Seismic Analysis of Rectangular and Hollow building with and without damper

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Abstract- *Earthquakes are natural hazards under which disasters are mainly caused by damage or collapse of buildings and other man-made structures. Experience has shown that for new constructions, establishing earthquake resisting regulations and their implementation is the critical safeguard against earthquake induced damage. In the present scenario of construction, it is needed to study the behaviour of every multi-storeyed building structure subjected to ground motion which is the common problem for construction. From experiments, it is found that use of dampers increases stiffness and strength of structure.*

Keywords- Seismic Analysis, Damping System, Dampers, Rectangular Building, Hollow Building.

I. INTRODUCTION

Though over the recent years heavy costs have been paid for accurate recognition of force of an earthquake in the research institutes of the world with the purpose of decreasing its damage, the increasing need for more research studies on the effects resulted from the earthquake is felt in the theoretical and laboratorial scales. New techniques for protecting buildings against earthquake have been developed with the aim of improving their capacity. Seismic isolation and energy dissipation are widely recognized as effective protection techniques for reaching the performance objectives of modern codes. There are a no of passive energy dissipating devices in use, such as metallic dampers, friction dampers, viscous fluid damper and visco-elastic dampers.

Dampers are the devices used to absorb or dissipate the structure's vibration from the earthquake and to increase the structure's damping and stiffness. Dampers system are designed and manufactured to protect structure integrity, control structural damage and prevent resident injury through the absorption of seismic energy and reduction of structural deformation.

In this study, it is planned to evaluate the seismic behavior of reinforced concrete rectangular and hollow building with and without fluid viscous dampers using seismic coefficient method.

II. LITERATURE REVIEW

Pramod Badole, Sumit Singh Shekhawat [1] The authors have published paper on "Seismic Analysis of normal RCC multistoried buildings with damper and isolaters using SAP Software". In this study, it is planned to evaluate seismic behavior of RC regular building with viscous fluid dampers, visco-elastic dampers and without any damping device using time history analysis. In this project, three models of the ten storied of normal RCC building is made and one is of RCC structure with damper system and another one RCC structure with isolator system is made and the analyses of the stresses and the displacement and the moments and shear forces of the structure is found in the static as well as dynamic analysis is done using SAAP software to make an earthquake resisting structure.

Varun M, B.S Sureshchandra [2] The authors have published paper on "Seismic analysis of multi storey rc building with and without fluid viscous damper". In this study G+12 storey building of rectangular plan is considered for the seismic analysis. The equivalent static method and response spectrum method is used for seismic evaluation of building with and without fluid viscous damper. ETABs 2017 software used for the analysis of the building, by considering seismic zone V and medium soil (Type II) as per IS 1893-2016. Storey displacement, storey shear, storey drift and modal periods and frequencies are considered for checking the performances of the building. Objective of this study is to compare results obtained from static and response spectrum analysis in both longitudinal and transverse direction for with and without damper building.

B.Naresh, J.Omprakash [3] The authors have published paper on "design of multistorey rcc-building with dampers using etabs". 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.

III. METHODOLOGY AND MODELING

Aim: To compare the seismic response of multi-storey building of varying heights, with and without the use of viscous dampers, using seismic coefficient method.

Methodology: Rectangular Shaped and Hollow Shaped Buildings of 9 Storeys are considered. The modeling of these buildings is done and fluid viscous dampers are applied on corners of building. Seismic analysis is carried out using seismic coefficient method. Thereafter, both the models are compared for displacement and base shear.

