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SEISMIC RETROFITTING OF MULTISTOREY BUILDINGS USING ETABS SOFTWARE

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ABSTRACT

The existing construction fund creates a much more serious and complex seismic safety problem compared to the safe design of the new construction earthquake. The vast majority of buildings located in seismic areas show shortcomings in their resistance to earthquake loads for a number of reasons. Older designs developed according to previous codes may not meet current seismic standards, as the focus previously made is mainly on providing sufficient power only for gravitational loads. This work includes different models, and from the analysis we get this from a period of time (X-direction) for all models, there are about 12 modes of analysis and calculation of the period of time (sec). The minimum floor drift is observed in the case of superficial 11 and maximum for the floor 1.

***Keywords**: Retrofitting, seismic, ETABS & storey drift*

1. INTRODUCTION

The engineering intent behind the earthquake-resistant is not to make buildings protected from earthquakes that will not be damaged even during a rare but strong earthquake; such buildings will be too strong as well as too expensive. Instead, engineers make buildings to withstand the effects of ground tremors, although they can be severely damaged but will not collapse during a severe earthquake. Thus, the safety of human life and the contents inside the building are provided in earthquake-resistant buildings. This is the main goal of seismic design codes around the world. The philosophy of earthquake design can be summarized as follows;

1. Under minor but frequent shaking, the main members of the building resist the impact of the earthquake without being damaged (staying in the elastic range); however, non-loading building parts may be damaged.

2. Under moderate but accidental shaking, the main elements may be subject to certain damaged damage, and other parts of the building may be damaged even in need of replacement.

3. Under severe but rare shaking, major members may suffer serious (even irreparable) damage, but the building must not be destroyed.

2. REVIEW OF LITERATURE

Yamada et al. (2015) studied, experimentally and analytically, the deformation and & the quality of destruction of systems that resist lateral loading, shift the wall structure for the RC frame and the steel mount for the metal multi-storey frame under the earthquake, as versions have three different spans along with three, six, and nine floors. Deformations as well as the results of the texture for all cases 3 are compared, and the differences are clarified by normalizing the proposed horizontal dimensions of resistance.

S.S. Patil et al. (2013) presented a seismic assessment of the building of excessive lifting with the help of various systems of resistance of lateral load, which are one) bare frame, 2) frame, three) frame of the structure of the shear wall. This analysis is completed by the response spectrum method and the use of STAAD Pro. The test result is based on parameters such as baseline shift, history deviation, and history drift. They realized that the design of the landslide walls provides less deviation of the story, as well as drift of the story compared to a bare frame and a tight frame.

Hassaballa A.Ye. etc. (2013) studied the seismic assessment of the development of the LCD and investigated the functionality of the existing design in case they are exposed to seismic loads. This particular construction frame has been explored by the Response Spectrum method, and the frame is calculated using the STAAD Pro program. To seismic evaluate a multi-storey structure, they used a static load as well as a seismic load and get the result that a design based on the reaction spectrum technique required large size to withstand huge displacement. And he realized that the drift resulting from the movement of the node as a result of a combination of seismic loads and static load was about two or three times greater than the allowable drifts.

3. METHODOLOGY

The analysis is carried out on the different models using ETABS software, following models have been considered.

1. Model I: G+10 storey building without retrofitting
2. Model II: G+10 storey building retrofitted with shear walls at corner at bottom storey
3. Model III: G+10 storey building retrofitted with shear walls at external central portion at bottom storey
4. Model IV: G+10 storey building retrofitted with plus shape shear walls at central portion at bottom storey.
5. Model V: G+10storey building retrofitted with straight shear walls at external portion at bottom storey
6. Model VI: G+10storey building retrofitted with braces at corner at bottom storey
7. Model VII: G+10storey building retrofitted with braces at external central portion at bottom storey
8. Model VIII: G+10storey building retrofitted with plus shape braces at central portion at bottom storey
9. Model IX: G+10storey building retrofitted with straight braces at external portion at bottom storey

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
Thickness of shear wall	230 mm
Size of brace	230 mm x 300 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

