International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Influence of Provision of Damper in RC Frame Residential Building under the Liner Dynamic Analysis

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ABSTRACT

Dumpers are energy-saving devices that also oppose the movement of the LCD building during an earthquake. Dumpers are used to resist the side forces coming to the structure. At the time of the earthquake, the multi-storey building was damaged, and a large deformation took place in the multi-storey building. Dempers reduce the vibration and deformation of the LCD building during an earthquake.Excessive deformations of reinforced concrete structures (LCDs) are the main cause of collapse during earthquake excitation. Currently, a device for scattering earthquake energy, such as structural dampers, is widely used to protect LCD structures that are designed to withstand strong seismic loads. Therefore, this study offers a comprehensive study of how damping devices affect the deformation of LCD buildings that are subject to seismic excitation. To this end, the multi-storey RC frame building with and without dampers is analyzed by ETABS software. The results of these analyzes are discussed in terms of various parameters, such as maximum displacement, base shift and main time period.

Keywords: - RC frame building, Dampers, Response Spectrum Analysis, Deformation, Base Shear

1.Introduction

In today's years, earthquakes are a major natural hazard in the damage to buildings. The earthquake causes soil vibration due to sudden energy release. This energy can be absorbed by a vibration control device called a structural damper. The decrease in structural response caused by dynamic effects was the subject of this study. The structural damper increases the rigidity of the building due to the reduction of vibration of the building.

An earthquake is a disturbance that causes the earth's surface to shake due to the movement underground along the fault plane or from volcanic activity. Despite the fact that the earthquake lasts a short period of time, it causes significant loss of life and damage to property every year. To reduce the effect, buildings / structures, such as public life houses, residential buildings, historic buildings, industrial buildings, must be designed to be seismic. The purpose of the analysis of the earthquake-resistant building is that the buildings must be able to withstand minor earthquakes without any damage. There are many ways to achieve this. One of them is the provision of dampers. A damper is a mechanical system that dissipates the energy of an earthquake into specialized devices that deform or yield during earthquakes. They increase the scattering of energy in the structure to which they are installed, so that the structure must withstand fewer earthquake forces. When seismic energy is transmitted through them, the dampers absorb part of it and thus inhibit the movement of the building.

The building responds to an earthquake that shakes differently. When the forces on a building or the movement of a building exceed certain limits, the damage increases in various forms and extends to different ones. Many design engineers use the usual approach to protect buildings from the destructive forces of earthquakes by increasing the strength of the building so that they do not collapse during an earthquake. To achieve a satisfactory earthquake response to the structure, there are various seismic methods to ensure structural control.

2. Literature Review

2.1 General

All structures built at high cost and structures with proper value, specially located in seismically activated areas, require safety for them. Designing such structures requires an improved response when these structures are challenged to withstand earthquakes. During earthquakes, the structures are induced into very large voltages, the scattering of which is necessary in order to make the structures less prone to failure. The means by which this energy is dissipated determine the level of structural degradation. Particular emphasis is placed on avoiding the loss of human lives due to earthquake actions

2.2 Literature Review:

Mohsen Kargahi et al. Evaluated the effectiveness of managing a shared configured mass damper (STMD) to reduce the seismic response of neighboring buildings. In this study, they analyzed two structures, each of which consisted of eight-storey buildings for which STDs were evaluated. A multi-objective genetic algorithm was used to optimally design the stiffness and damping parameters of STMD. Numerical analyzes have shown that STMD can effectively control the dynamic response of RC structures, and can also reduce the effect of knocking between neighboring buildings that are affected by earthquake disturbances compared to traditional TMD [1].

Yukihiro Tokuda et al. Experienced on configured mass vibration absorbers (TMVA). This study showed that TMVA is used for many sectors of the mechanical industry, civil, aerospace, but in this study TMVA was used in the most general form as a secondary system, the parameters of which were controlled to suppress maximum vibration of the primary system [2].

Nitendra G. Mahajan et al. It has been shown that the secondary system can have a common spring mass damper, and TMVA suppresses the vibrations of the primary system at the point of its attachment. Minor modifications were made, and very accurate results were extracted from this installation. It was later suggested that the design could be based on frequency adjustment, resulting in an equal damping factor, and an accurate clear approximation to the optimal damping parameters was found. An approach to finding the optimal amount of damping was suggested later in this study [3].

Thakur V.M. etc. This study showed that mass distribution is one of the most important factors for MTMD (multiple tuned mass damper) to reduce the effectively dynamic response of the main system. Control the mass distribution with other parameters, such as damping factor, frequency range, number of dampers, etc. the reaction of the structures can be controlled [4].

Kasai, K. and others. The effect of different mass distribution, such as the mass distribution in the form of a bell and the distribution of parabolic mass, was shown on the reaction of the system. Finally, it was shown that among all mass distribution systems, the modified mass distribution in the form of a bell is superior to all others. This study found that reducing the dynamic response of the structure makes it smoother and increases the throughput of the flat area. It has also been suggested that lower damping values associated with MTMD make it more efficient [5].

K. KRISHNE GOWDA and others. Presents the results of an experimental evaluation of the effectiveness of the use of viscous dampers to a reinforced concrete moment that resists construction structures. A unique feature of these torque-resistant concrete building structures, as is common practice in Taiwan, is that slightly reinforced concrete exterior walls and interior wall partitions are provided in construction, but are not taken into account for their contribution to rigidity and strength in the design process [6].

