

# Vibration control of framed structure using tuned mass damper

Shatabdi Das

Asst.professor, civil engineering

Teample city institute technology and engineering,Khurda,Odisha

**Abstract:-**In earthquake engineering,vibration control is a set of technical means to mitigate seismic impacts in building and non building structures.All seismic vibration control device may be passive,active or hybrid.Tuned mass damper is known as harmonic absorber or seismic damper,is a device mounted in structure to reduce the amplitude of mechanical vibration. Their application can prevent discomfort, damage or out right structure.In this paper we can utilize Etabs-2015 for vibration control using tuned mass damper.In this paper we can study or analyze without damper or with damper and comparison of drift value and displacement value and compare between them.

**Index Term-**Earthquake,Tuned mass damper,Response spectrum analysis,Etabs

**INTRODUCTION-**The structural system designed to carry may not carry vertical load but carry lateral load.if it has the design of lateral load will increase in structural load subsequently with increase in storey.As the seismic load acting on the structure is a function of self weight of the structure.These structure has light flexible as compared to relatively low damping.For vibration control high rise building is equipped with artificial damping device for vibration control through energy dissipation.A tuned mass damper(TMD) is a device consisting of mass ,spring and a damper that is attached to the structure in order to dynamic response of the structure.The secondary mass is designed to have natural frequency which is depend on mass ,stiffness tuned to the primary structure.

The ETAB 2015 is a finite element based structural program for analysis and design of civil structure.ETAB has proven best method for productivity and practical general purpose for structure today.ETAB is most easiest and structural analysis of design today.

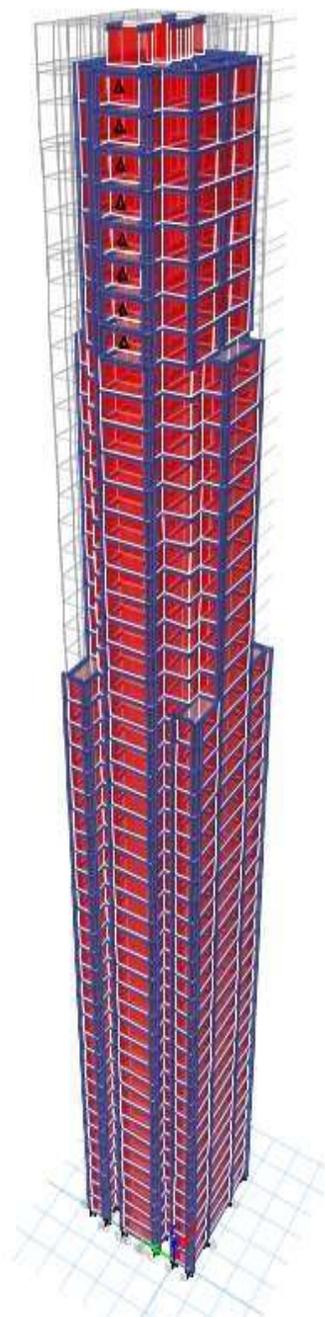
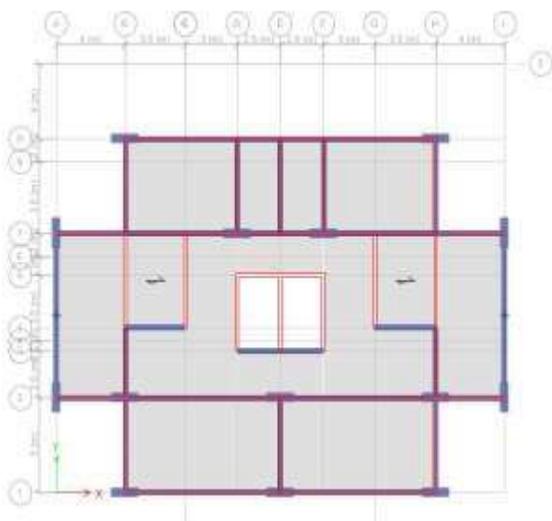
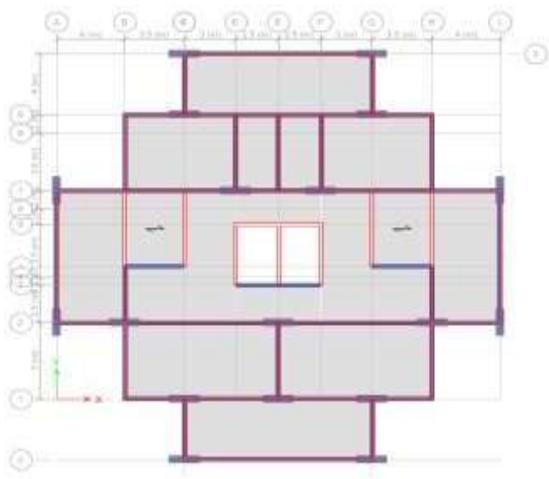
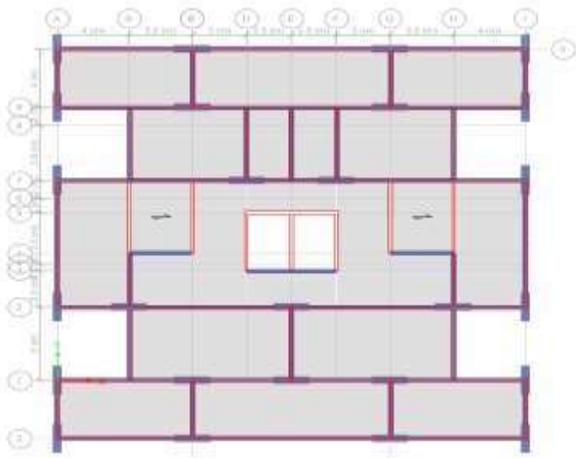
**Methodology-**A tuned mass damper consist of mass, spring and damper that is attached to the structure in order to reduce dynamic response of structure whenever a strong lateral force such as strong lateral force such as an earthquake or high wind hits.