Modeling of buildings:

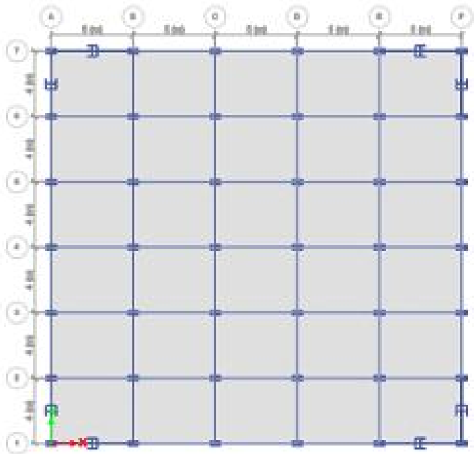


Fig.1. Plan of Rectangular building

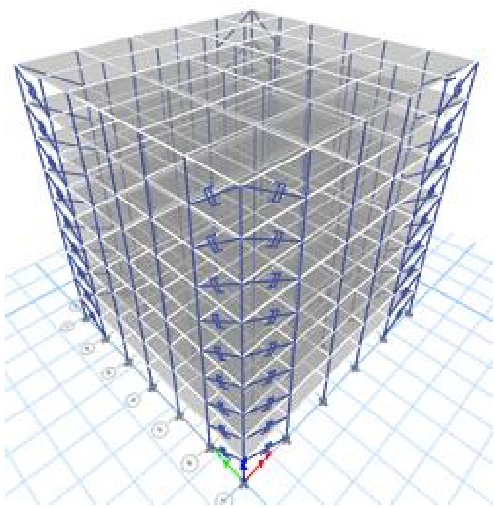


Fig.2. 3d view of Rectangular Building

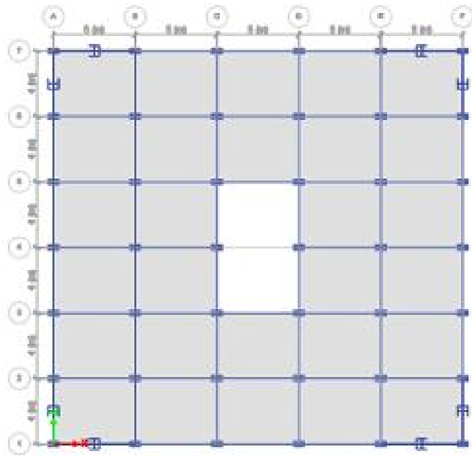


Fig.3. Plan of Rectangular building

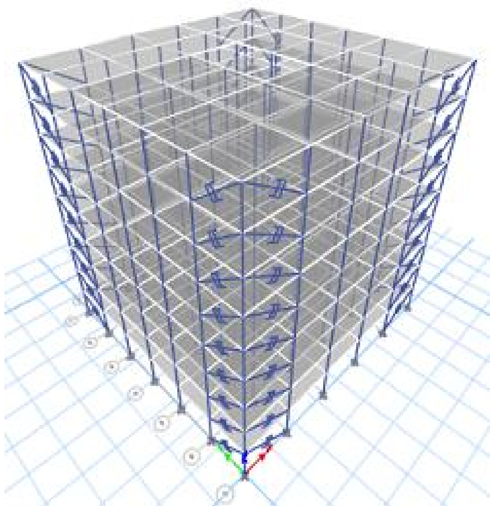


Fig.4. 3d view of Hollow Building

IV. RESULTS

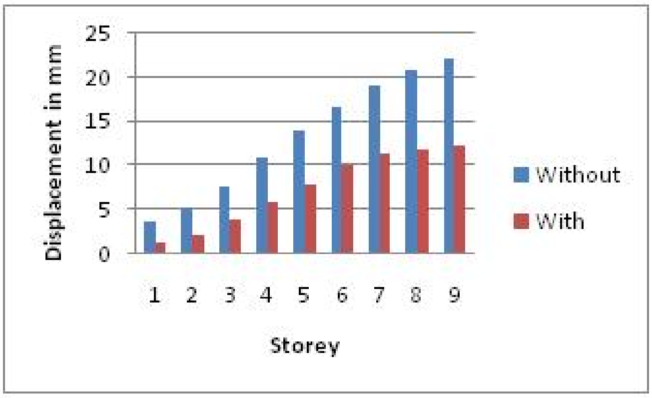
i. Rectangular Building

The Rectangular building has been analyzed for parameters like displacement and base shear and the result tables and graphs are as follows:

a. Displacement

Displacement in mm (X-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	3.47	1.05	69.74
2	4.99	2.06	58.71
3	7.51	3.74	50.19
4	10.75	5.67	47.25
5	13.83	7.75	43.96
6	16.6	9.86	40.6
7	18.94	11.25	40.6
8	20.73	11.78	43.17
9	22.16	12.1	45.39