3. Modeling and Analysis of Building

Table 1: Analysis data for example building

Plane dimensions	16m x 16 m
Total height of building	34.5 m
Height of each storey	3.0 m
Height of parapet	1.0 m
Depth of foundation	1.5 m
Size of beams	300 mm x 500 mm
size of columns	600 mm x 600 mm
Thickness of slab	125 mm
Thickness of external walls	230 mm
Thickness of internal walls	150 mm
Seismic zone	III
Soil condition	Medium
Response reduction factor	5
Importance factor	1.2
Floor finishes	1.0 kN/m^2
Live load at all floors	2.0 kN/m^2
Grade of Concrete	M30
Grade of Steel	Fe500
Density of Concrete	25 kN/m^3
Density of brick masonry	20 kN/m^3

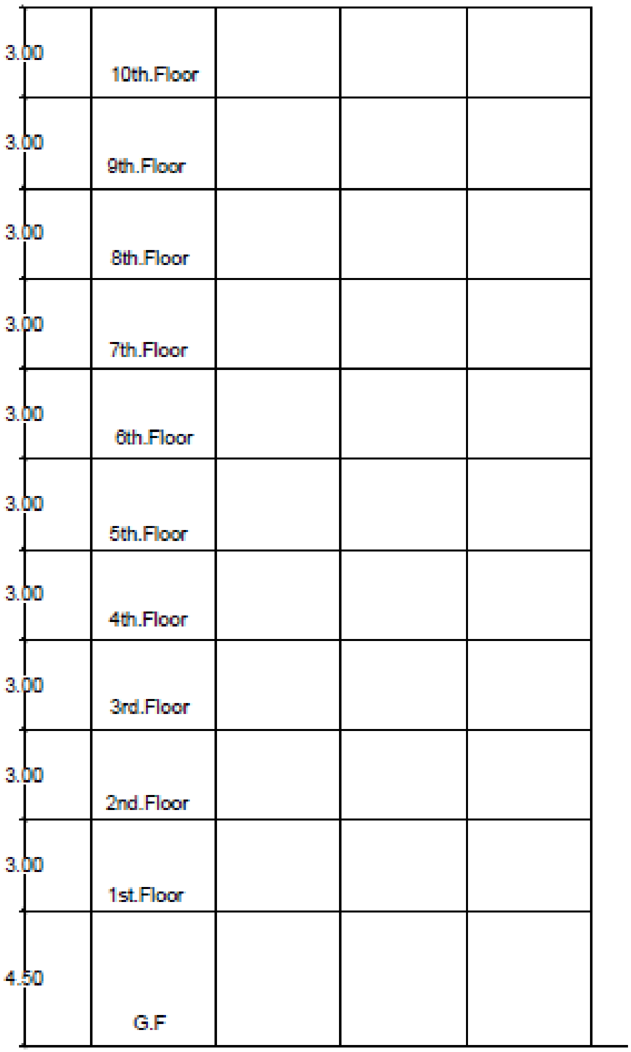

Figure 1: Elevation of building

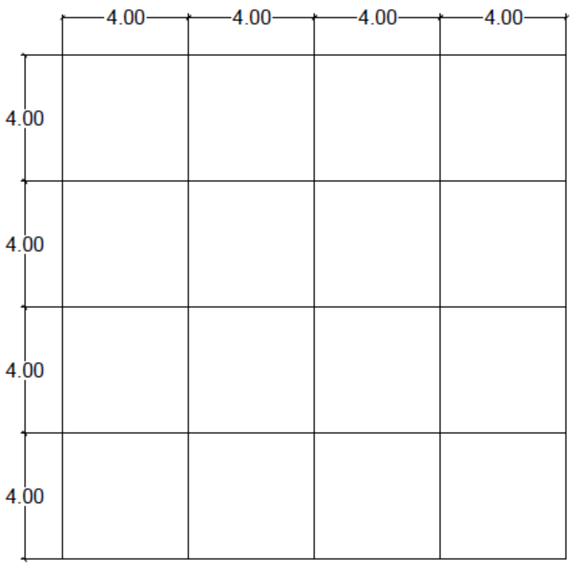

Figure 2: Elevation of building

The following models are prepared using ETABS software

i. Model of building without damper
ii. Model of building with damper at edge
iii. Model of building with damper at periphery
iv. Model of building with damper at core

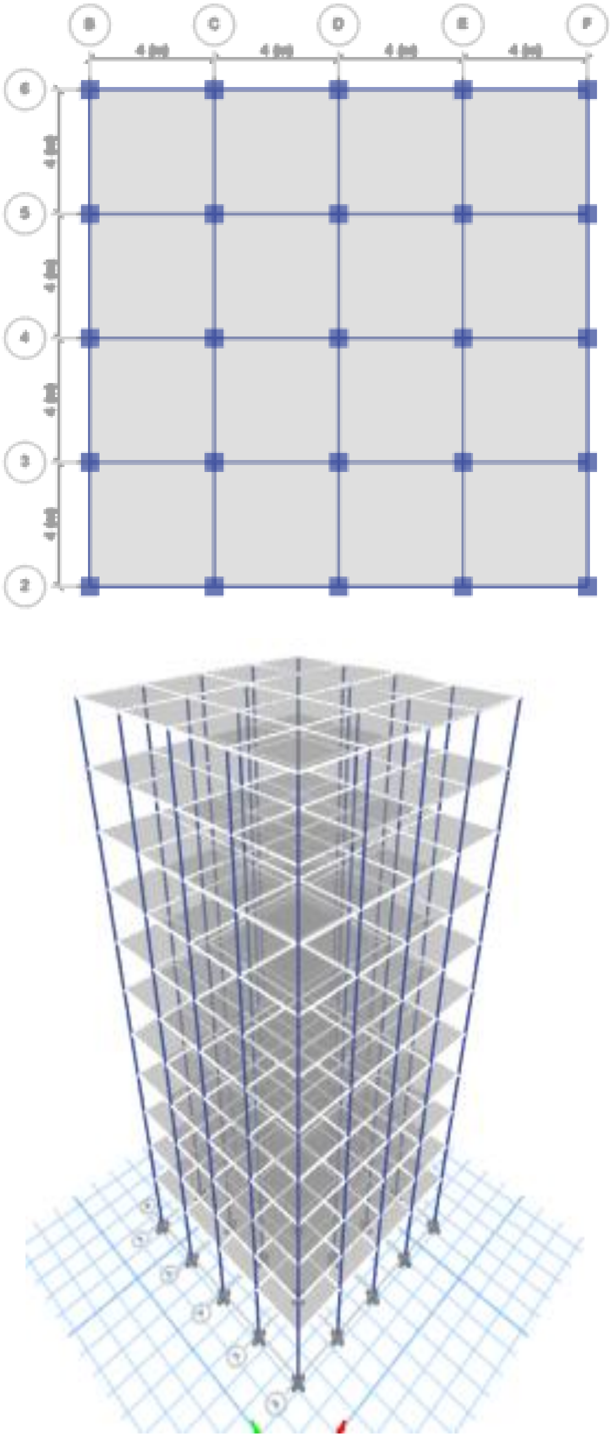

Figure 3: 3D Model of building generated in ETABS

Model I:

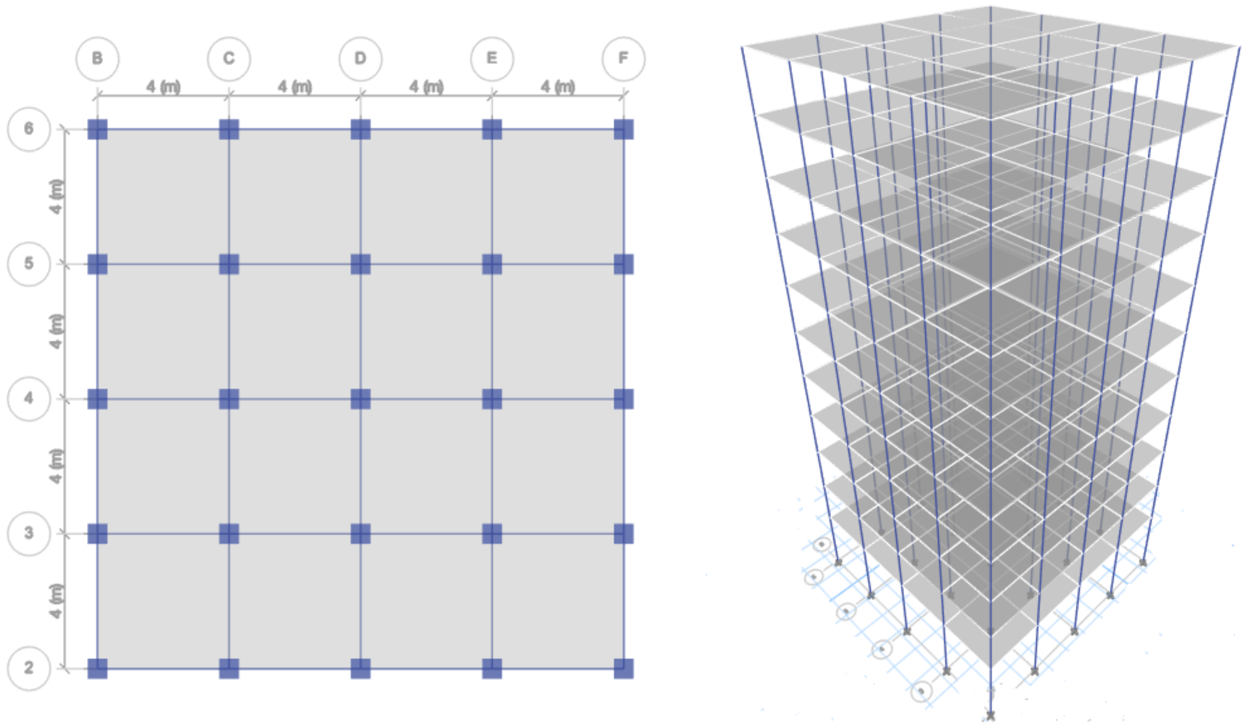

Figure 4: Model of building without damper generated in ETABS

Model II:

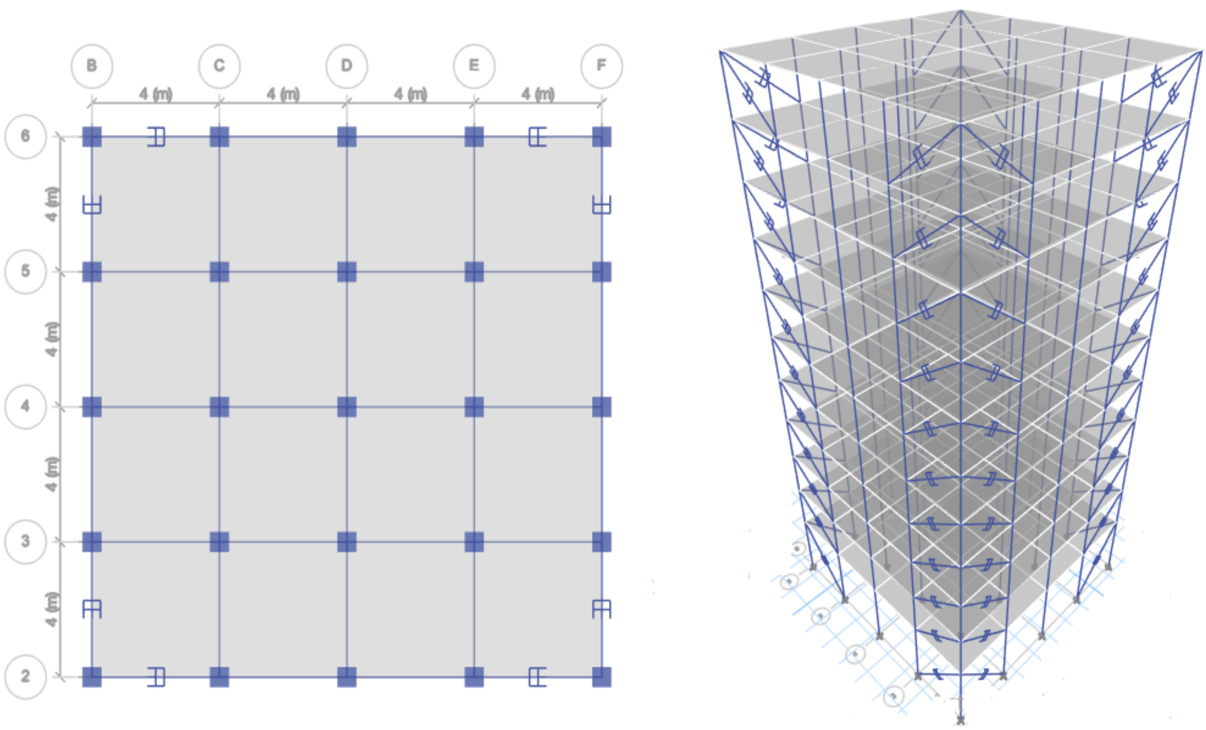

Figure 5: Model of building with damper at edge generated in ETABS

Model III:

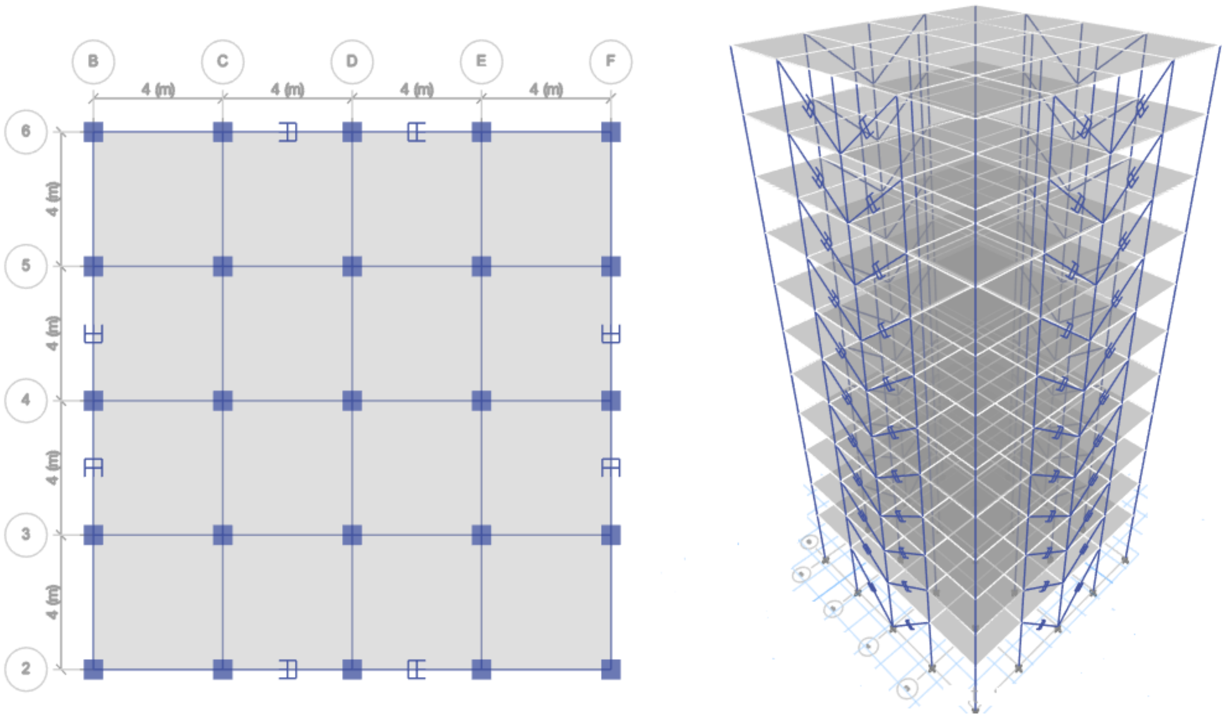

Figure 6: Model of building with damper at periphery generated in ETABS

Model IV:

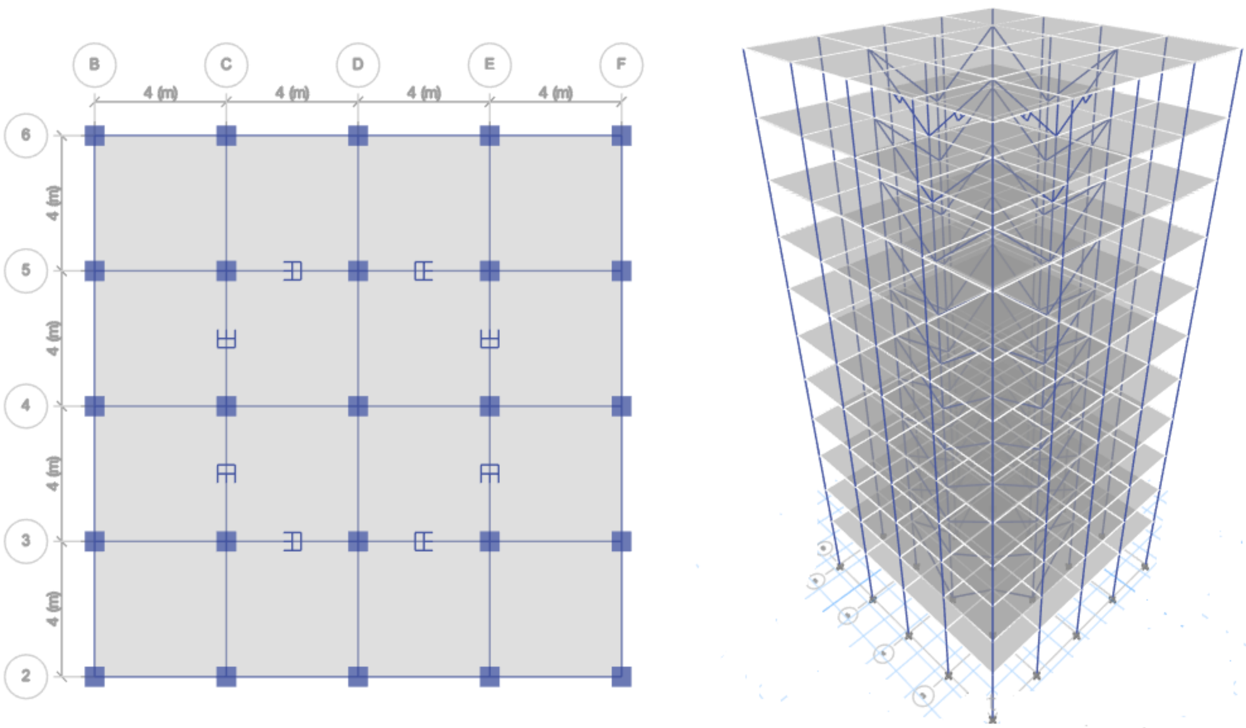

Figure 7: Model of building with damper at core generated in ETABS

4. Results

The following results obtained in terms of the storey displacement, storey drift, time period and storey shear as obtained in the ETABS software.