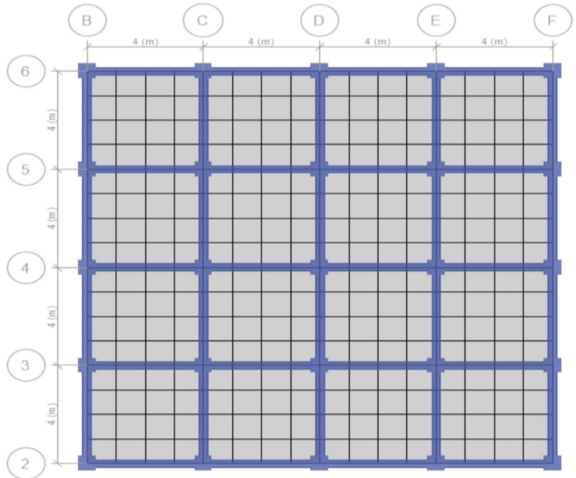

Figure 1: Plan of building

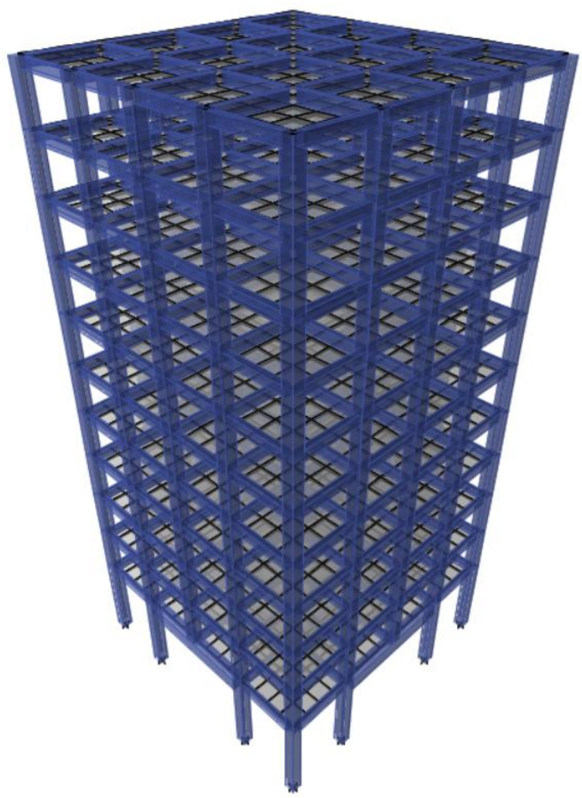

Figure 2: 3D Model of building generated in ETABS

4. RESULTS & DISCUSSIONS

The different models are analyzed using ETABS software, the results in terms of the displacement, storey drift, storey shear, storey stiffness and time period is obtained and it is mentioned as follows.

