IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Seismic Resistant structure by using Tuned mass Damper

[1]Nishant Satpute, [2]Dattatray Zod , [3]Prajwal Dive, [4]Pranay Bagade, [5]Dishant Jambhulkar
[1]Student, [2345]Student
[1]Civil engineering ,
[1]Guru Nanak Institution Of Technology , Nagpur, India.

Abstract: This Current trends in construction industry demands taller and lighter structures, which are also more flexible and having quite low damping value. This increases failure possibilities and also problems from serviceability point of view. Now-a-days several techniques are available to minimize the vibration of the structure, out of the several techniques available for vibration control ,concept of using TMD is a newer one. This study was made to study the effectiveness of using TMD for controlling vibration of structure. At first a numerical algorithm was developed to investigate the response of a shear building fitted with a TMD. Then another numerical algorithm was developed to investigate the response of a 2D frame model fitted with a TMD. A total of three loading conditions were applied at the base of the structure. First one was a sinusoidal loading, the second one was corresponding to compatible time history as per spectra of IS-1894 (Part -1):2002 for 5% damping at rocky soil with (PGA = 1g) and the third one was 1940 El Centro Earthquake record with (PGA = 0.313g).

From the study it was found that, TMD can be effectively used for vibration control of structures. TMD was more effective when damping ratio of the structure is less. Gradually increasing the mass ratio of the TMD results in gradual decrement in the displacement response of the structure.

***Index Terms* – Tuned mass damper, Vibration, Frame structure, Damping Ratio.**

I. INTRODUCTION

Vibration control is having its roots primarily in aerospace related problems such as tracking and pointing, and in flexible space structures, the technology quickly moved into civil engineering and infrastructure-related issues, such as the protection of buildings and bridges from extreme loads of earthquakes and winds.

The number of tall buildings being built is increasing day by day. Today we cannot have a count of number of low-rise or medium rise and high rise buildings existing in the world. Mostly these structures are having low natural damping. So increasing damping capacity of a structural system, or considering the need for other mechanical means to increase the damping capacity of a building, has become increasingly common in the new generation of tall and super tall buildings. But, it should be made a routine design practice to design the damping capacity into a structural system while designing the structural system.

The control of structural vibrations produced by earthquake or wind can be done by various means such as modifying rigidities, masses, damping, or shape, and by providing passive or active counter forces. To date, some methods of structural control have been used successfully and newly proposed methods offer the possibility of extending applications and improving efficiency.

The selection of a particular type of vibration control device is governed by a number of factors which include efficiency, compactness and weight, capital cost, operating cost, maintenance requirements and safety.

Tuned mass dampers (TMD) have been widely used for vibration control in mechanical engineering systems. In recent years, TMD theory has been adopted to reduce vibrations of tall buildings and other civil engineering structures. Dynamic absorbers and tuned mass dampers are the realizations of tuned absorbers and tuned dampers for structural vibration control applications. The inertial, resilient, and dissipative elements in such devices are: mass, spring and dashpot (or material damping) for linear applications and their rotary counterparts in rotational applications. Depending on the application, these devices are sized from a few ounces (grams) to many tons. Other configurations such as pendulum absorbers/dampers, and sloshing liquid absorbers/dampers have also been realized for vibration mitigation applications.

TMD is attached to a structure in order to reduce the dynamic response of the structure. The frequency of the damper is tuned to a particular structural frequency so that when that frequency is excited, the damper will resonate out of phase with the structural motion. The mass is usually attached to the building via a spring-dashpot system and energy is dissipated by the dashpot as relative motion develops between the mass and the structure.

II. LITERATURE REVIEW

1)Kenny C. S(1984) Spectral density functions of wind-induced acceleration responses of Sydney Tower identify natural frequencies of vibration of 0.10 Hz and 0.50 Hz for the first mode and second mode respectively was analysed. For natural frequencies and damping measurements. Two accelerometers were installed in the Tower, one at Turret Level 8 to monitor the first mode vibrations and one near the Intermediate Anchorage Ring to monitor the second mode vibrations.