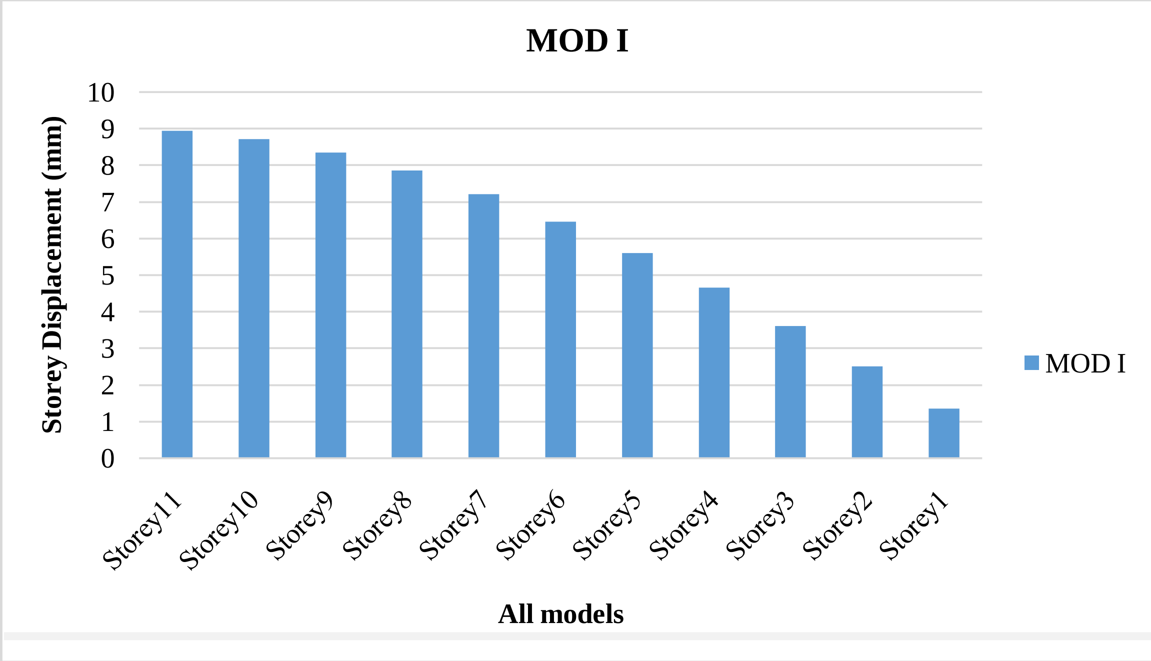

Fig.8: Storey Displacement for model-I

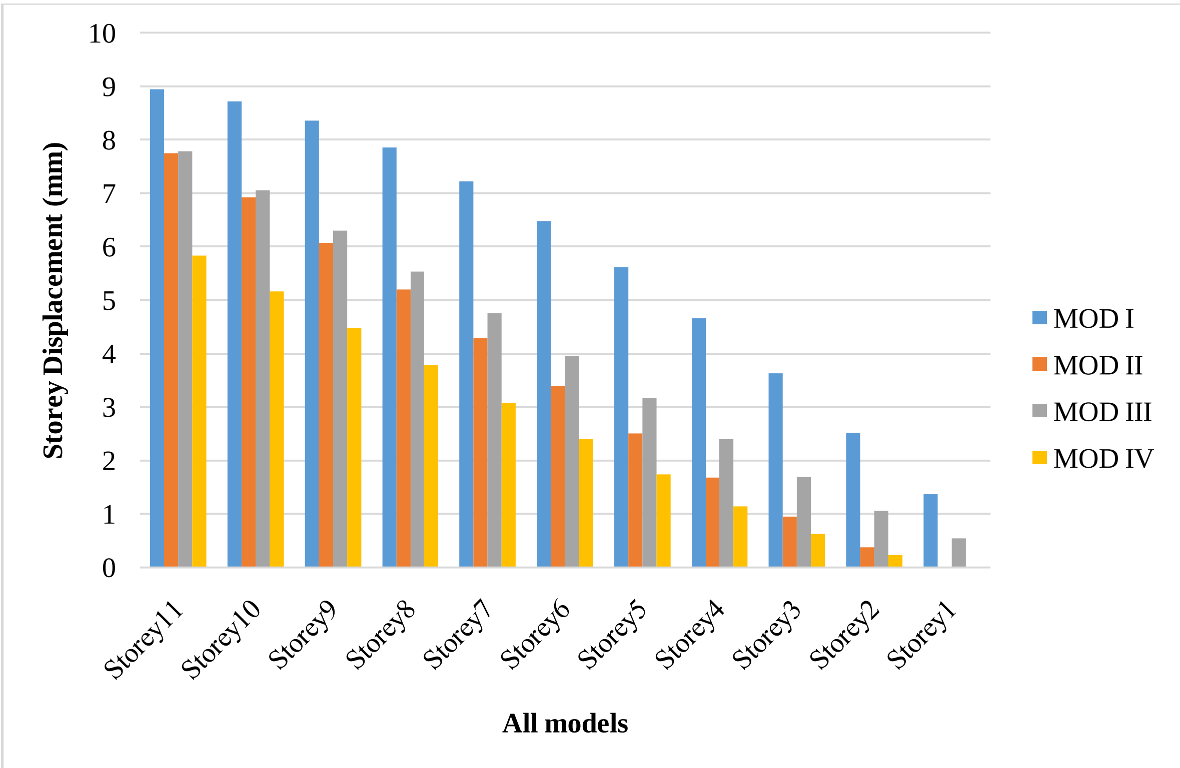

Fig.9: Storey Displacement for all models

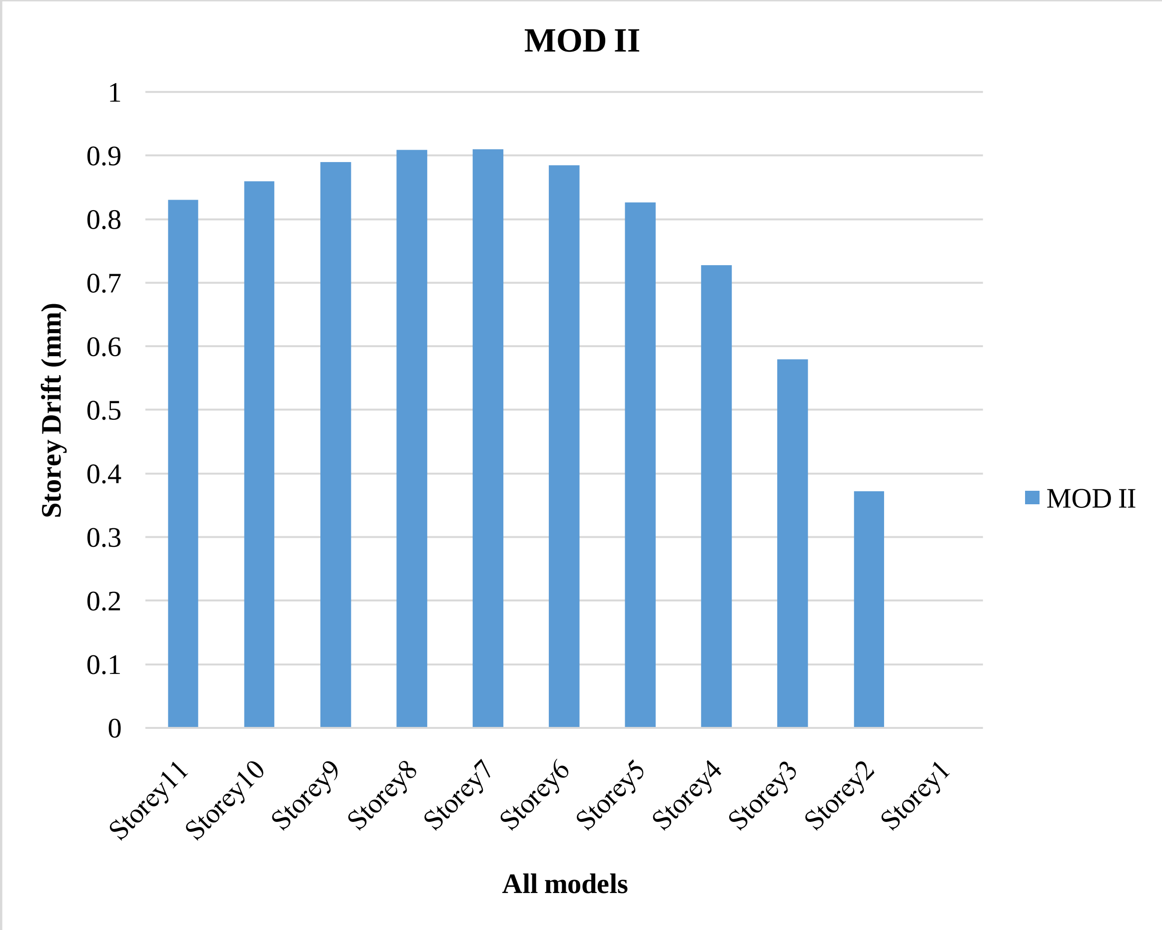

Fig.10: Storey Drift for model-II

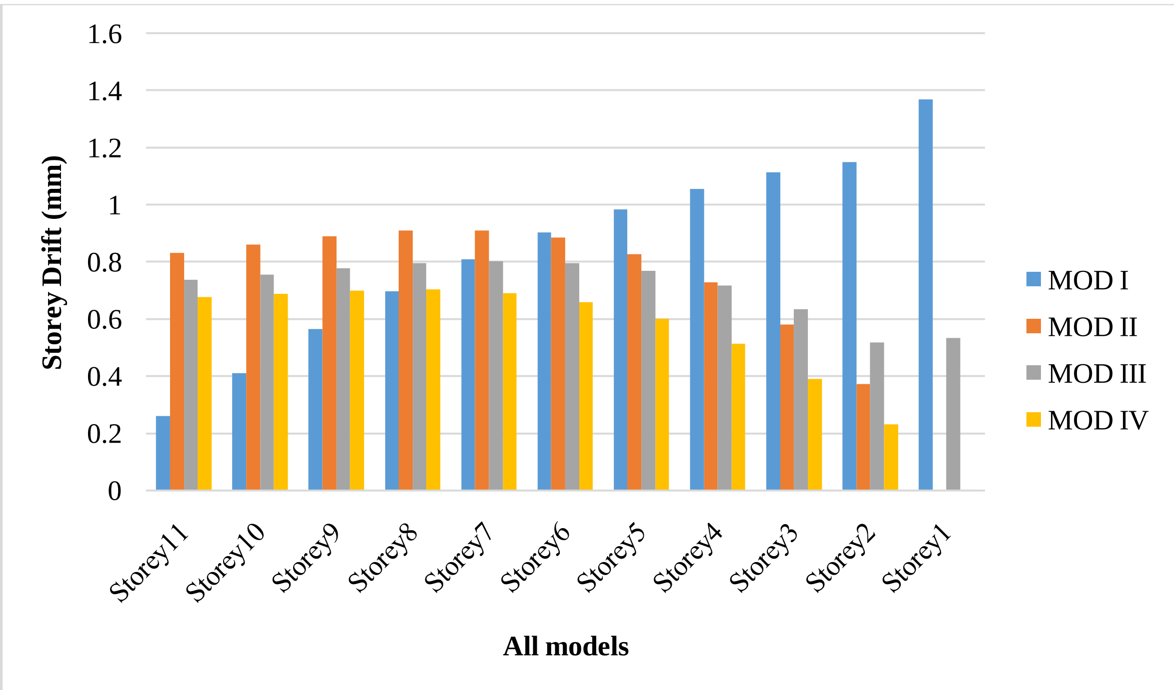

Fig.11: Storey Drift for all models

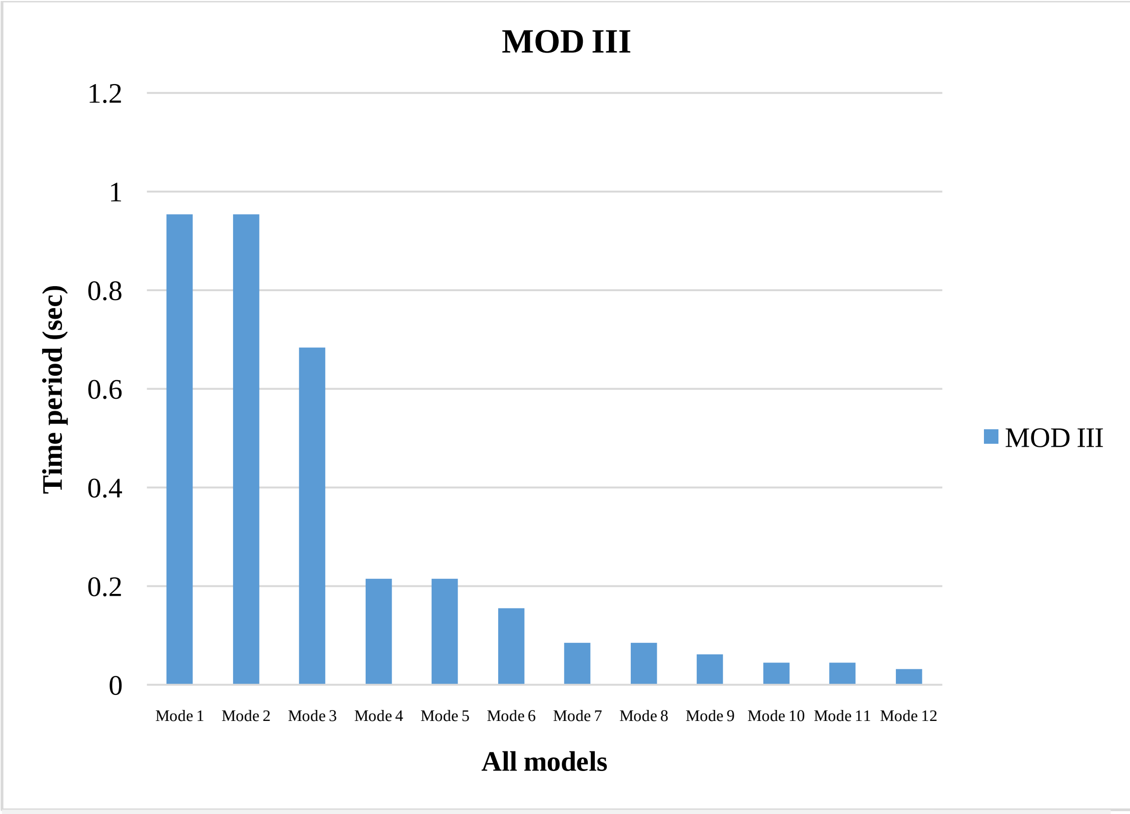

