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Optimization of the Dampers Position in High Rise Building

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Abstract: ***In India the need of high-rise buildings are increasing day by day and it is being constructed also but most of them has common issue of low natural damping. So, increasing capacity of damping of a structural system has become common in the new generation f high rise building. It can be controlled by various means but selecting damper has a number of factors as efficiency, capital cost, operating cost, compactness and weight, maintenance requirements and safety.***

In this present study analysis of an R.C framed high-rise building of 15 storey located in seismic zone V and soil type III having plan dimension 24 m x 25 m and the total height is 45 m is assigned with dampers at different positions (a) building without damper (b) building with dampers at face corner (c) building with dampers at face Centre (d) building with dampers at inner corner (e) building with dampers at inner Centre is carried out. The parameters like roof displacement, storey drift, base shear, ultimate displacement, ductility factor and pattern of hinge formation were investigated and results were compared.

It is observed that the model with dampers at inner Centre has less roof displacement and storey drift as compared to other models whereas the model with dampers at inner corner has more base shear, ultimate displacement and ductility factor. Above analysis is done in Etabs.

Keywords: damper, base shear, roof displacement, storey drift, ductility factor, FVD.

I. INTRODUCTION

As earthquake and wind produces vibrations to the structures which can be reduced by various methods such as modifying rigidities, masses, damping, shape and providing active and passive counter forces. Till now many methods of controlling vibrations are used successfully and some new proposed methods are offering the possibility of extending applications and improving efficiency.

Fluid viscous damping is a way to add energy dissipation to the lateral system of a building structure, addition to this can provide damping as high as 30% of critical damping or sometimes more and horizontal floor accelerations and lateral deformation by 50% or sometimes more.Addition of FVD dissipate energy and reduce building response to dynamic inputs is gaining worldwide acceptance.

This paper presents an application of FVD in high rise structure to suppress the anticipated seismic induced accelerations and this system proves to be very cost-effective method to reduce wind motions and resist seismic lateral loads and deflections of structures.

II. STRUCTURAL MODELLING

A. Introduction

A computational model is prepared on which a Linear and Non-Linear Static Analysis are performed. In this chapter a model is considered with dampers at different location such as dampers at face corner, dampers at face centre, dampers at middle corner, and damper at middle centre.

Table-1: - Building description

Plan dimension	24mx25m
Column size	700mmx700mm
Beam size	550mmx300mm
Thickness of slab	150mm
Ground Floor height	3m
Typical floor height	3m
No. of storey	15
No. of bays in x-direction	4
No. of bays in y- direction	5
Live load	3.5 kN/m^2
Floor finish load	1 kN/m^2
Seismic zone	V
Soil type	III

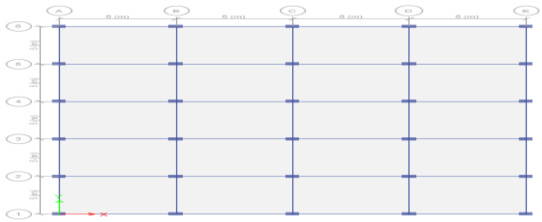

Fig.1:- Plan Of Building.

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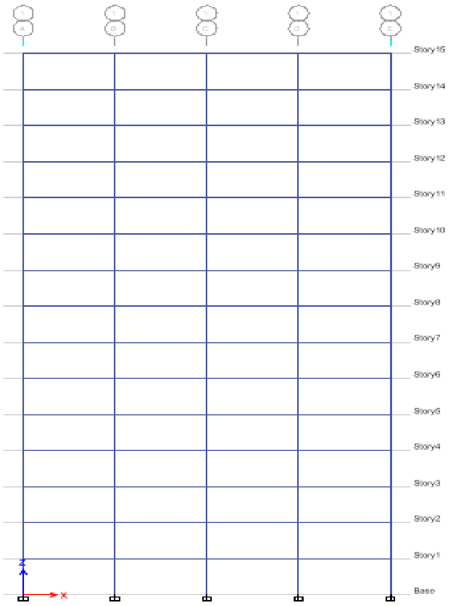