Here we analyse G+51 multi storey building.Analytical modelling of structural component has been done.The effect of soil structure has been ignored.The column are considered fixed from base.Beam and columns are modelled from frame element joined nodes to nodes.Here we use building as ETABS basis model.Trial and error method has been used to find mass attached to damper.

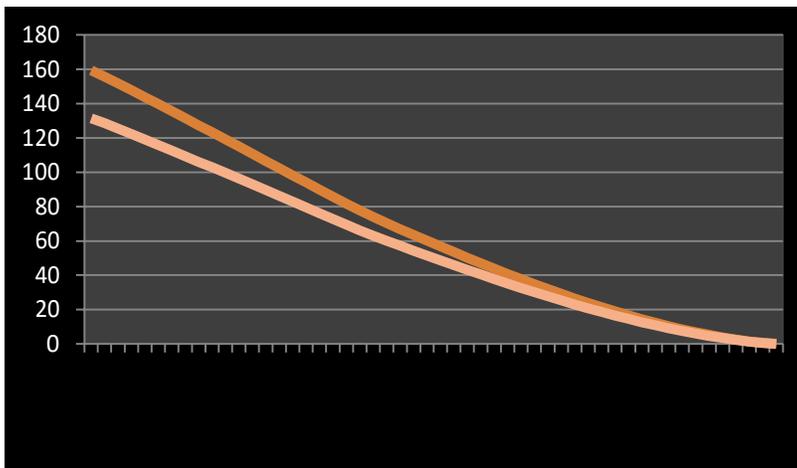
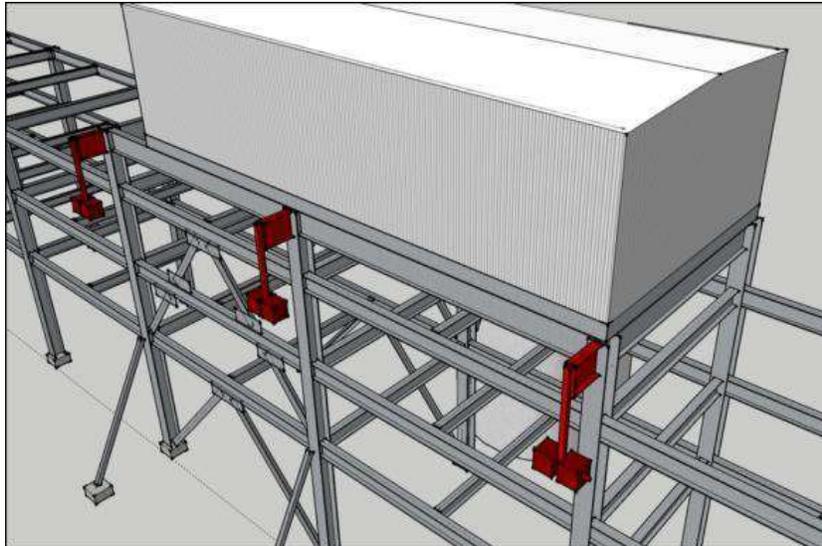
**I. MODELLINGDETAILS**