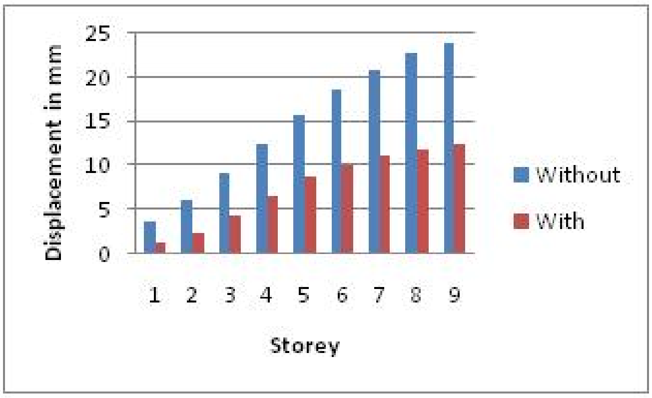
Table 1: Displacement in X-direction



Graph 1: Displacement in X-direction

Displacement in mm (Y-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	3.48	1.08	68.96
2	5.89	2.29	61.12
3	9.05	4.18	53.81
4	12.42	6.4	48.47
5	15.61	8.6	44.9
6	18.48	10.04	47.67
7	20.9	11.01	47.32
8	22.71	11.73	48.34
9	23.79	12.28	48.38

Table 2: Displacement in Y-direction

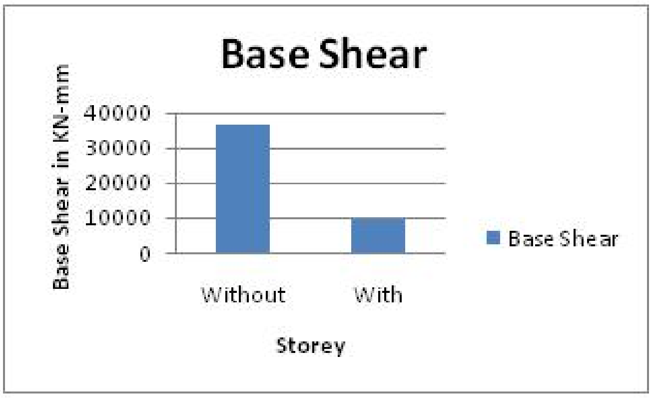


Graph 2: Displacement in Y-direction

b. Base Shear

Base Shear in KN-mm		
Without Damper	**With Damper**	**Percentage Reduction %**
36599.35	9456.006	75.16

Table 3: Base Shear



Graph 1: Displacement in X-direction

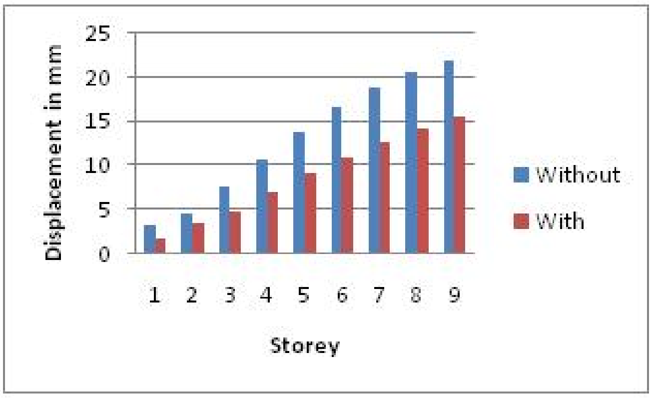
ii. Hollow Building

The Hollow building has been analyzed for parameters like displacement and base shear and the result tables and graphs are as follows:

a. Displacement

Displacement in mm (X-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	3.09	1.44	53.39
2	4.47	3.34	25.27
3	7.43	4.62	37.81
4	10.66	6.77	36.49
5	13.74	9.02	34.35
6	16.51	10.82	34.6
7	18.85	12.62	33.05
8	20.65	14.25	30.99
9	21.89	15.47	29.32

