Performance of SMRF with Visco-elastic Damper in High Seismicity Region

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Abstract-Dampers now-a-days widely used for the vibration control of structures. Because of use Damper the structure becomes more safe and economical .This Paper is focused on the Design of Steel structures with and without visco-elastics damper. Damper is used to resist lateral forces on the structure. Time history analysis is carried out on G+5,10,15 steel structure with and without visco-elastic damper byusing etabs 2020.The results shows that the vale of maximum displacement, drift is more in case ofstructure without damper and less in case of steel structure with damper.

Keywords: Visco-elastic Damper, steel frames, Seismic response

INTRODUCTION

The Visco-elastic Dampers are more applied instrument for controlling reactions of the structures. The dampers are applied dependent on various development advancement so as to diminish the basic reaction to the seismic excitation. Over last few years the world has experienced various earthquakes. Because of this increased loss of human life and structures also damaged. In most recent couple of years, numerous fundamental improvements in seismic codes are turned up. Most extreme of the alteration in the seismic plan territory get from more noteworthy consciousness of real helpless structures exhibitions in contemporary tremors. Because of the restored information on the current structures conduct, retrofit of structures is a central undertaking in decreasing seismic hazard. New methods for securing structures against seismictremor have been created with the point of improving ability. Seismic separation and vitality scattering are generally perceived as powerful security strategies for arriving at the presentation destinations of current codes. Notwithstanding, numerous codes incorporate plan particulars for seismically confined structures, while there is still need of improved guidelines for vitality scattering defensive frame works.

PROPERTIES OF VISCOELASTIC DAMPERS

The Visco-elastic dampers have been effectively used in various tall structures as a reasonable vitality scattering framework to smother wind-and earthquake-initiated movement of building structures. This sort of damper disperses the structure's mechanical vitality by changing over it into heat. A few factors, for example, encompassing temperature and the stacking recurrence will influence the presentation and subsequently the viability of the damper framework.VE dampers have had the option to expand the general damping of the structure essentially, subsequently improving the general execution of powerfully touchy structures. The Viscoelastic material exhibit combined features of elastic solid and viscous liquid when undergoing deformation, i.e. material will return to their original shape after one cycle of deformation but with a some amount of energy lost as heat.

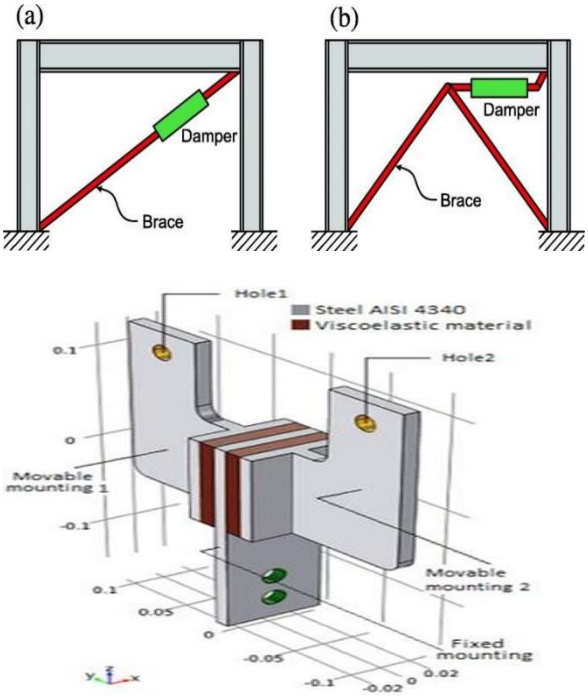
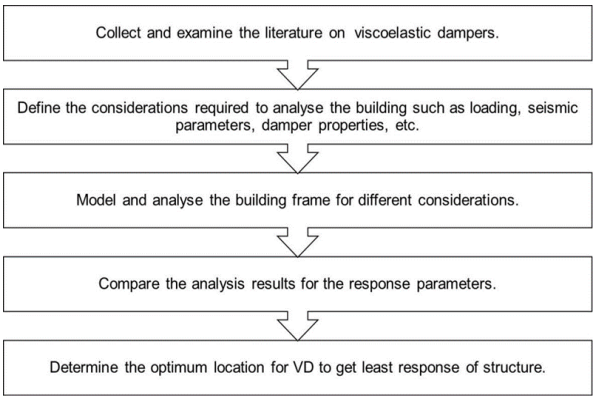


