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A Comparative Study on RC Frame Building with Lateral Load Resisting Systems Reducing Earthquake Induced Motion

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***Abstract* -** Over few decades, structures constructed in earthquake prone areas may leads to serious damages. Structure should be built in such a way that; it should resist no only the gravity loads but also the earthquake loads to make the building as earthquake resistant. Any structure we built should perform satisfactorily throughout its life span in terms of durable and reliable and also the structure should be designed not only for gravity loads but also for seismic load. The end results of a seismic activity are nothing but the destruction of structures which in turn leads to loss of life. Amongst various lateral load resisting systems; shear-wall and Tune mass damper are the viable solutions for making the structure as earthquake resistant. An attempt has been made in analysing G+4 RC frame structure with & without lateral load resisting systems subjected to seismic forces to evaluate the performance in terms of Lateral Displacement, Storey Shear and Storey Drifts.

Keywords: Lateral load resisting systems, Shear Wall, Tuned Mass Damper

I. INTRODUCTION

From days of yore, nature's powers have impacted human life. Of the relative multitude of catastrophic events, e.g., seismic tremors, floods, twisters, storms, dry spells and volcanic emissions, the most un-comprehended and the most ruinous are earthquakes. The size and severity is assessed by magnitude and intensity. To overcome the ill-effects of these natural calamities, lateral load resisting system can be one the modified approach in making the structure more vulnerable to seismic waves.

1.1Lateral Load Resisting Systems

Some of the lateral load resisting systems mentioned below may be the viable solutions for the structure to perform better against earthquake forces

A. Shear Wall

Shear wall is nothing but a wall in a building which resists lateral loads produced by wind and earthquakes. Adequate safety and protection against non-structural damages during moderate seismic waves will be provided by shear walls.

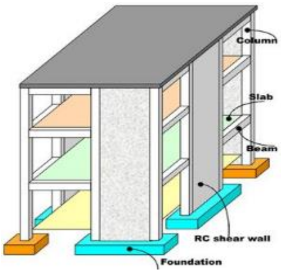

Fig 1.1 Shear wall

B. Tuned Mass Damper

Tuned mass damper (TMD) is a device fixed in structures to prevent the failure caused by vibration.

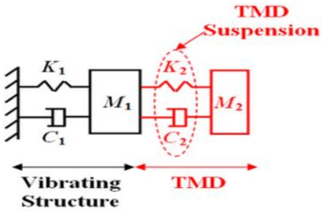

Fig 1.2 Tuned Mass Damper

The aim is to study the performance of structure wrt lateral displacement, Storey Drift and Storey Shear when controlled structure is modified with different lateral load resisting systems such as Shear wall, and TMD

II. LITERATURE REVIEW

Alex Y. Tuan and G. Q. Shang (2014) studied 101-storey building using a TMD. Their study includes the determination of optimal parameters of the TMD and behaviour under lateral loads. The obtained results were checked with test data and on-site recordings.

Thakur V. M and Pachpor P. D (2012) performed seismic analysis of multi-storied building with tuned mass damper. In this paper, a six storied building of rectangular shape with TMD (percentage masses 2% and 3%) made of RCC constructed at the top of the building is considered with an account of three different recorded time histories of past earthquakes for the analysis using finite element software SAP 2000.

Christoph Adam and Thomas Furtmuller (2010) studied the performance of TMD in structures. In this study, structures are modelled as elastic SDOF oscillators and they are installed with a TMD. It is found that TMDs are effective with light structural damping.

III. METHODOLOGY

To develop 3D model and to carry out the analysis, E-TABS software is used. The application of lateral loads and evaluation of performance of building are based on the Indian standards.

A. Description of the model

A model of 2 bays each of 6m long along x-axis and 3 bays each of 5m long along y-axis is considered for analysis of G+4 storey building. The important features of this building are shown below.

Structure	OMRF
Storey Height	3m
No of Storey	G + 4
Bay width	6 m along X-direction; 5 m along Y-direction
Beam Dimension	200 X 600
Column Dimension	200 X 600 (exterior); 200X750 (interior)
Slab thickness	150mm
Grade of Concrete	M25
Grade of Steel	Fe415
Soil type	Medium
Seismic Zone	II

MODELING AND ANALYSIS

Following models are used in the present study

Model 1: CS Model 3: PSW

Model 2: CSW Model 4: TMD

Where CS: Controlled Structure; CSW: Corner Shear wall; PSW: Peripheral Shear wall; TMD: Tuned Mass Damper