Fig.2: - Elevation Of Building

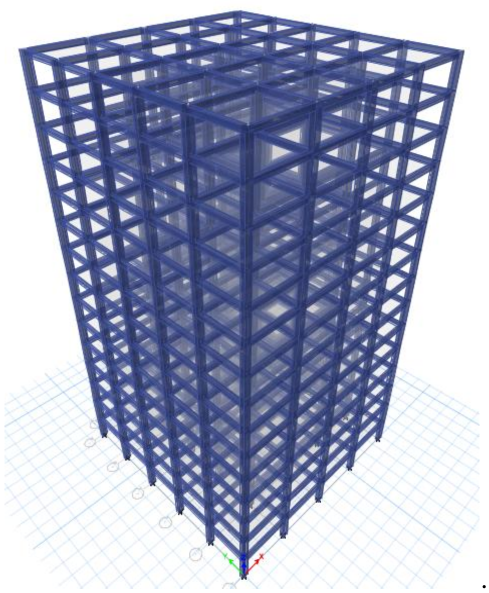

FIG.3:- 3D VIEW OF BUILDING

III. DAMPERS

Table-2: - Properties of Dampers

Link Type	Damper Exponential
Link name	Fluid Viscous Damper
Weight of Damper	500kN
Mass of Damper	98kg