2)Genda Chen(2004) The proposed procedure is applied to place the dampers on the floors of the six story building for maximum reduction of the accelerations under a stochastic seismic load and 13 earthquake records. Numerical results show that the multiple dampers can effectively reduce the acceleration of the uncontrolled structure by 10–25% more than a single damper. It is found that time-history analyses indicate that the multiple dampers weighing 3% of total structural weight can reduce the floor acceleration up to 40%. The multiple dampers can even suppress the peak of acceleration responses due to impulsive excitations, which a single damper of equal mass cannot achieve

3)Roberto villaverde(2003) An investigation is carried out of a 13 story building to assess the viability and effectiveness of a recently proposed roof isolation system that aims at reducing the response of building to earthquake. The roof isolation system entails the intersection the flexible laminated rubber bearing between building's roof and the columns that support it addition of viscous damper connected between the roof and rest of the building. It is based on the concept of vibration absorber.

4)Jerod G. Johnson(2003)gives feasibility of placing tuned mass damper at top in the form of limber rooftop moment frame to reduce seismic acceleration response. Six existing structure were analytically studied using a suite of time history and response spectra records. The analyses indicate that there is an increase in fundamental period increase generally esult in a decrease in seismic acceleration response for the same time history and response spectra records.

5)Mehdi Setareh(2007)A semi-active magneto-rheological device is used in a pendulum tuned mass damper PTMD system to control the excessive vibrations of building floors. This device is called semi-active pendulum tuned mass damper SAPTMD. Analytical and experimental studies are conducted to compare the performance of the SAPTMD with its equivalent passive counterpart. An equivalent single degree of freedom model for the SAPTMD is developed to derive the equations of motion of the coupled SAPTMD-floor system. A numerical integration technique is used to compute the floor dynamic response, and the optimal design parameters of the SAPTMD are found using an optimization algorithm. Effects of off-tuning due to the variations of the floor mass on the performance of the PTMD and SAPTMD are studied both analytically and experimentally. From this study it can be concluded that for the control laws considered here an optimum SAPTMD performs similarly to its equivalent PTMD, however, it is superior to the PTMD when the floor is subjected to off-tuning due to floor mass variations from sources other than human presence.

III. METHEDOLOGY

Thetemplateisusedtoformatyourpaperandstylethetex If the structure not properly designed and constructed with required quality they may cause large destruction of structures due to earthquakes. Time history analysis is an useful technique for seismic analysis of structure when the structure shows nonlinear response. This method is step by step analysis of the seismic responses of a structure to a specified loading that may change with time.

1) Extensive literature survey by referring books, technical papers carried out to understand basic concept of topic.

2) Selection of type of structures.

3) Modeling of the selected structures

4) Analytical work is to be carried out.

5) Interpretation of result and conclusion. In the present work it is proposed to carry out seismic analysis of multistored RCC buildings using time history analysis method considering mass irregularity at different floor levels with the help of ETABS software.

3.1 Forced Vibration analysis of TMD-Structure interaction problem

For frame structure the equation of motion of this tmd–structure system can be written in the following form.

$$[M]\{\ddot{}\} + [C]\{\dot{}\} + K\{X\} = -[M]\{\ddot{X}_g\} + \{F_{tmd}\}$$

where,

[M] = The global mass matrix of the 2D frame structure

[C] = The global damping matrix of the frame structure (Assumed to be a zeromatrix, as damping is neglected in the structure)

[K] = The global stiffness matrix of the 2D frame structure

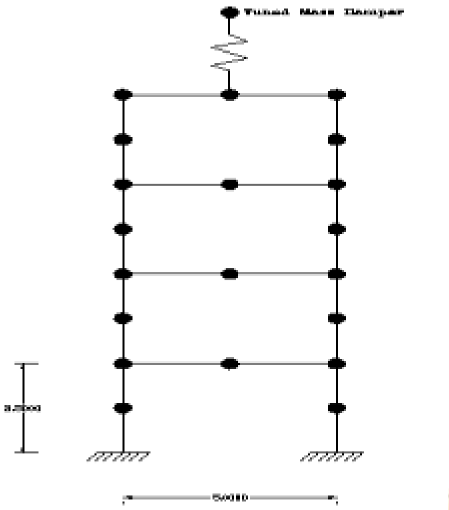
{X} = The global nodal displacement vector