Grade of Concrete	M 45 For Columns and M40 For Beams
Grade of Reinforcing Steel	HYSD 415
Dimension of Beam	250×600 mm
Dimension of Column	1 to 20 storey: 500 X 2000 mm 20 to 34 storey: 500 mm X 1800mm 35 to 51 storey: 500 mm X 1600mm
Thickness of Slab	Floor Slab :- 150mm Staircase Slab :- 200 mm
Height of Typical Storey	4 m
Dead Load	Dead load according to IS 875 part I
Live Load	Live load according to IS 875 part II
Wind Load	Wind load according to IS 875 part III
Earthquake Load	Criteria as per IS 1893: 2002 Zone IV Site Type III
Density of Concrete	25 KN/m <sup>3</sup>
Seismic Intensity	Very Severe
Response Reduction Factor	5
Zone Factor	0.36
Damping Ratio	5%
Structural Class	C
Wind Speed Zone	5
Basic Wind Speed	55 m/s
Risk Coefficient	1.00
Wind Design Code	IS 875:1987 (Part 3)
RCC Design Code	IS 456:2000
Steel Design Code	IS 800:2007
Load Combinations	As per IS 1893:2002 (part 1) and IS 456:2000
Location of Damper	For Top 8 Storey's (From 43 to 51)

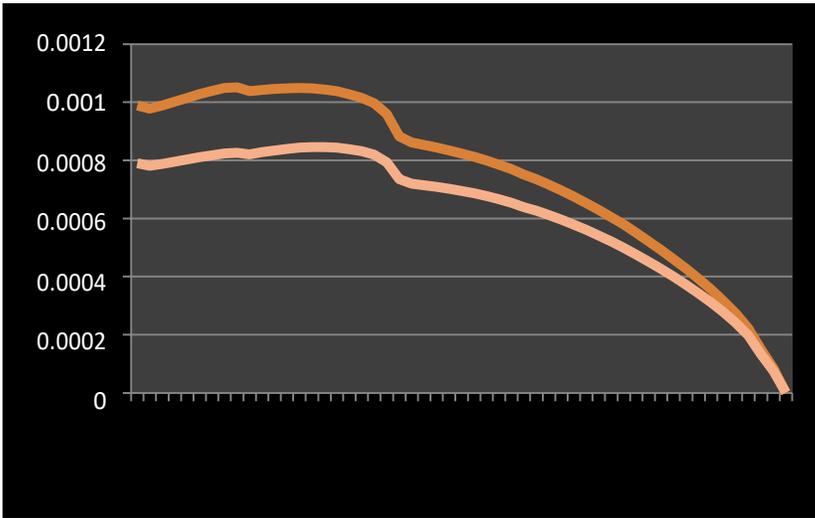
For the analysis work ,model of concrete frame building (G+51) floors are made to know the realistic behaviour of building during earthquake. The length of the building at ground is 27 m and 26 m. The typical storey height is 4 m.



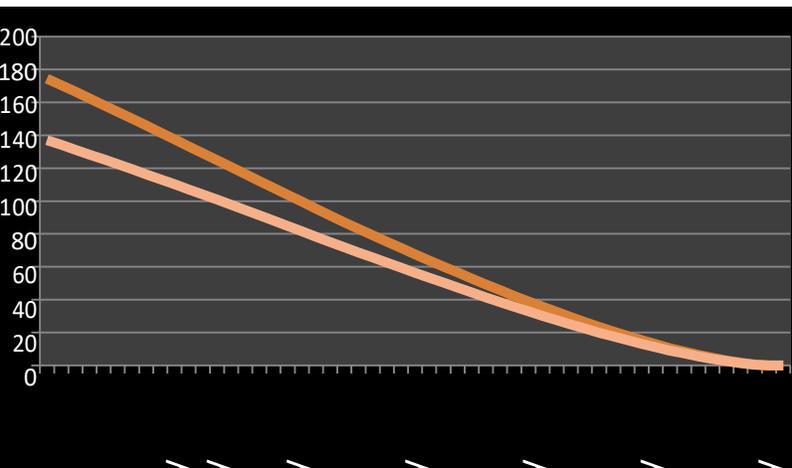
**Damper detail:**-The tuned mass damper used is the distributed type of tuned mass damper i.e. instead of using long pendulum with huge mass, tuned mass damper is divided into small distributed pendulum mass damper each of having mass of 100 kg , installed for top eight storey at outer face on both side of building



**Displacement Graph for Eqx (mm)**  
Maximum Displacement without Damper:-159.295  
Maximum Displacement with Damper: - 131.434%  
Reduction: - 17