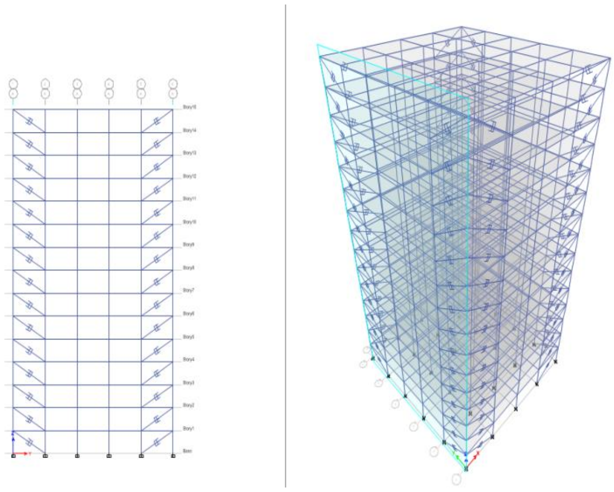

Fig.4:-Dampers At Face Corner

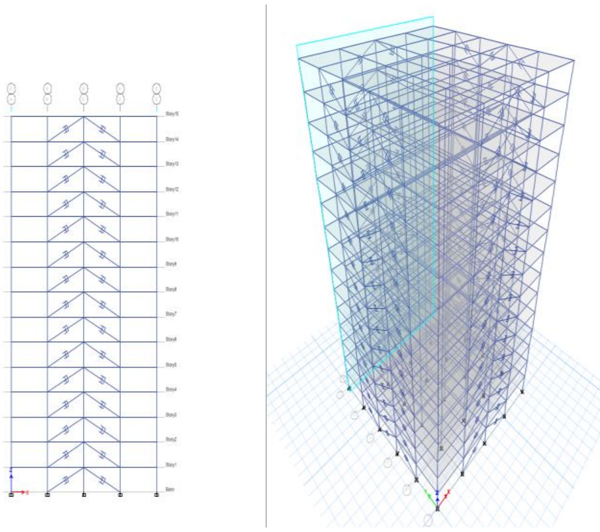

Fig.5:-Dampers At Face Centre

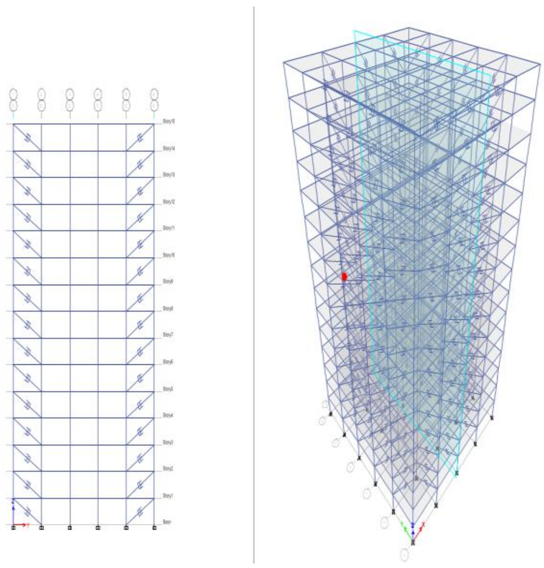

Fig.6:-Dampers At Inner Corner

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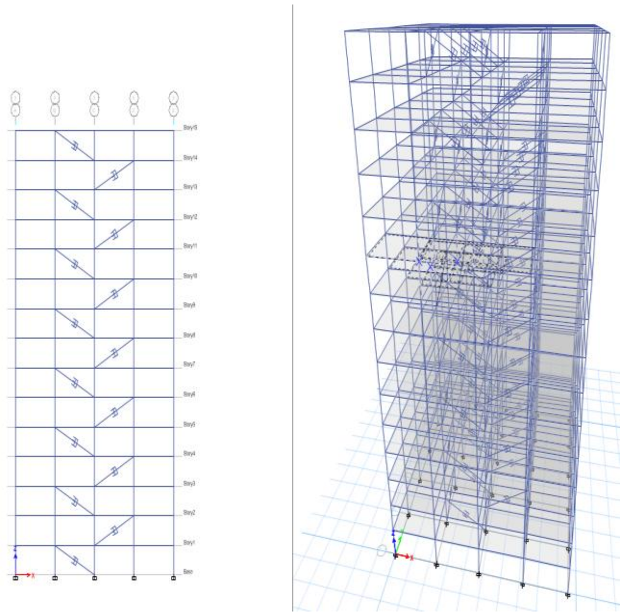

Fig.7:-Dampers At Inner Centre

IV. RESULT

A. Linear Static Method

Results obtained from Linear static analysis are discussed for bare frame, dampers with face corner, dampers with face centre, dampers with inner corners and dampers with inner centre by Response Spectrum method.

In this method, two factors are compared for each model these two factors are: -

1. Displacement.
2. Storey drift.

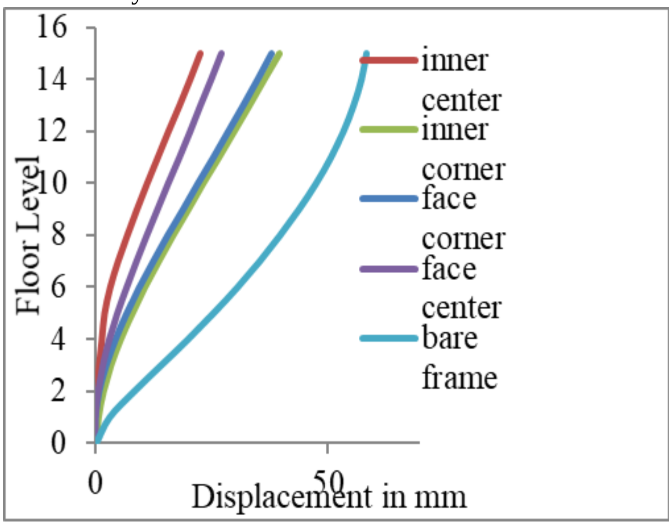

Fig.8: - Comparison Curve Of Maximum Displacement.

1. I found that the maximum displacement of model with dampers at face centre is 2.16 times decreased by model without damper, 1.4 times with face corner, 1.46 times with inner corner and 1.2 times increased with inner centre.

2. I found that the maximum displacement of model with dampers at face corner is 1.54 times decreased by model without damper, 1.04 times with inner corner, 1.68 times increased with inner centre and 1.4 times with face centre.

3. I found that the maximum displacement of model with dampers at inner centre is 2.59 times decreased by model without damper, 1.68 times with face corner, 1.68 times with inner corner and 1.2 times with face centre.

4. I found that the maximum storey drift of model with dampers at inner corner is 1.74 times decreased by model without damper, 1.01 times increased with face corner, 1.42 times with face centre and 1.73 times with inner centre.

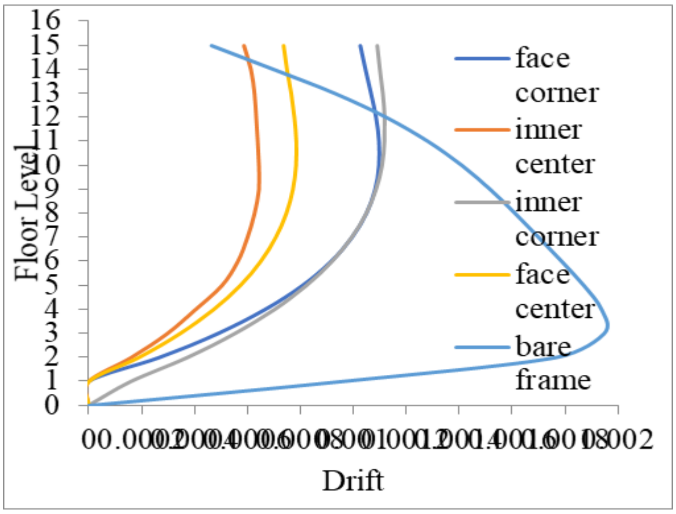

Fig.9: - COMPARISON CURVE OF MAXIMUM STOREY DRIFT.

1. I found that the maximum storey drift of model with dampers at face centre is 2.48 times decreased by model without damper, 1.4 times with face corner, 1.4 times with inner corner and 1.22 times increased with inner centre.