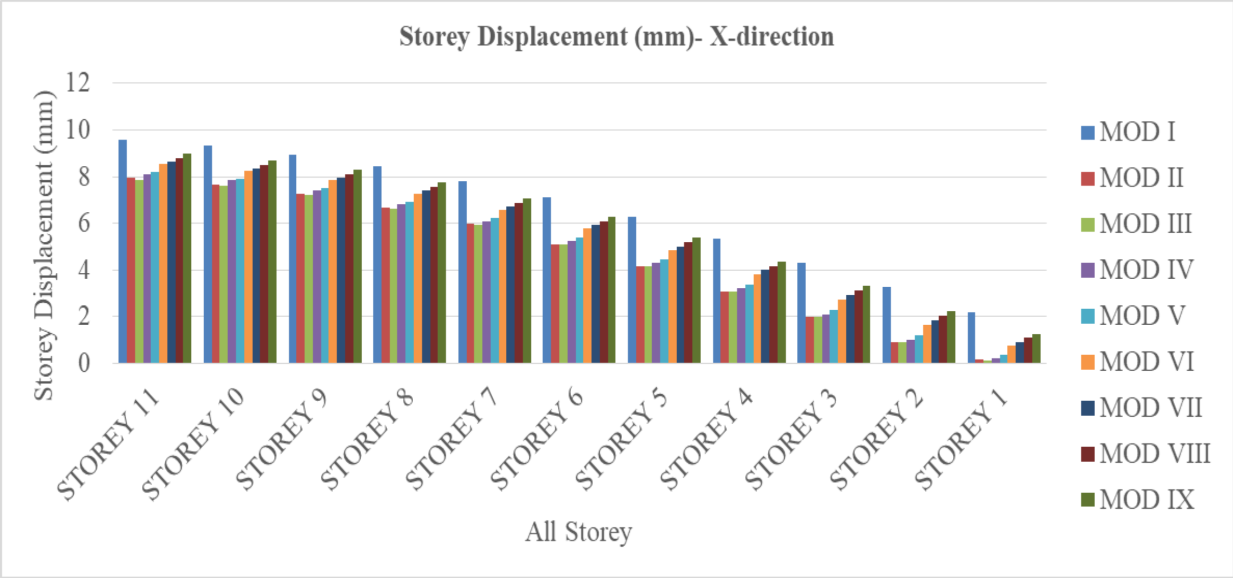

Figure 3: Storey Displacement (X-direction) for all models

The above diagram is for Storey Displacement (X-direction) for all models, there are all nine models with all 11 storey have been presented. The maximum displacement is observed in the case of storey 11, the model-1 (Model I: G+10 storey building without retrofitting) gives the maximum displacement and the model-3 (Model III: G+10storey building retrofitted with shear walls at external central portion at bottom storey) gives the minimum displacement.

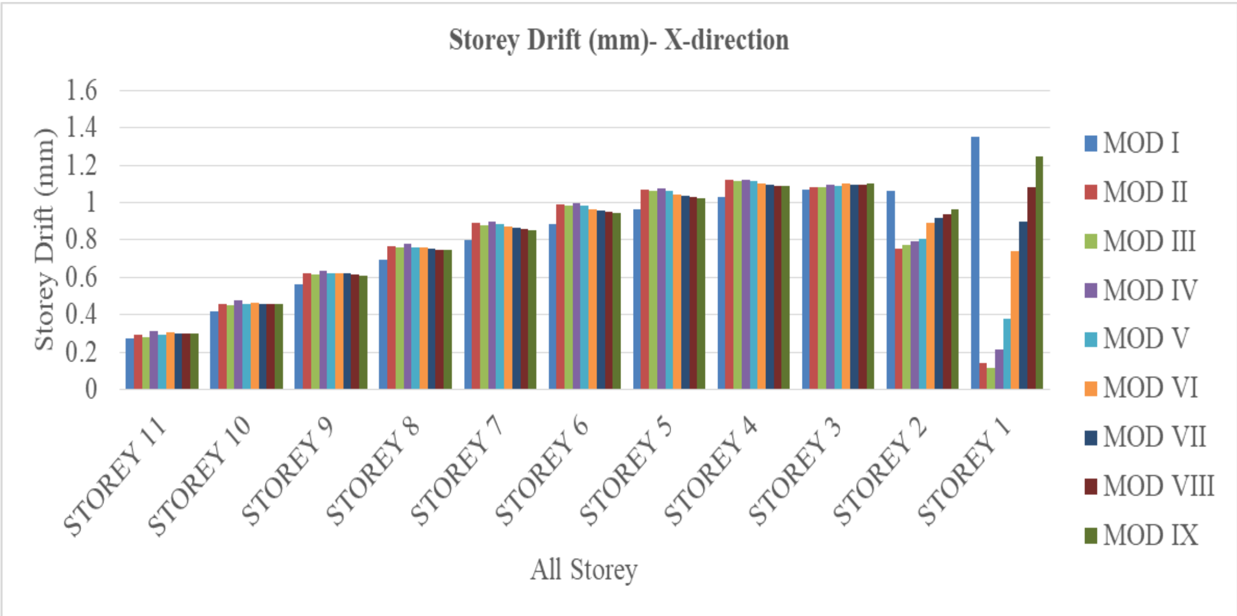

Figure 4:Storey Drift (X-direction) for all models

The above graph gives the details about Storey Drift (X-direction) for all models, the storey drift goes on decreasing from the storey no. 4 towards storey no.11. The minimum storey drift is observed in the case of storey 11 and maximum for the storey 1.