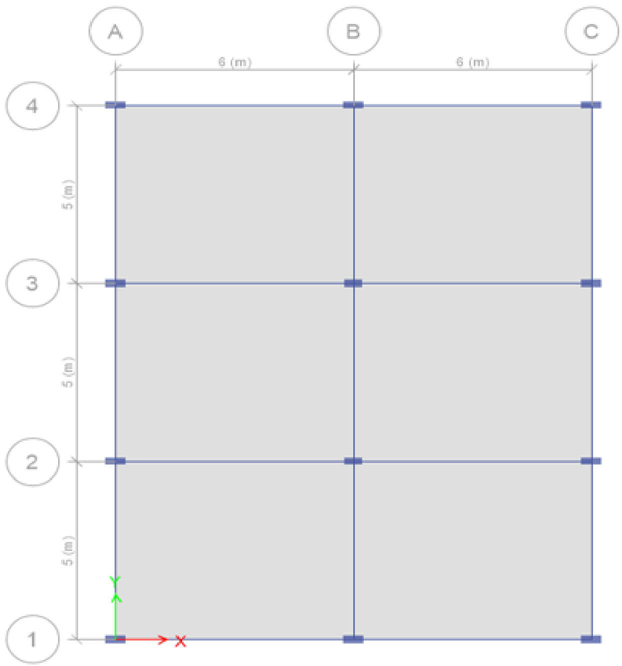

Fig 3.1: Plan of CS

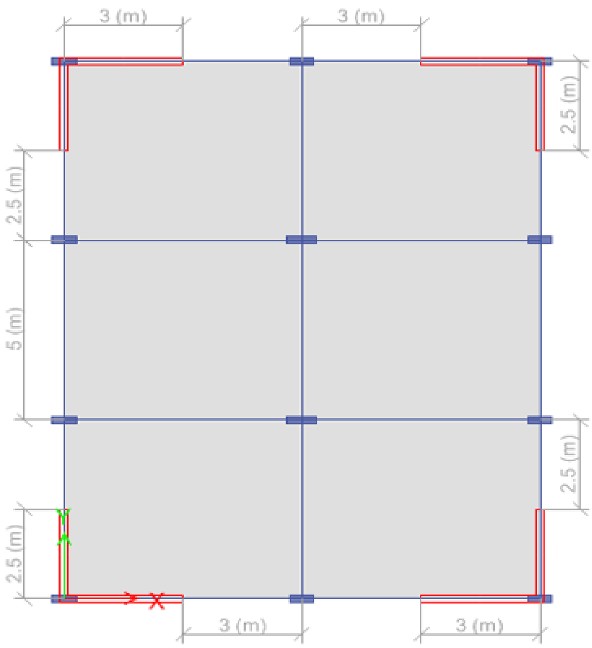

Fig 3.2: Plan of CSW

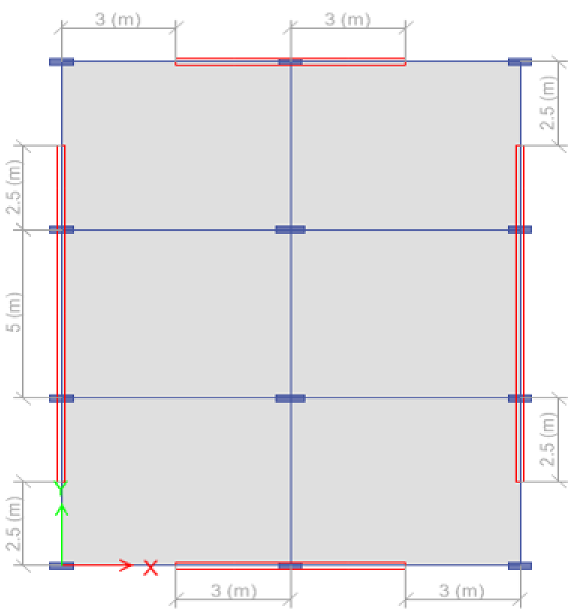

Fig 3.3: Plan with PSW

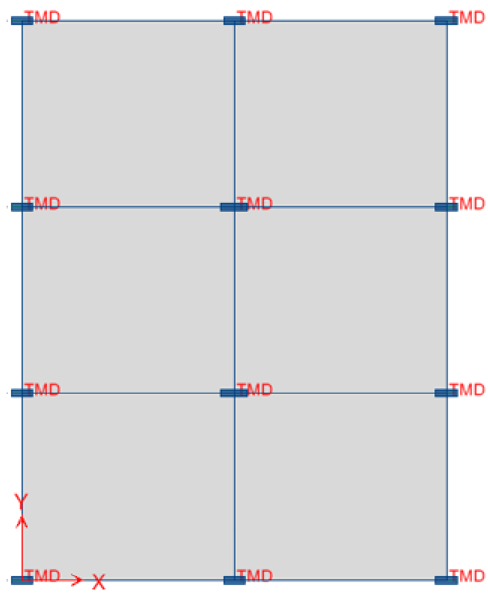

Fig 3.4: Plan with TMD

IV. Results & Discussions

The storey response of the above modelled structures is analysed and results are furnished in the form of graphs