2. I found that the maximums storey drift of model with dampers at face corner is 1.77 times decreased by model without damper, 1.01 times with inner corner, 1.70 times increased with inner centre and 1.4 times with face centre.

3. I found that the maximum storey drift of model with dampers at inner centre is 3.02 times decreased by model without damper, 1.70 times with face corner, 1.73 times with inner corner and 1.22 times with face centre.

4. I found that the maximum storey drift of model with dampers at inner corner is 1.74 times decreased by model without damper, 1.01 times increased with face corner, 1.42 times with face centre and 1.73 times with inner centre.

B. Non-Linear Static Method

Results obtained from Non-Linear static analysis are discussed for bare frame, dampers with face corner, dampers with face centre, dampers with inner corners and dampers with inner centre by Pushover method.

In this method, two factors are compared for each model these three factors are: -

1. Base Shear.
2. Ductility Factor.
3. Formation of Hinges.

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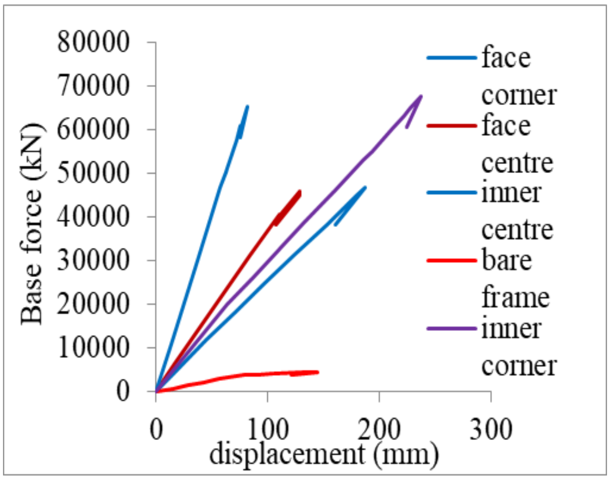

Fig.9: - Base Force V/S Displacement Curves

Fig-9 shows pushover curves for 15 storied bare frame building without damper and with dampers at different positions as face corner, face centre, inner corner and inner centre. Initially, in case of bare frame structure the base shear increases as displacement increases. After attaining certain base shear, the bare frame gets yielded and displacement is increased without significant increase in base shear. From pushover curve, the following points were observed: -

1. Framed building with dampers at face corner has base shear increases by 10.56 times of base shear attained by frame building without damper and displacement increased by 1.29 times than that of bare frame building without damper.

2. Framed building with dampers at face centre has base shear increases by 10.19 times of base shear attained by frame building without damper and displacement decreased by 1.13 times than that of bare frame building without damper.

3. Framed building with dampers at inner corner has base shear increases by 15.29 times of base shear attained by frame building without damper and displacement increased by 1.63 times than that of bare frame building without damper.

4. Framed building with dampers at inner centre has base shear increases by 14.77 times of base shear attained by frame building without damper and displacement decreased by 1.77 times than that of bare frame building without damper.

Table-3:- Ductility factor

Models	Yield displacement (m)	Ultimate displacement (m)	Ductility factor(μ)
Without damper	0.0832	0.1446	1.7379
Face centre	0.0388	0.1278	3.2938
Face corner	0.0427	0.1868	4.3747
Inner centre	0.0378	0.0815	2.1560
Inner corner	0.0382	0.2368	6.1989

V. CONCLUSIONS

1. I observed that the maximum displacement of model with dampers at inner centre is 2.59 times decreased by model without damper, 1.68 times with face corner, 1.68 times with inner corner and 1.2 times with face centre.

2. I observed that the maximum storey drift of model with dampers at inner centre is 3.02 times decreased by model without damper, 1.70 times with face corner, 1.73 times with inner corner and 1.22 times with face centre.

3. Model with damper at inner corner has base shear increased by 15.29 times the base shear of model without damper, 1.44 times by face corner, 1.03 times by inner centre and 1.49 times by face centre.

4. The roof displacement of model with dampers at inner corner is increased by 1.63 times than that of model without damper, 1.26 times by face corner, 2.90 times by inner centre and 1.85 times by face centre.

5. Ductility factor of model with dampers at inner corner is increased by 3.57 times the model without damper, 1.88 times the model with damper at face centre, 1.41 times the model with damper at face corner and 2.87 times the model with dampers at inner centre.

6. At same base shear the number of hinges formed is very less in the model with dampers at inner corner as compared to other models.

7. From above points, I founded that the frame building with dampers at inner corner shows maximum displacement which means it shows better ductility than framed building with and without dampers at other positions

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