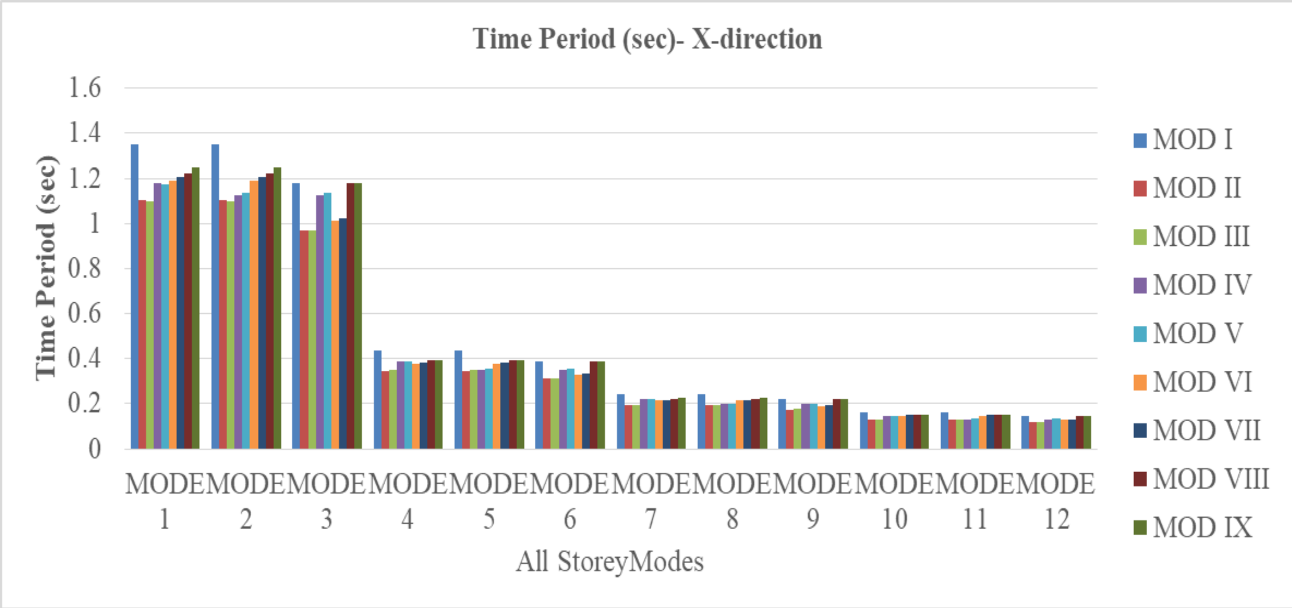

Figure 5:Time Period (X-direction) for all models

The above graph gives the details about Time Period (X-direction) for all models, there are around 12 modes for the analysis and calculation of time period (sec). The maximum value of time period is observed for the mode-1 and the value of time period goes on decreasing as the number of modes increases.

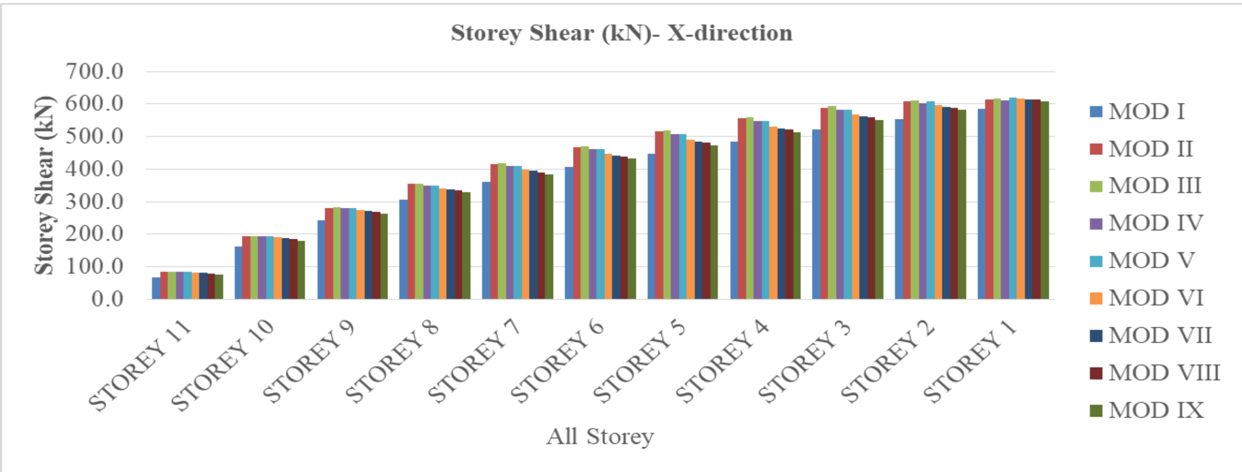

Figure 6:Storey Shear (X-direction) for all models

The storey shear (X-direction) for all models is mentioned in the above graph. The storey shear for all 11 storey has been mentioned also. The maximum storey shear is observed for the storey 1 and the minimum storey shear is observed for the storey 11.