Fig.12: Time Period for model-III

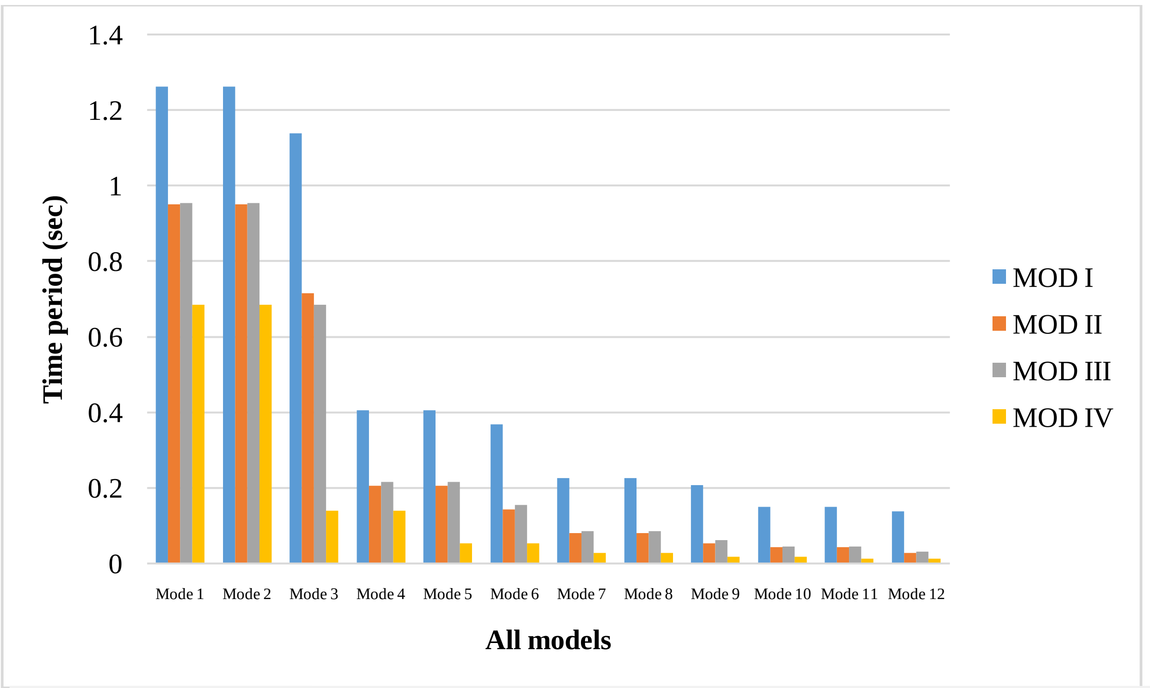

Fig.13: Time Period for all models

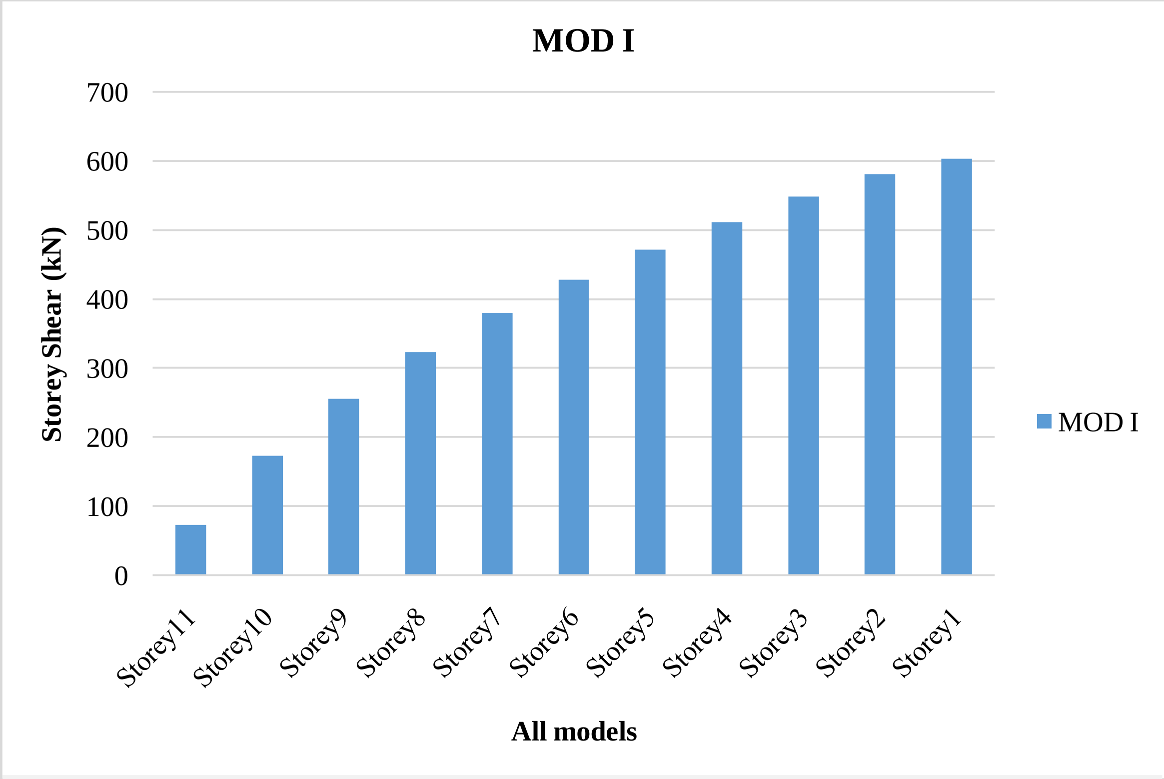

Fig.14: Time Period for model-I

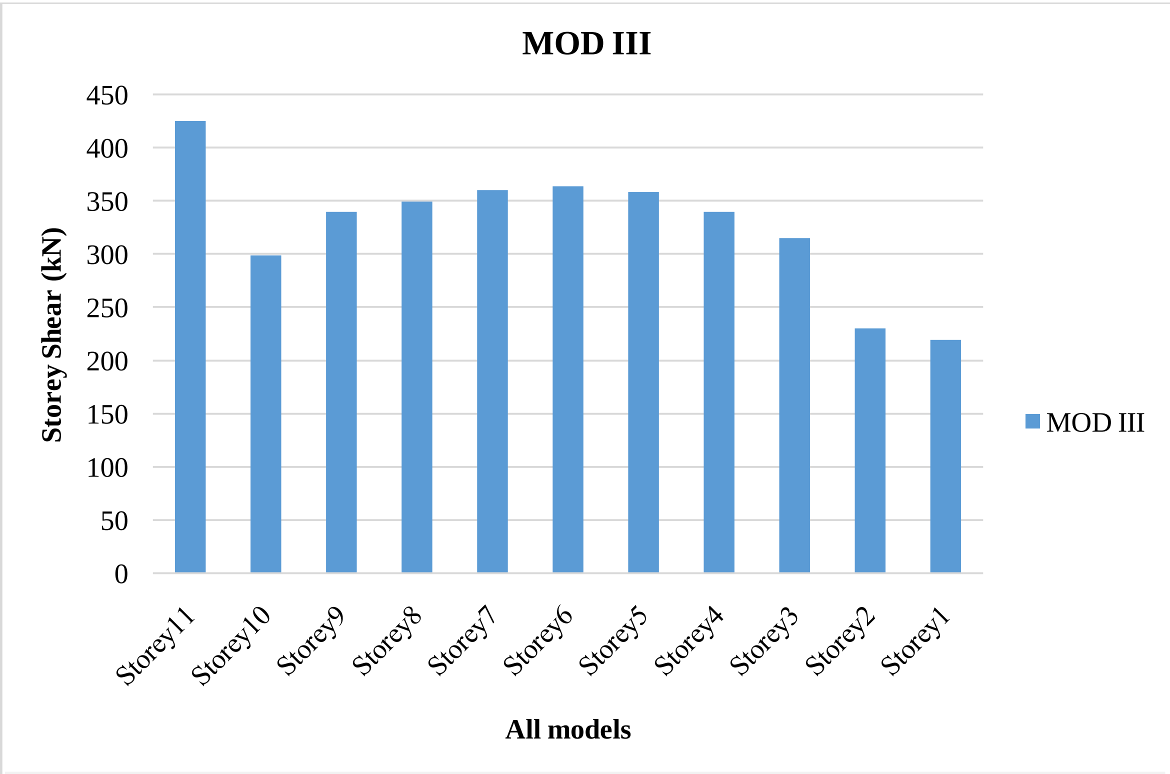

Fig.15: Time Period for model-III

5. Conclusions:

The following conclusions can be drawn based on the results obtained in the ETABS software.

i. The storey displacement is found to be maximum in the model-I and it is minimum in the model-IV.
ii. The storey drift is observed to maximum in the storey-1 and then it goes on decreasing while storey drift is maximum in the storey 7 for the model-II.
iii. The time period is maximum in the model-1 while it goes on decreasing as the modes goes on increasing.
iv. The storey shear is observed to maximum in the storey-1 and then it goes on decreasing while storey shear is maximum in the storey 7for the model-II.
v. Overall the model IV is assumed to have the optimum results as compared to the other models.

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