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Analysis of G+4 And G+10 Building Using Water Tank as Tuned Mass Damper – A Review

Shifanaz Sheikh[1], Ganesh Mahalle[2]

[1]PG student, Department of Civil Engineering, BIT College of Engineering, Ballarpur
[2]Professor, Department of Civil Engineering, BIT College of Engineering, Ballarpur

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Abstract – Due to urbanization and population growth, urban areas have tended to develop building vertically. Tall multistory building vibrates under seismic as well as strong wind action to resist this, various type of damper is used. Now a day's people are being using damper to reduce vibration. This paper shows review of literature of various water tank as tuned mass damper as passive control device and their behavior on multistory structures. the characteristics of the structure with and without damper is studied in different seismic zone. This paper contributes by investigating various past work finished with similar research topics.

***Key Words*:** tuned mass damper, multistorey, passive control device.

1.INTRODUCTION

Since the earthquake forces are random and unpredictable, seismic analysis became primary concern. The main parameter of seismic analysis is load carrying capacity, ductility, stiffness, damping and mass. To resist seismic vibration and wind vibration various approaches has been used. They are generally divided into four groups, i.e active control devices, Passive control devices, Semi active control and hybrid control devices. In Active control device, external power sources impart force to structure. active tuned mass damper, active tuned liquid column damper and active variable stiffness damper are the example of active control device. Passive control device works on energy transformation principle it includes base isolation, tuned mass damper (TMD), tuned liquid damper(TLD), viscous fluid damper and metallic yield damper etc.in semi control device create force as consequence of structure's motion, but they can't provide energy to system and it consist of variable orifice damper, variable friction damper etc.hybrid control device is a combination of active control devices and passive control devices. Energy and force required to operate hybrid control devices are far less than active and passive control devices

Tuned mass damper (TMD) is device consist of a mass, spring and damper attached to the structure to reduce dynamic response. TMD control vibration of structure using mass to done tuning is done according to frequencies.

Tuned liquid damper (TLD) is consist of container consist of liquid that uses sloshing energy to reduce dynamic response of the system.

2. LITERATURE REVIEW

D.Rupesh Kumar,fahimeh hoseinzadah(2015) carried out study of tuned mass damper considering water tank as TMD. they modeled damper on top and intermediate story using response spectrum analysis. Seven RCC frame are analyze in two categories of building with vertical irregularities and building with vertical regularities. They analyzed using dynamic analysis in ETABS. total 63 modals with different H/D ratios are considered. It is found out that for extracting the maximum benefit, building shall be modeled with using 3 TMDs.the elevated RCC water tank on top and intermediate storey as it reduces time period ,base shear and story drift simultaneously. For buildings with one TMD modeled at the center of gravity of the top storey, and buildings with four TMDs modeled at four corners at the top storey there is no commendable reduction in all the three parameters. For buildings with one TMD modeled at the mid height maximum reduction in the base shear is achieved, but the storey drift increases conversely. And for buildings with one TMD modeled at the second storey too, there is no worthy reduction in all the three parameters.

Tejashri S. and Pranesh Mrunal, 2013, presents investigation carried to study the feasibility using water tank as passive TMD using SAP. Three, seven and ten storey building were taken for study. Tank is placed on the roof. The behavior of the tank subjected to five earthquake data, namely, Elcentro, Bhuj, Kobe, Chichi and N-Palm was studied under four conditions, namely building only with damping, empty tank with damping, full tank with damping and full tank without damping. The results show if the tank is tuned properly it can reduce the peak response of structures subjected to seismic forces. Time History analysis has been carried out for all models namely full model without tank, model with empty tank without damping, model with filled tank with damping and model with filled tank without damping for models M3, M7 and M10.they concluded that for model M3 all earthquake data and from all conditions tank full of water mounted on structure shows almost 40% reduction in response than for structure only. For M7 and M10 it was shown that The response of full water tank is 50%and 40% respectively less than for structure only. The procedure used for implementation of TMD can be satisfactorily used.