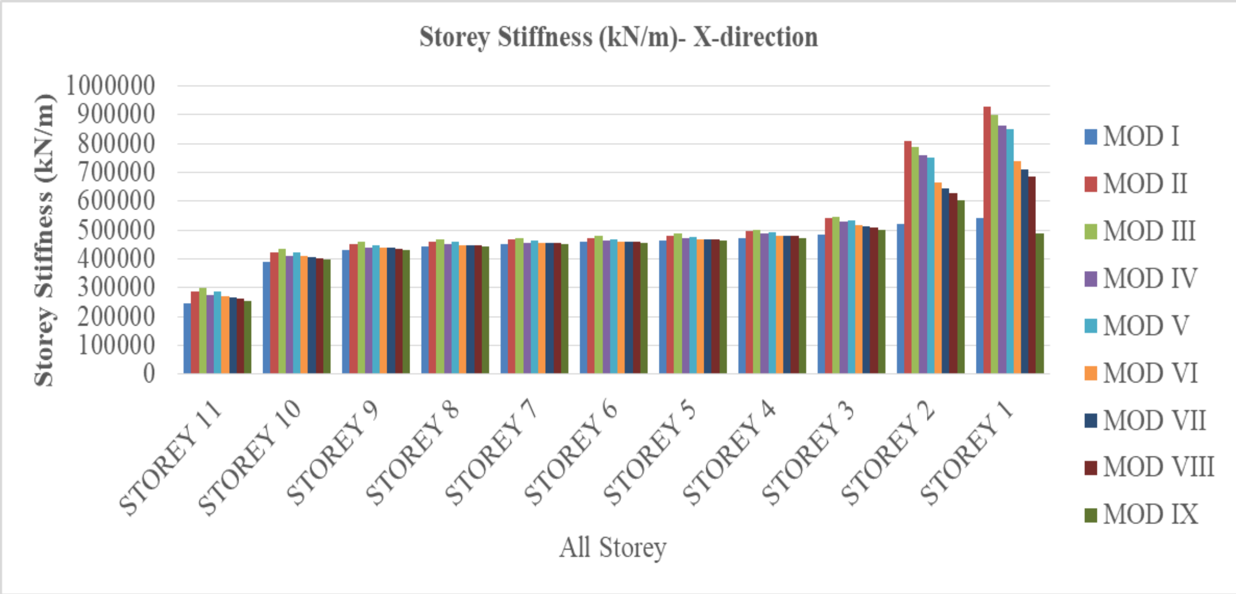

Figure 7: Storey Stiffness (X-direction) for all models

The above graph is related to Storey Stiffness (X-direction) for all models, the different storey have been mentioned in the graph. The storey stiffness for the storey 1 is observed to be maximum for the all models and the storey stiffness of the storey 11 is observed to be minimum.

5. CONCLUSION

The present work consists of the analysis of the different models which includes Model I: G+10 storey building without retrofitting, Model II: G+10storey building retrofitted with shear walls at corner at bottom storey, Model III: G+10storey building retrofitted with shear walls at external central portion at bottom storey, Model IV: G+10storey building retrofitted with plus shape shear walls at central portion at bottom storey, Model V: G+10storey building retrofitted with straight shear walls at external portion at bottom storey, Model VI: G+10storey building retrofitted with braces at corner at bottom storey, Model VII: G+10storey building retrofitted with braces at external central portion at bottom storey, Model VIII: G+10storey building retrofitted with plus shape braces at central portion at bottom storey and Model IX: G+10storey building retrofitted with straight braces at external portion at bottom storey. The following conclusions are drawn.

1. From Storey Displacement (X-direction) for all models, there are all nine models with all 11 storey have been presented. The maximum displacement is observed in the case of storey 11, the model-1 (Model I: G+10 storey building without retrofitting) gives the maximum displacement and the model-3 (Model III: G+10storey building retrofitted with shear walls at external central portion at bottom storey) gives the minimum displacement.

2. From Storey Drift (X-direction) for all models, the storey drift goes on decreasing from the storey no. 4 towards storey no.11. The minimum storey drift is observed in the case of storey 11 and maximum for the storey 1.

3. From Time Period (X-direction) for all models, there are around 12 modes for the analysis and calculation of time period (sec). The maximum value of time period is observed for the mode-1 and the value of time period goes on decreasing as the number of modes increases.

4. The storey shear (X-direction) for all models is compared. The storey shear for all 11 storey has been mentioned also. The maximum storey shear is observed for the storey 1 and the minimum storey shear is observed for the storey 11.

5. From Storey Stiffness (X-direction) for all models, the different storey is compared. The storey stiffness for the storey 1 is observed to be maximum for the all models and the storey stiffness of the storey 11 is observed to be minimum.

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