Fig.1.Viscoelastic Damper

METHODOLOGY

To lesson the reaction of the structure viably utilizing without dampers and viscoelastic dampers and demonstrating the most productive in the soundness of the structure between two. The investigation in this theory depends on straight and non-linear examination. Exact demonstrating of the non linear properties ofdifferent basic components is significant in non-linear examination.



1.Design Data

Material properties-Fe 345 and Fe 415 evaluation of steel section are utilized for all section propertiestaken according to IS 800:2007.Steel bar with stress and modulus of elasticity is taken according to IS 800:2007.

2.Description of Members used:

Column sizes:

Schedule of column	G+5	G+10	G+15
C1-C25	ISWB 150-ISWB 600	ISWB 150-ISWB 600	ISWB 150-ISWB 600

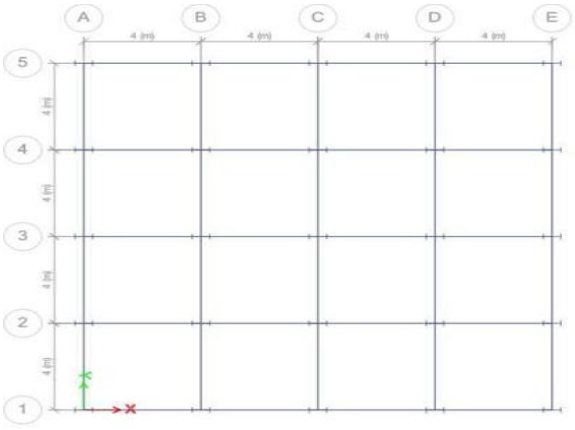
Beam size: Bottom to second last floor ISMC 175 and ISMC 100

3.General Details

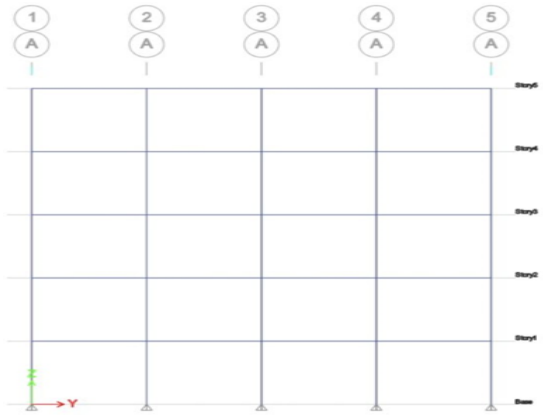
No.of storeys	G+5,10,15
Plan dimension	16x16
Seismic zone	V
Type of structure	SMRF
Storey height	3
Dead load	1
Live load	1
Earthquake load	IS 1893:2016(Part 1)
Wind load	IS 875:2015
Seismic properties	
Zone Factor(Z)	0.36
Response reduction factor	5
Importance factor	1
Soil type	II
Damping ratio	0.05

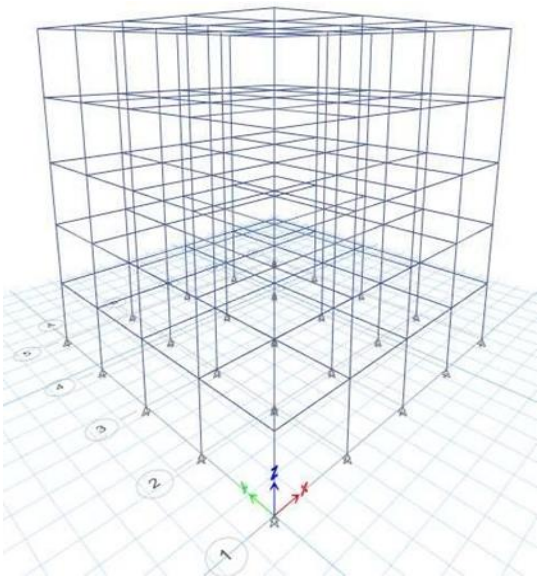
Viscoelastic properties	
Mass	98 kg
Weight	500 Kn
Eff.stiffness	30000 kn/m
Eff.Damping	420 kn(s/m)