$\{\ddot{X}_g\}$= Ground Acceleration

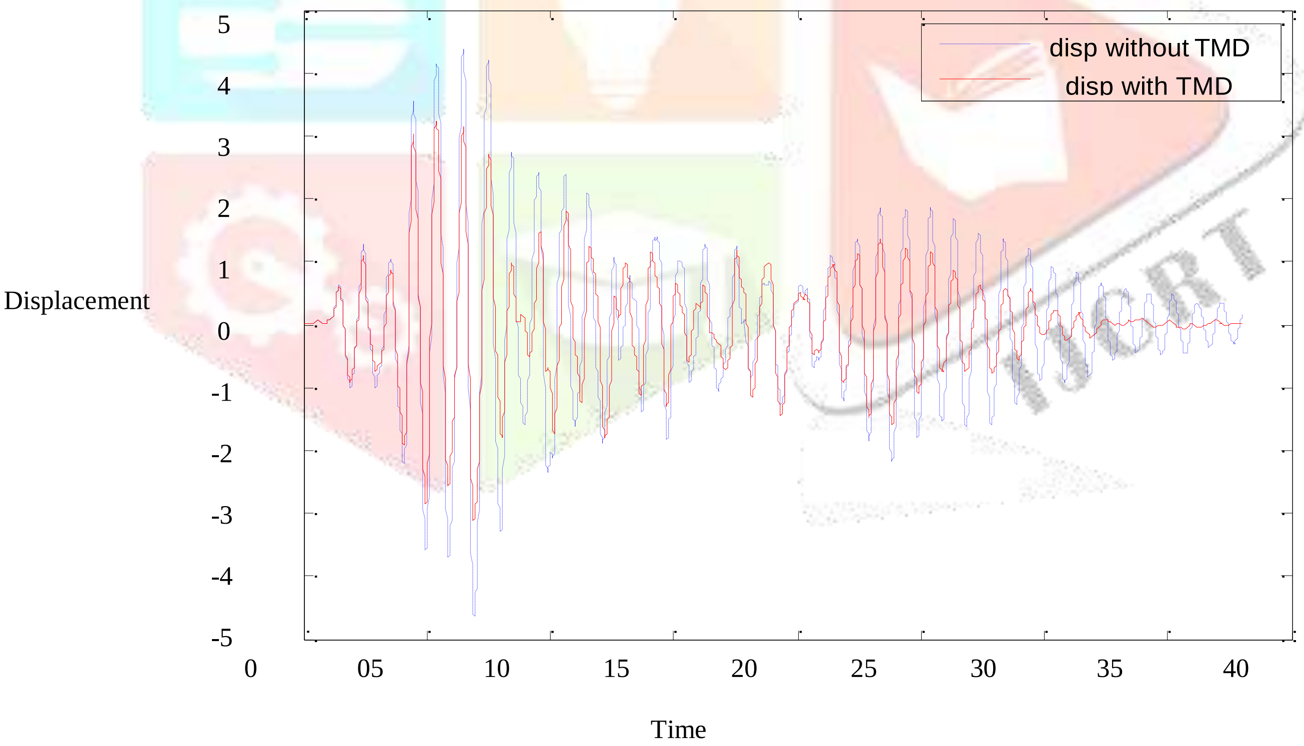
$\{F_{tmd}\}$=Resisting force to the structure at corresponding nodes due to TMD

IV RESULT AND DISCUSSION

The TMD is placed at the 10th 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 massratio=0.1 and tuning ratio=1