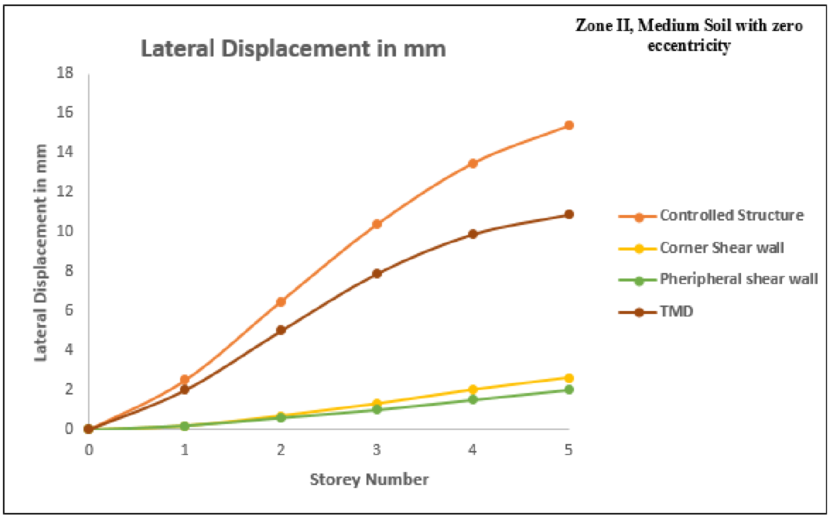

Figure 4.1: Variation of lateral displacement at different storeys for with and without lateral resisting systems

The above graph shows that; peripheral shear wall can be an optimal solution in reducing the lateral displacement of structure with medium soil located in zone 2

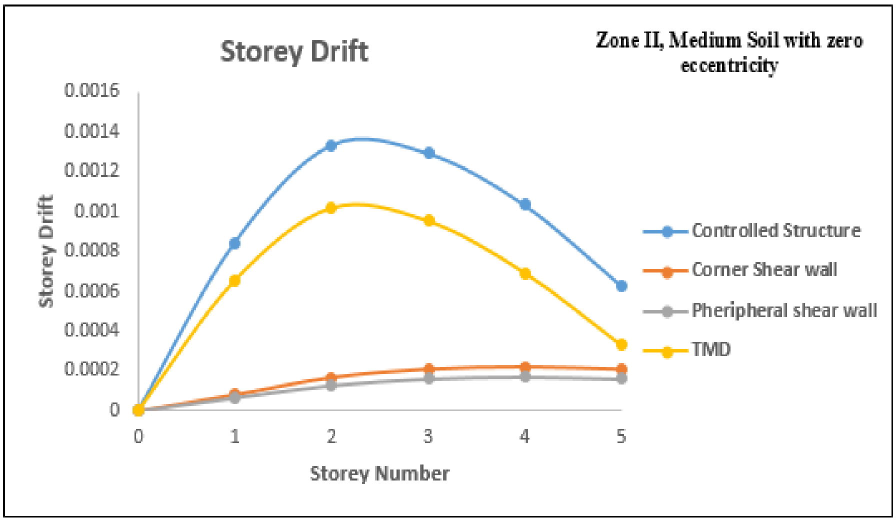

Figure 4.2: Variation of storey drift at different storeys for with and without lateral resisting systems

The above graph shows that; peripheral shear wall can be an optimal solution in reducing the storey drift of structure with medium soil located in zone 2

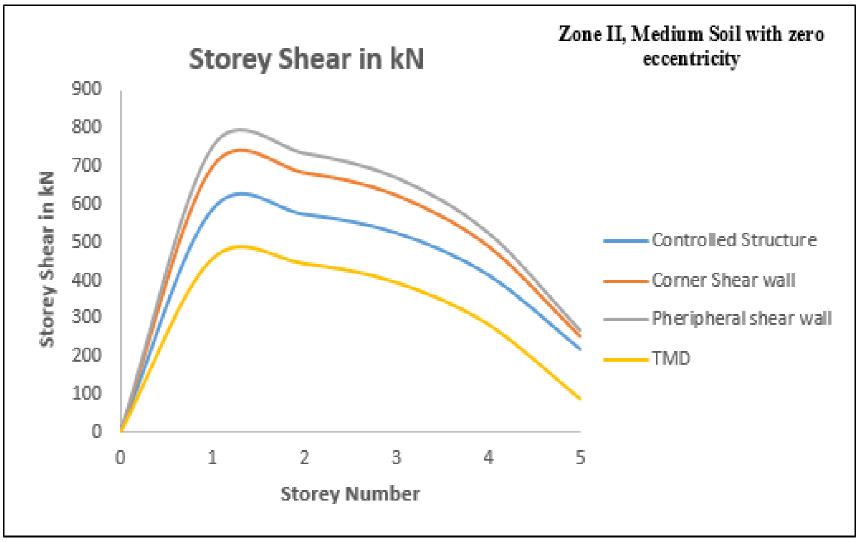

Figure 4.3: Variation of Storey shear at different storeys for with and without lateral resisting systems

The above graph that; peripheral shear wall can be an optimal solution in reducing the storey drift of structure with medium soil located in zone 2

Conclusion

In the present study, the 3D model of 15m high building having 5 storeys with a floor to floor height of 3m built on medium soil and located in seismic zone II is considered for the analysis the lateral displacement, storey drift and storey shear using ETABS software.

Seismic waves cause more lateral displacement, storey and storey shear for a controlled structure. It was observed that structure with peripheral shear has performed better in reducing the lateral displacement and storey drift by absorbing more energy and TMD has performed better among the lateral load resisting systems in reduce the base shear of the structure substantially there by giving a desired level of human comfort, safety and economy of the structure.

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