Modeling of Steel Structure without Damper



Plan Elevation





3D View Fig.2 steel Structure without Damper

Modeling of Steel structure with Damper

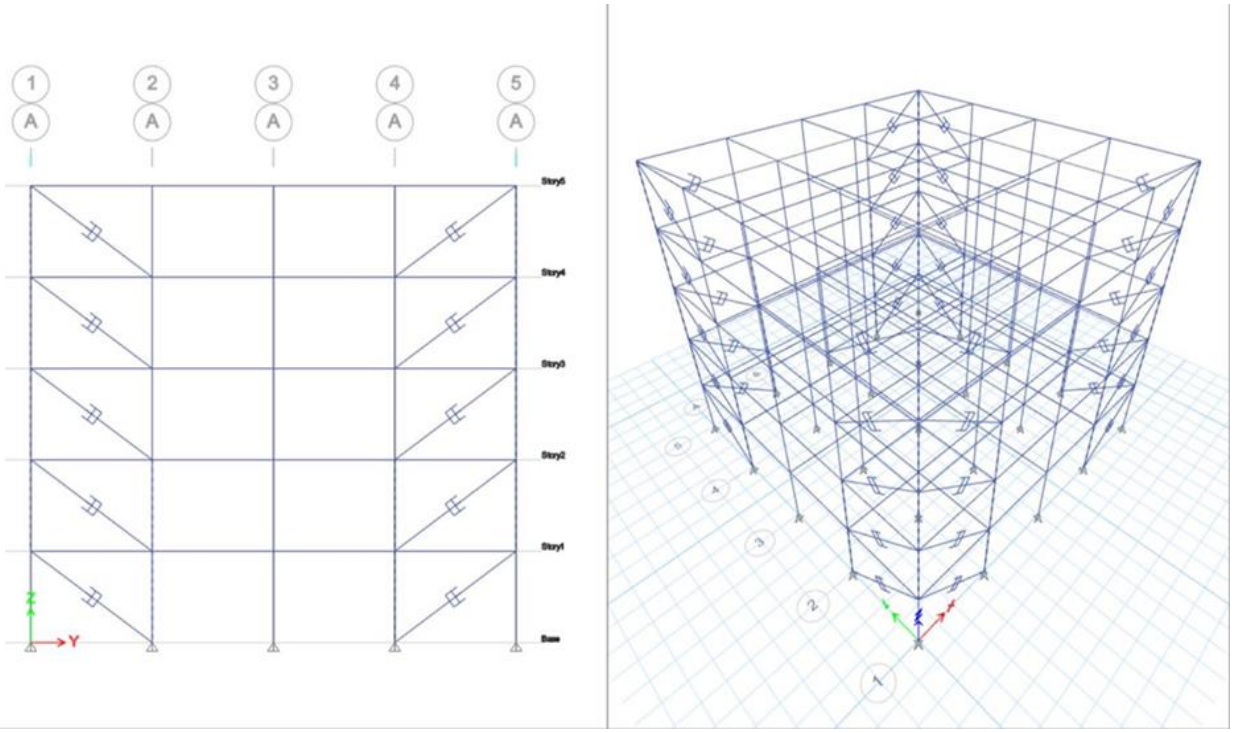


Fig.3 .Steel Structure with damper

The Seismic Response and Earthquake motion with viscoelastic damper is same for all 5-storey,10 storey,15 storey and properties are also same. The Results for displacement, story drift for both with and without dampers are noted. Comparative study on damper with and without damper is carried out.