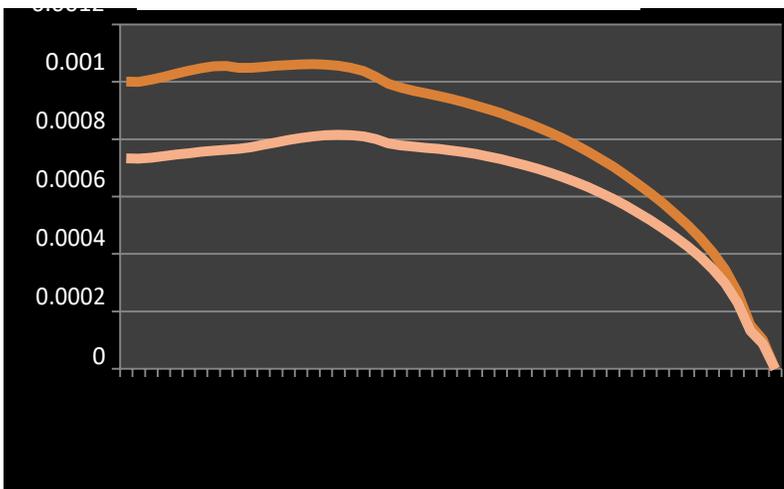


Drift Graph for Eqx (mm)  
Maximum Displacement without Damper: - 0.000989  
Maximum Displacement with Damper: - 0.00079  
% Reduction: - 20



