# Regular High Rise Building Vibration Control By Tuned Mass Damper: A Performance Analysis

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***Abstract—*** *Seismic This vibration never injure the people but the main factor is to injure the people that the collapse of multistory structure. Sometimes the sudden vibration arises and the structure will collapse. this may get results of the displacement of the structure. To avoid this situation, we applied the another massive structure i.e. tuned mass damper. Tuned mass damper is just like a pendulum. Whenever the structure moves to the left side then the tuned mass damper goes right side and vice versa. Which may get results of the small displacement arises in the structure. The tuned mass damper (TMD) for vibration control of tower subjected to multi-dimensional seismic excitations is studied in this paper. Calculation model of the tuned mass damper is introduced and the equations of motion of a tower with tuned mass damper are derived and the calculation parameter of the tuned mass damper are given based on the control structure. According to a practical engineering, the three- dimensional finite element model of a tower is established using SAP2000. Three typical seismic records are selected according the code of seismic design. Vibration control for tower model with tuned mass damper under multidimensional seismic excitation is performed by using numerical simulation. The maximum responses of displacement and axial force of the tower structure without and with TMD are obtained. The result shows that TMD could decrease the responses of the tower in three directions, and the tower with TMD can be a reference for tower practice engineering Application.*
*Keywords—SAP 2000 , TMD , ma.*

## I. INTRODUCTION

Vibration This means to fluctuation of the ground surface which result in damages of high rise structure in this zone. It is periodic or non periodic. With the permutation of engineering the vibration extenuation technique has show the way to civil engineering and infrastructure field. The high rise structure has been constructed all over the world and the volume has been increased day by day. This is not only concerned with residential building for high density of population, commercial zones and space saving but also prove that the country has become way to standard. As the seismic load acting on the structure and wind load also acing on the structure, that structure not sustain that kind of load and may damped. The structure made comparatively light and flexible which have relatively low natural damping. This result may get that the structure makes more vibration prone under wind , earthquake loading. In many cases this type of large displacement s may not be a threat to integrity of the structure but steady state of vibration can cause considerable discomfort and even illness to the building occupant. All the structure in the world may follows law of conservation of energy. the energy is inflict on the structure with the help of wind and the earthquake load is fully diminished in such a way that the structure will less vibrate. The structural vibration can be controlled which are produced by earthquake and wind can be done by various means such as modifying rigidities, masses, damping and by providing passive and active counter forces. In a modern structure, the total damping has been done about 5% of the critical. So that the high rise structure has been supplied by artificial damping device for the vibration control through energy dissipation. For the selection of damping devices, various factor that affect on that selection i.e. efficiency, compactness, weight, capital cost, operating cost, maintenance requirement and safety.

In Japan, there were many times earthquake arises and Japanese was face that situation. One day that structure had been made named as PAGODA. Tuned mass damper is a device which is used for reducing the vibration of the high rise structure. This device is a vibration control device in mechanical engineering. TMD is absorbed the tuned and the damper for the used as a control application in structural vibration the secondary mass system is depended on its mass and stiffness which is designed to have the natural frequency. The particular frequency of the structural will excited then the TMD will resonate out of phase with the structural motion and reduces the response. Then the excess energy can be transferred to the secondary mass system and is dissipated by the dashpot due to relative motion between them at a later time .As the frequency of the earthquake is more then only single TMD is not applicable to sustain. This vibration then the multi TMD's are used which reduces the large frequency and the displacement which is produced on the upper portion of the structure will get reduced. As the multi TMD's exceeds the operation cost maintenance cost and safety parameter the size of the TMD will increased by ounce (gram) to tons.

TMD is reduces the dynamic responses of the structure. The frequency of the damper in matched with the particular structural frequency so that when the frequency in excited. A spring dashpot system is used to attach the mass with the building and the relative motion is developed between the mass and the Structure.

## II LITERATURE REVIEW

The main three factors that govern the particular type of analysis process to be applied to structural depend upon the type of externally applied loads, the behavior of the structure/or structural materials and the type of structural model selected. Dynamic analysis is two types, linear and nonlinear analysis. The building frame has been analyzed by linear time history analysis.

If non-linear behavior is not involved in structure, the linear time history analysis is the best method to find out the response of a structure than any other method. In this method the response of a structure is find out at discrete time interval which require a great computational effort. Another interesting advantage of this method is that the relative values of response quantities are saved in the response histories.