RESULTS

In the present Study, Viscoelastic Dampers are used to reduce the seismic effect of the structure which are subjected to earthquake load. The Frames(with and without viscoelastic damper) is modeled according to theproperties of the structure designed in the work. Dynamic analysis is carried out by time history analysis according to Indian standard codes by using Etabs 2020 software. Because of symmetric modeling Values are same in both direction. The seismic behaviour of steel structure is judged by observing the parameters such as storey displacement and drift.

Comparative graphs between with and without visco-elastic damper

Table1. Story Drift G+5

STORY	WITHOUT DAMP. G+5	WITH DAMP. G+5
base	0	0
story-1	0.069	0
story-2	0.121	0.005
story-3	0.152	0.017
story-4	0.178	0.031
story-5	0.193	0.047

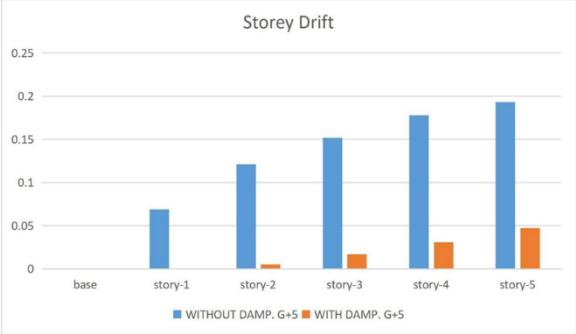


Fig.Graph of Storey Response G+5

Table 2.Storey Drift G+15

STORY	WITHOUT DAMP. G+10	WITH DAMP. G+10
base	0	0
story-1	0.009	0
story-2	0.026	0.001
story-3	0.045	0.003
story-4	0.064	0.006
story-5	0.082	0.01
story-6	0.097	0.014
story-7	0.109	0.018

story-8	0.119	0.022
story-9	0.125	0.027
story-10	0.13	0.031

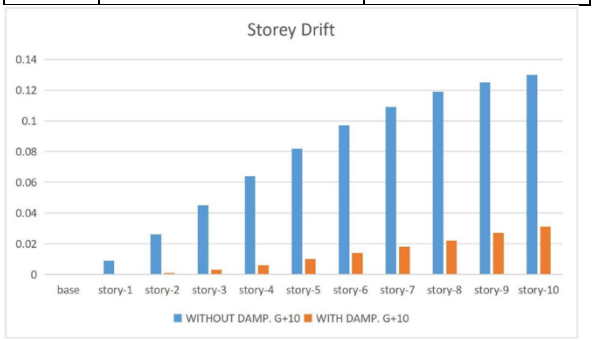


Fig.Graph of storey response G+10

Table 3.Storey Drift G+15

STORY	WITHOUT DAMP. G+10	WITH DAMP. G+10
base	0	0
story-1	0.005	0
story-2	0.014	0.0004
story-3	0.024	0.001
story-4	0.035	0.002
story-5	0.045	0.003
story-6	0.055	0.005
story-7	0.064	0.006
story-8	0.072	0.008
story-9	0.08	0.01
story-10	0.086	0.014
story-11	0.092	0.019
story-12	0.096	0.023
story-13	0.099	0.026
story-14	0.102	0.027
story-15	0.104	0.029

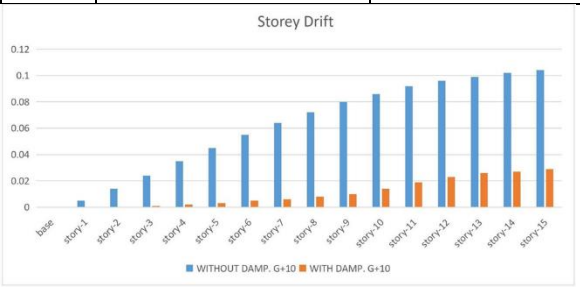


Fig.Graph of storey response G+15

Table 4. Maximum Displacement G+5

Storey	With Damper	Without Damper
Storey 1	5.721	2.23
Storey 2	9.82	3.82
Storey 3	15.377	5.99
Storey 4	21.913	8.54
Storey 5	29.23	11.39

