"SEISMIC RESISTANT STRUCTURE BY USING TUNED MASS DAMPER"

Prof. Rashmi Pantawane[1], Nishant Satpute[2], Dattaray Zod[3], Prajwal Dive[4], Pranay Bagade[5], Dishant Jambhulkar[6]

[1]*Assistant Professor, Dept. of Civil Engineering, GNIT, Nagpur*
[2,3,4,5,6]*B.E. 8thSemester, Dept. of Civil Engineering, GNIT Nagpur*

Abstract - *A new control strategy to improve a tuned mass damper (TMD) is developed for the vibration control of a large structure subjected to external disturbances. The feedback gain of the proposed algorithm is linear to the response acceleration of the primal system and it is optimized in the frequency domain under a harmonic excitation. According to this method both the feedback gain and the TMD parameters are optimized in the frequency domain and they are expressed in a set of closed form solutions. The performance of the proposed control method is discussed and compared with that of a passive TMD.*

Key Words: **TMD, Harmonic, Frequency, Algorithm, Acceleration.**

1. INTRODUCTION

During recent earthquakes, reinforced concrete structures with deep spandrel girders and short columns failed or sustained heavy damage particularly due to brittle shear failure of the column. Reinforced concrete frames are classified according to their anticipated failure modes. Designing procedures for these structures are reviewed critically and alternative methods are proposed. The field of Earthquake Engineering has existed in our country for over 35 years now. Indian earthquake engineers have made significant contributions to the seismic safety of several important structures in the country.

1.1 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(2001) 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)Yogesh Ravindra Suryawanshi (2012) Carried out a study of inner working of Tuned Mass Damper and technology of TMD in Taipei 101 tower. The theory behind this TMD is that, if a smaller mass is attached to a multi degree of freedom system and tuned it precisely, it will help to reduce the oscillation of the system in any direction. For the efficient working its frequency should be tuned to the fundamental frequency of the structure. Here in Taipei 101 tower in Taiwan a massive steel sphere is provided as TMD. This massive steel sphere will counteract the building's oscillations. For this optimization is essential to the efficient working of the tuned mass damper system, as well as the safety of the structure and inhabitants around it. As the number of storeys are increasing day by day and buildings reach greater and greater heights, tuned mass damper technology is an essential part of maintaining the structural integrity of the places. No power source is required for its operation.

6)Ashish A. Mohite (2015) A Tuned mass damper (TMD) is a device which compresses of a mass, and spring that is attached to a structure 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. Taller become more susceptible to dynamic excitations such as wind and seismic excitation. For the structure safety and occupants comfort, the vibrations of the tall buildings are serious concerns for both engineers and architects. In order to mitigate the vibration, here adopted Tuned Mass Damper. Tall buildings and observation towers are occasionally vibrated under strong winds and become uncomfortable for occupants. Therefore, to reduce the vibration in those structures, various types of dampers are being developed recently. However, there is no sure way to predict the wind-induced response of a structure with a damper system and to estimate the suppressing effects of dampers under earthquake loadings. Here a symmetrical moment resistance frame (MRF) three – dimensional model with and without tuned mass damper analysed by using software ETABS which is constructed from concrete, steel or composite material. Moment resistance frames can be sufficient for a building up to 20 storey. A tuned mass damper (TMD) is placed on its top and through it to study its effects on structural response due to time history analysis with and without the tuned mass damper (TMD) in a ETABS. The result obtained from software analysis of 10th, 12th, 14th, 16th, 18th, and 21th storey building with and without tuned mass damper and compare result with each other and found that it is more efficient in reducing acceleration and displacement of structure.5% TMD is more efficient for regular building. Provision of TMD is more efficient by providing it on the top storey.

7)Haruna Ibrahim (2015) Preliminary results on the passive control of the structural response of single degree of freedom (SDOF) and two dimensional multi-storeyed frames using Tuned Mass Damper (TMD) are presented here. At first a numerical analysis was developed to investigate the response of a shear building fitted with a tune mass damper. Then another numerical was developed to investigate the response of a 2D frame model fitted and without Tuned Mass Damper (TDM). From the study it was found that, tuned mass damper can be effectively used for vibration control of structures. Tuned mass damper (TMD) was more effective when damping ratio of the structure is less. It is also observed that due to increase in tuned mass damper damping ratio, the movement of tuned mass damper is also decreases. The most important feature of the TMDs is the tuning of frequencies, that is, the frequency of the TMD is made equal to the fundamental frequency of the structure. Because of various uncertainties inherent in the properties of both the TMD and the structure, perfect tuning is very difficult to achieve. As a consequence, there comes multi-tuned mass dampers (MTMDs) for better tuning. Tuned mass damper are designed to reduce wind responses on tall buildings, this study is made to study the effectiveness of using tuned mass damper for controlling vibration of structure due to excitation force (wind). Based on the simulation results, it shows that the response of the structure subjected to excitation force system is relatively higher without tuned mass damper which shows the effectiveness of TDM in controlling the vibration on the structure. It also observed that the displacement response is decreased by increasing damping ratio of TMD.

3. 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. Many of the studies have shown seismic analysis of the RCC structures with different irregularities such as mass irregularity, stiffness and vertical geometry irregularity. Whenever a structure having different irregularity, it is necessary to analyzing the building in various earthquake zones. From many past studies it is clear that effect of earthquake on structure can be minimize by providing shear wall, base isolation etc.

REFERENCES

[1] 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.

[2] Genda Chen, Jingning Wu “Optimal Placement Of Multiple Tune Mass Dampers For Seismic Structures” J. Struct. Eng. 127:1054-1062, Sep.2001

[3] Roberto Villaverde “Aseismic Roof Isolation System: Feasibility Study with 13-Story Building” Journal of structural engineering, 128:188-196.2002.

[4] O R Jaiswal “Simple tuned mass damper to control seismic response of elevated tanks” 13th World Conference on Earthquake Engineering Vancouver, B. C., Canada, August 1-6, 2004, Paper No. 2923.

[5] Johnson, Lawrence D. Reaveley ,Chris Pantelides Jerod G “A rooftop tuned mass damper frame” Earthquake Engng Struct. Dynamics. 32:965–984 (DOI: 10.1002/eqe.257)2003.

[6] O R Jaiswal “Simple tuned mass damper to control seismic response of elevated tanks” 13th World Conference on Earthquake Engineering Vancouver, B. C., Canada, August 1-6, 2004, Paper No. 2923

[7] Ashish A. Mohite, Prof. G.R. Patil. "Earthquake Analysis of Tall Building with Tuned Mass Damper" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN : 2278-1684, p-ISSN : 2320–334X PP 113-122 ,2015

[8] Haruna Ibrahim, Daha S. Aliyu, Hafizu Hamza "Vibration control of a frames structure using tuned mass damper" 2nd international conference on science, technology and management, University of Delhi(UD),Conference Centre,New Delhi (India)27 September 2015