**Steps for the dynamic analysis of 2D frame**

1. Discretising the domain: Dividing the each element into number of small part connected by nodes and numbering them globally.
2. Formulation of the Element matrices: The element or local stiffness and mass matrix is found for all elements, which is symmetric of size 6×6.
3. Assembling the global stiffness matrices: The element stiffness matrices are then transformed to global coordinate system and combined globally based on their degrees of freedom values.
4. Applying the boundary condition: The boundary condition is applied by suitably deleting the rows and columns of the mass and stiffness matrix corresponding zero force or displacements.
5. Solving the equation: The equation is solved in MATLAB to get the value of U by using Newmark's beta method.

## III METHODOLOGY

The TMD is placed at the $10^{TH}$ storey and the 2D frame structure is subjected to both corresponding to compatible time history as per spectra of IS-1894(Part-1):2002 for 5% damping at rocky soil and 1940 El Centro earthquake load and the amplitudes of displacement is noted at the extreme right node of the 10th storey with TMD and without TMD. The TMD is having mass ratio=0.1 and tuning ratio=1

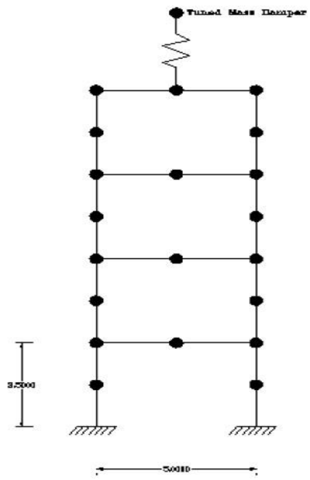


Fig 4.8 a) Damper Structure Arrangement for 2D frame 11

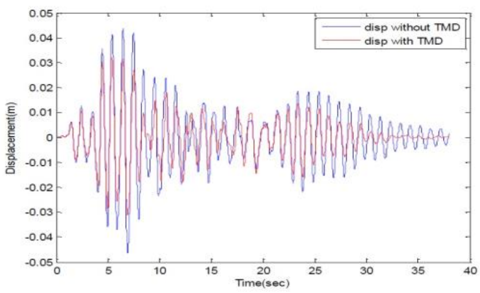


Fig 4.8 b) the amplitude of vibration at the top storey of 2d frame with the placing of TMD at the top storey for the 5% damping at rocky soil earthquake loading acting on the structure.

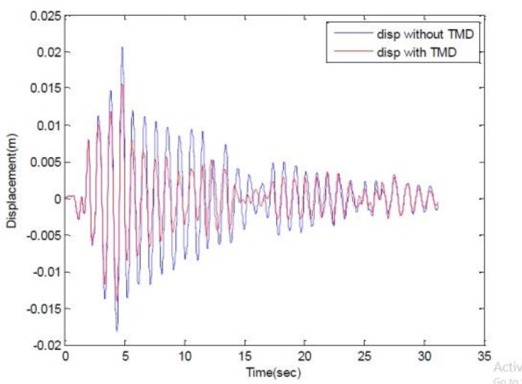


Fig 4.8 c) Amplitude of vibration at top storey of 2D frame by placing TMD at top storey when, El Centro(1940) earthquake loading acting on the structure.
Fig 4.8 Amplitude of vibration at top storey of 2D frame by placing TMD at top storey when subjected to different earthquake loadings.

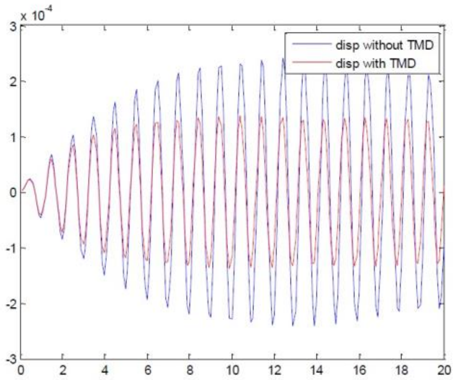


Fig 4.8 d) Amplitude of vibration at top storey of 2D frame by placing TMD at top storey when subjected to sinusoidal acceleration

**Following conclusions can be made from this study:**

1) For controlling the vibration of the structure, it is found that, TMD has been successfully used
2) For the damping ratio i.e. 2% is more effective for reducing the displacement response than that of damping ratio 5%.
3) Applying the two earthquake loadings, first is the one corresponding to compatible time history as per details of IS-1894(Part -1):2002 for 5% damping at rocky soil and the second is the 1940 El Centro Earthquake shows that, as we increase the mass ratio of TMD it decreases the displacement responses of the columns.

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