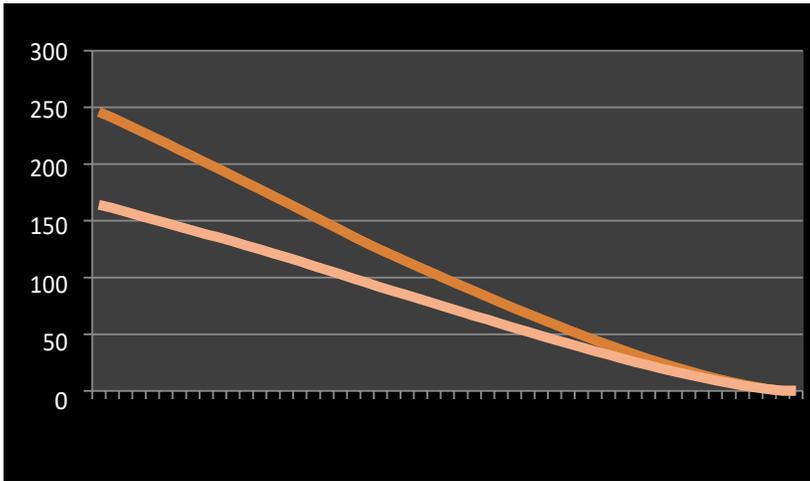
Graph for EqY (mm)  
Displacement

Displacement Graph



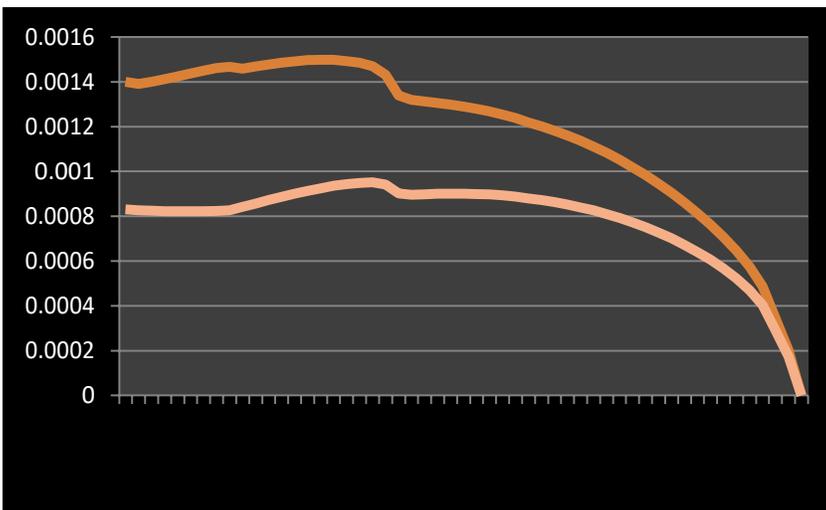
Drift Graph for EqY (mm)  
Maximum

Displacement

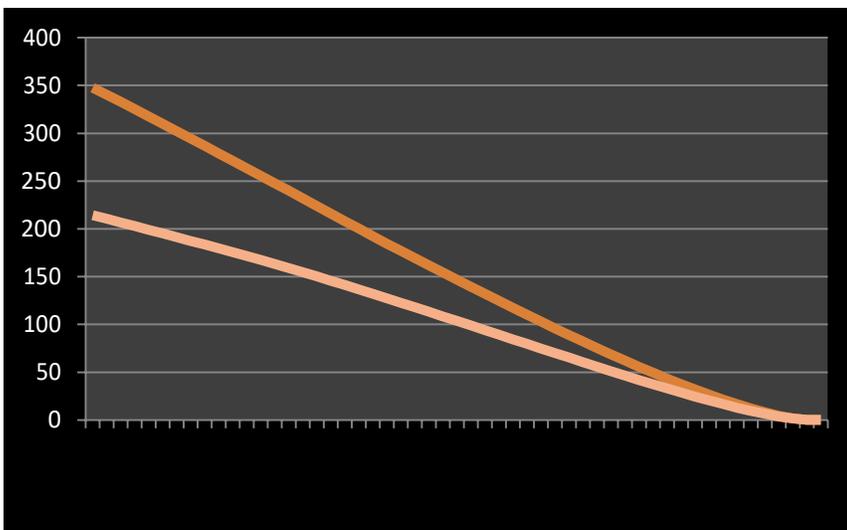


**Displacement Graph for wind x (mm)**  
 Maximum Displacement without Damper: - 246.063  
 Maximum Displacement with Damper: - 164.136

Displacement Graph

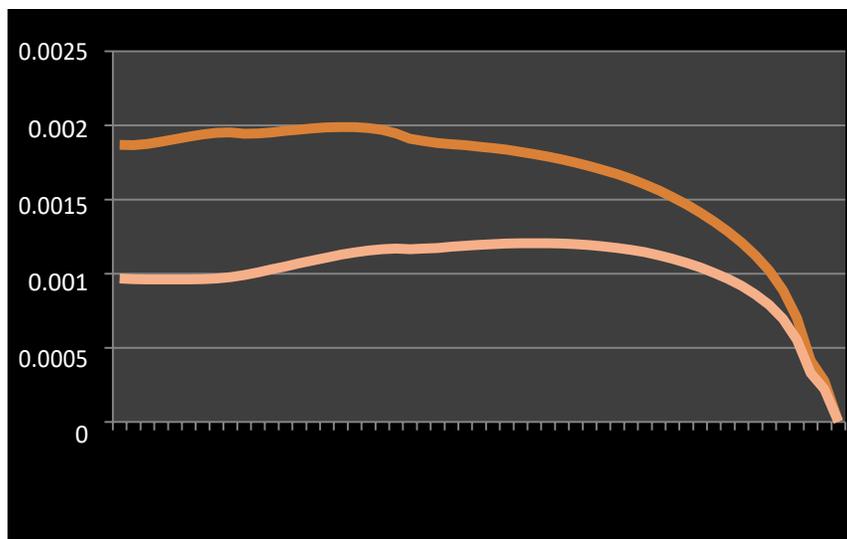


**Drift Graph for wind x (mm)** Maximum Displacement without Damper:- 0.0014  
 Maximum Displacement with Damper: - 0.000831  
 % Reduction: - 40



**Displacement Graph for wind y (mm)**  
 Maximum Displacement without Damper: - 347.821  
 Maximum Displacement with Damper: - 214.254  
 % Reduction: - 38.4

Displacement graph



**Drift Graph for wind y (mm)** Maximum Displacement without Damper: - 0.0018 Maximum

Displacement with Damper: - 0.00096

% Reduction: - 45

Maximum Storey Displacement	Without Damper(mm)		With Damper(mm)	
Eqx	159.295		131.434	
Eqy	174.578		131.164	
Wind X	246.063		164.136	
Wind Y	347.821		214.254	
Maximum Storey Drift (mm)				
Eqx	0.000989		0.00079	
Eqy	0.001		0.000733	
Wind X	0.0014		0.000831	
Wind Y	0.0018		0.00096	
Maximum Storey Acceleration(mm/s <sup>2</sup> )	RES Y(UX)	RES Y(UY)	RES Y(UX)	RES Y(UY)
Storey 51	885.88	811.72	765.18	737.93
Storey 50	866.7	730.87	749.8	661.46

1. Conclusion-The values of displacement and drift are found to be more on structure when structure is acted upon by dynamic conditions without damper.
2. But by assigning Tuned Mass Damper to structure, the structure is going to be more stable as the value of displacement and drift are reduced.
3. The acceleration also reduced significantly using tuned mass damper.
4. From the analysis and observations of graph we can conclude that, the percentage decrease in the displacement and drift values found to be reduced by 28% and 32% respectively.

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