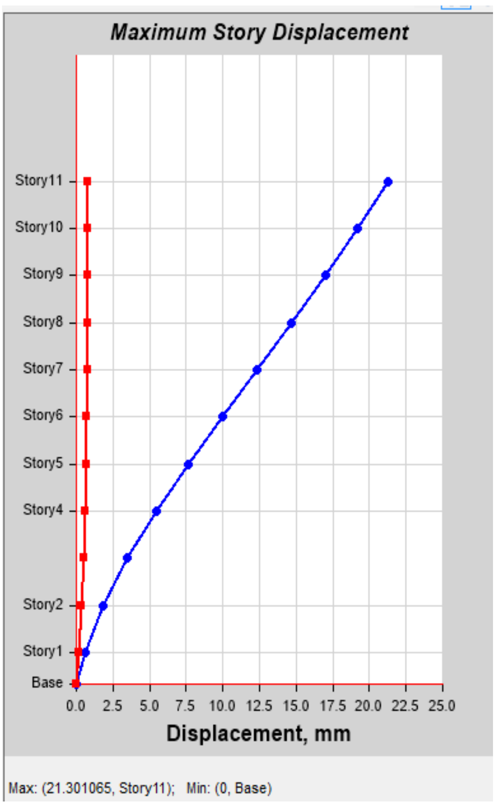
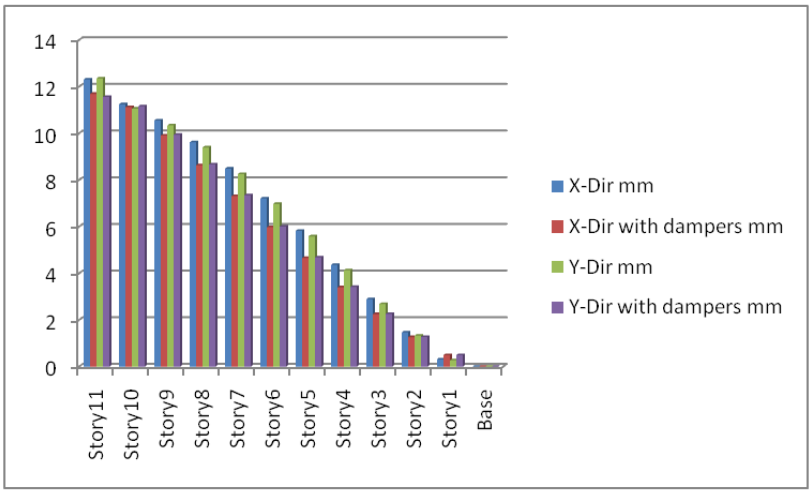
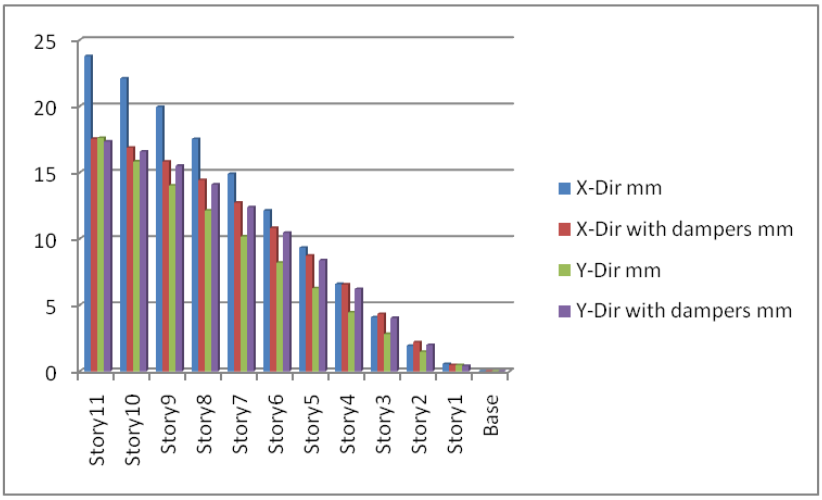


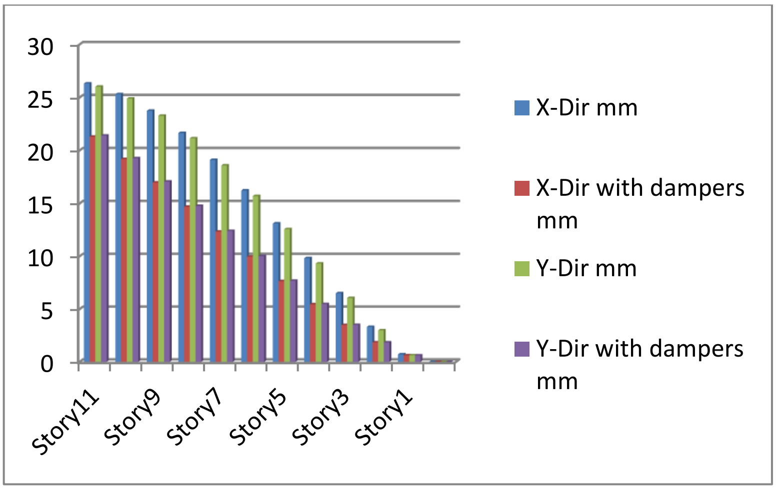
Fig 16: Max Storey Response in X-Direction With dampers Zone V



Comparison of Storey response in Zone III with and without dampers



Comparison of Storey response in Zone IV with and without dampers



Comparison of Storey response in Zone V with and without dampers

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CONCLUSIONS

- The main objective of this study was to design a reinforced concrete structure in different earthquake zones.
- The results of this study indicate that the structural response can be reduced by using a fluid viscous damper.
- Maximum storey displacements reduced with the introduction of dampers in the structure at each storey
- It has been observed that storey drifts have been reduced to a much lower value with buildings having fluid viscous dampers
- Application of damper reduces the maximum storey displacement in each floor. Hence, Dampers at each storey gives satisfactory result under seismic condition.
- By applying viscous damper to the structure there is reduction of about 60% to 80% in drift value at top and bottom stories

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