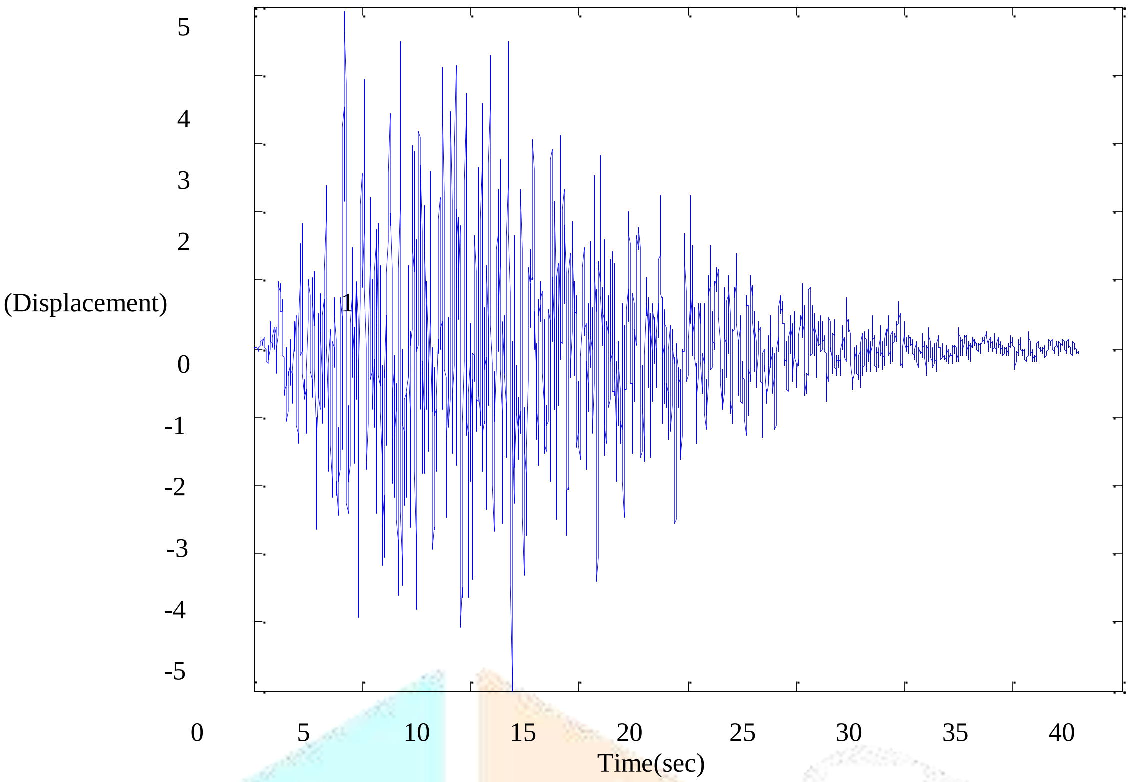
Multi Storey Frame with TMD



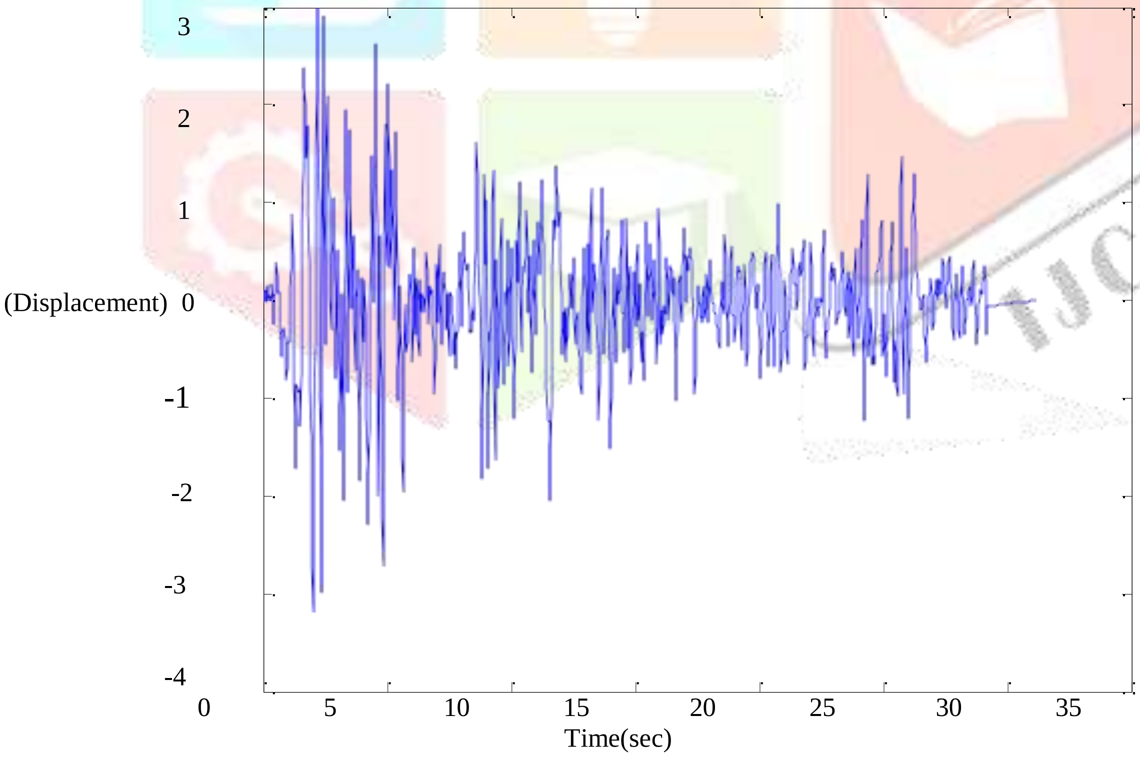
Amplitude of vibration at top storey of 2D frame by placing TMD at top storey when, corresponding to compatible time history as per spectra of IS-1894(Part- 1):2002 for 5 damping at rocky soil earthquake loading acting on the structure