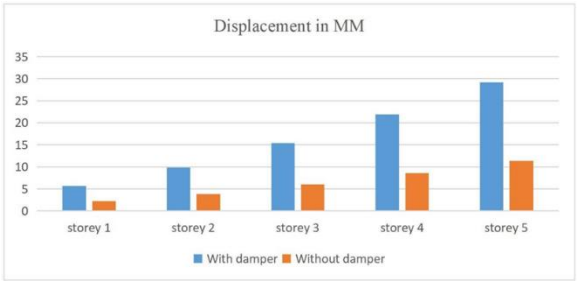


Fig.Graph of maxmimum displacement G+5

Table 5.Maximum Displacement G+10

Storey	With Damper	Without Damper
Storey 1	5.963	2.31
Storey 2	19.589	7.63
Storey 3	24.936	9.72
Storey 4	30.83	12.02
Storey 5	38.436	14.99
Storey 6	48.037	18.73
Storey 7	53.467	20.852
Storey 8	57.731	22.51
Storey 9	65.594	25.58
Storey 10	66.295	25.85

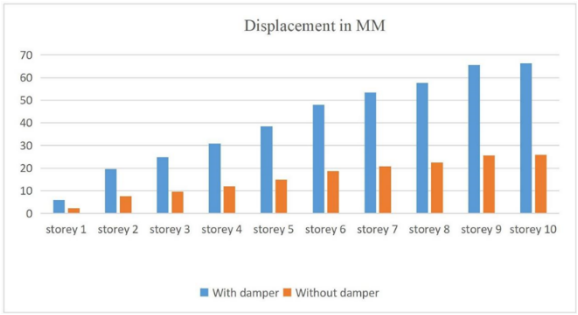


Fig.Graph of Maximum Displacement G+10

Table 6.Maximum Displacement G+15

Storey	With Damper	Without Damper
Storey 1	7.917	3.08
Storey 2	15.462	6.03
Storey 3	24.438	9.53
Storey 4	33.824	13.19
Storey 5	42.62	16.62
Storey 6	49.654	19.36
Storey 7	54.48	21.24
Storey 8	57.852	22.56
Storey 9	63.23	24.65
Storey 10	78.206	30.50
Storey 11	94.459	36.83
Storey 12	110.429	43.067
Storey 13	126.456	49.31
Storey 14	140.687	54.860
Storey 15	160.382	62.54

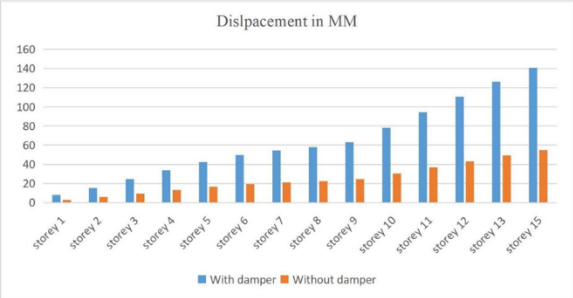


Fig.Graph of Maximum Displacement G+15

CONCLUSION

In this study, Viscoelastic damper is used to control the seismic response of the structure which is subjected to the earthquake load. The plan of G+5,10,15 stories is modelled and subjected to the class of gravity load using Etabs 2020.As per IS 1893-2015 code, the structure is subjected to the earthquake load. The time history method is used for non-linear dynamic analysis. Ground motion is applied to the structure to comparethe behaviour of structure with and without VED. After analysing the structure and considering the static anddynamic values the scale factor is fixed. After the analysis of structure, the results obtained and compared.

Based on the results and discussion given in graphs the following conclusions are as follows.

- According to the obtained results, viscous damper in structure results in the decrease of Frame displacement and drift.
- The maximum displacement are dramatically decreased with use of VED.
- The frame model which is without damper obtained the results of max. displacement as 160.382 mm and story drift as 0.129 mm for san fernando ground motion .For models withVED, this displacement is reduced by 39%-50%.
- From the storey response we also concluded displacement of building without damper ismore as compared to viscoelastic damper.
- Viscous damper has more base shear as compared to without damper steel structure.

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