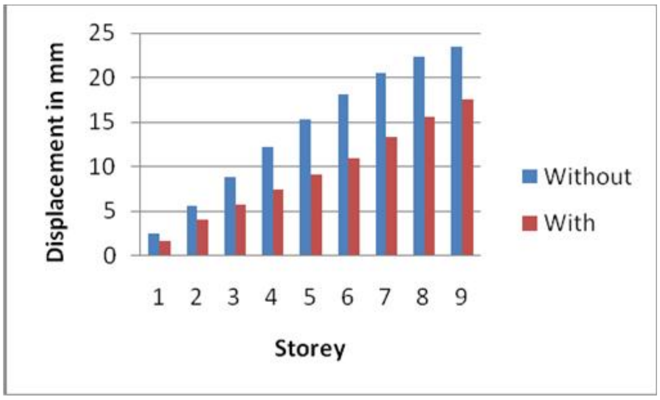
Table 4: Displacement in X-direction



Graph 4: Displacement in X-direction

Displacement in mm (Y-direction)			
Storey	**Without Damper**	**With Damper**	**Percentage Reduction %**
1	2.49	1.71	31.32
2	5.68	4.12	27.46
3	8.89	5.75	35.32
4	12.22	7.47	38.87
5	15.35	9.1	40.71
6	18.18	11.01	39.43
7	20.56	13.34	35.11
8	22.34	15.54	30.43
9	23.41	17.6	24.81

Table 5: Displacement in Y-direction

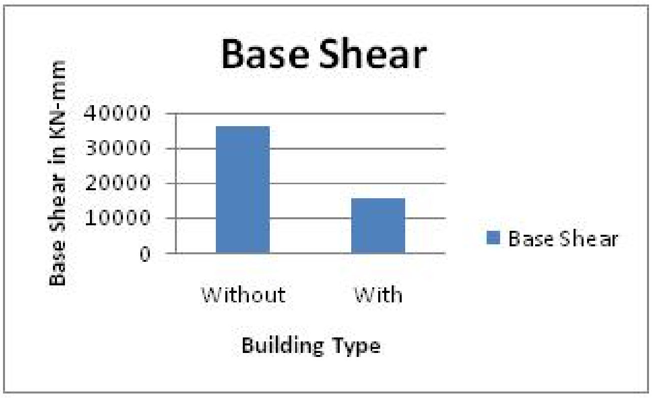


Graph 5: Displacement in Y-direction

b. Base Shear

Base Shear in KN-mm		
Without Damper	**With Damper**	**Percentage Reduction %**
36056.89	15493.07	57.03

Table 6: Base Shear



Graph 6: Base Shear

V.CONCLUSION

The following points can be concluded from the above study:

1. Rectangular Shaped and Hollow Shaped Buildings with dampers placed at corners are having lower values of displacement and base shear as compared to buildings without dampers.
2. The values of percentage reduction for displacement goes on decreasing from bottom storey to top storey in both the building models except in Storey 2 of I Shaped building.
3. The Base Shear is reduced up to 75.16% and 57.03% in Rectangular Shaped and Hollow Shaped Buildings respectively after the application of dampers.
4. When dampers are applied to the buildings, there is an average reduction of about 50-70 % in displacement and base shear in both the building models.

5. The shape of the building model affects the structural response of building.
6. Structures with dampers can be used for tall buildings as it gives strength and stability in high seismic zone.

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