4.2 Time Histories of Random Ground Acceleration

A total of two random ground acceleration cases are considered for the analysis. The first is the compatible time history as per spectra of IS-1894 (Part -1):2002 for 5% damping at rocky soil. (PGA = 1.0g). The second is the 1940 El Centro Earthquake record (PGA = 0.313g)



. Compatible time history as per spectra of IS-1894 (Part -1):2002 for 5% damping at rocky soil



Acceleration Time histories of past earth quakes

V CONCLUSION

If the structure not properly designed and constructed with required quality they may cause large destruction of structures due to earthquakes. Time history analysis is an useful technique for seismic analysis of structure when the structure shows nonlinear response. This method is step by step analysis of the seismic responses of a structure to a specified loading that may change with time.

Interpretation of result and conclusion. In the present work it is proposed to carry out seismic analysis of multi story RCC buildings using time history analysis method considering mass irregularity at different floor levels.Current trends in construction industry demands taller and lighter structures, which are also more flexible and having quite low damping value. This increases failure possibilities and also, problems from serviceability point of view. Several techniques are available today to minimize the vibration of the structure, out of which concept of using of TMD is one. This study is made to study the effectiveness of using TMD for controlling vibration of structure. A numerical algorithm was developed to model the multi-storey multi-degree of freedom building frame structure as shear building with a TMD. Another numerical algorithm is also developed to analyse 2D-MDOF frame structure fitted with a TMD. A total of three loading conditions are applied at the base of the structure. First one is a sinusoidal loading and the second one corresponding to compatible time history as per spectra of IS-1894(Part -1):2002 for 5% damping at rocky soil and the third one is 1940 El Centro Earthquake record (PGA = 0.313g).

Following conclusions can be made from this study:

1)It has been found that the TMD can be successfully used to control vibration of the structure.

2)TMD is more effective in reducing the displacement responses of structures with low damping ratios (2). But, it is less effective for structures with high damping ratios (5).

3)Applying the two earthquake loadings, first is the one corresponding to compatible time history as per spectra of IS-1894(Part -1):2002 for 5% damping at rocky soil and second being the 1940 El Centro Earthquake it has been found that increasing the mass ratio of the TMD decreases the displacement response of the structure.

5.1 FUTHER SCOPE OF STUDY

1)Both the structure and Damper model considered in this study are linear one; this provides a further scope to study this problem using a nonlinear model for TMD as well as for structure.

2)The frame model considered here is two-dimensional, which can be further studied to include 3-dimensional structure model.

3)Further scope, also includes studying the possibility of constructing Active TMD.

REFERENCES

[1] Seismology committee(1999). Structural Engineer Association of California.
[2] K. T. Chen, C. H. Chou, S. H. Chang, and Y. H. Liu, "Intelligent active vibration control in an isolation platform," Applied Acoustics, vol. 69, no. 11, pp. 1063–1084, 2008. K. T. Chen, C. H. Chou, S. H. Chang, and Y. H. Liu, "Intelligent active vibration control in an isolation platform," Applied Acoustics, vol. 69, no. 11, pp. 1063–1084, 2008.
[3] Kajima corporation " a survey on concepts of designs and executing of superframe RCearthquake proof structure"(2003)
[4] Quake expose nuke – plant danger july 18,2007
[5] Rational design of structure. (university of birtish Columbia, Canada) (2004)