Jong Wan Hu,Kobra Naeim, Iman Mansouri, Hamed Rahman Shokrgozar, 2019 , performed seismic analysis on low-rise and midrise building using TMD and TLD damper Both TMD and TLD at structure modeled with five various mass, stiffness, and damping percentage. In this paper, 4 and 12-story buildings with a special steel moment frame system and residential occupancy were considered. The buildings were located in a zone with a very high level of relative seismic hazard Iranian National Building Code Part-6 was used in order to estimate gravity loading. They also investigated the effects of TMD and TLD as passive vibration reduction devices for low-

rise and mid-rise buildings. They performed comparison TMD and TLD structure. We observed that by comparing the behavior of 4 and 12 story building in TMD and TLD structures subjected to far field and near field ground motion observed that using TMD remarkably decreases the structural responses, and this reduction in the 4-story structure subjected to near field earthquake was higher than far field record near-field, while in the TMD this reduction in the 4-story building subjected to near-field earthquakes was higher than far-field records. TLD-TMD did not decrease responses.

Muhammad jamil ahmad, Qaisar uz Zaman Khan and Syed Muhammad Ali 2016, describes that they carried out investigation using water tank as TLD.they consider two 4 storey model with water tank mounted on top. They tested on uni-axial freedom shaking table with different levels of water in water tank El Centro earthquake time history 50 % was applied to both structures to investigate the response acceleration and deflection of the structures at fourth floor level. The efficiency of quantity of water has been investigated with reference to response acceleration and deflection recorded by data acquisition software through accelerometers and displacement transducers installed at level of fourth floor of models. It was found that the weight of water 2.5 and 2.0 % weights of structures gave minimum response acceleration and deflection for Model 1 and Model 2, respectively.

M.Mahesh and Dr. N. Murali Krishna 2021, carried out study on L-shape buildings T-shape building and U-shape and rectangular building of 10, 15 stories height in different seismic zones using history analysis in zone III and zone IV. They concluded that the TLD modeling of water tanks have invariably reduced the magnitudes of base shear and maximum lateral displacements to an extent of twenty percent. Increasing water levels in tanks, with either single or multiple TLD's have resulted in the marginal increase in base shear but sustainable decrease the maximum lateral displacements of RCC buildings with L shaped plans. A similar behavior is noticed for buildings with rectangular, T shaped and U-shaped plans as well. The structural design of high raised RCC buildings with multiple water tanks is most economical when the water tanks are modelled as TLD's. for design purpose, the maximum values of base shear and maximum lateral displacements shall be considered based on the quantum of water in tanks.

Dhirendra K. Pandey, Sudib K. Mishra 2022, considers deep water tank as tuned liquid damper. This study exploits the impulsive liquid mass to implement a tuned liquid mass damper (TLMD) by flexibly attaching the tank to the structure. They performed shake table experiment involves solution of the governing equations for the structure –TLMD system, in which vibration of liquid is described by the Housner model.The simulation and the experiment results corroborate well. Comparative assessments with TMD and TLD with identical mass ratio show comparable efficiency.

3.OBJECTIVES

- To study the performance of Tuned liquid damper as tuned mass damper.
- To study the behavior of G+4 and G+10 building with using water tank as TMD considering water tank as lumped mass without sloshing effect.
- To study the floor wise performance of tuned mass damper.
- To study the performance of tuned mass damper with several depths of water.
- To study the effect of story drift, story displacement, time period, story shear and base shear.
- To study the performance of building using time history analysis.

4.METHODOLOGY

- G+4 and G+10 having water tank as tuned mass damper as lumped mass with and without TMD construction are taken into account. The performance with and without Tuned Mass Damper is analyzed by time history analysis.
- Analysis and design is carried out for dead load, live load, lateral earthquake load. For earthquake loads Time History analysis is done.
- To consider extreme conditions of lateral loads, the buildings are considered to be located in zone IV.
- Before running the simulation, all required inputs, material properties, design parameters, analysis parameters, and boundary conditions were applied in accordance with Indian Civil Engineering standards.
- Modelling, analysis and design of structure are carried out using ETABS software.

5. CONCLUSIONS

- The use of water tank as tuned mass damper subjected to seismic loading found out to be effective.
- From above studies it can be concluded that TLD can be effectively use as TMD.
- Tuned mass damper as a controlling device reduces damages substantially and increases structural safety and prevent building from seismic as well as lateral vibration.
- The experimental research and analysis carried by research authors explained that TMD can be used successfully to monitor the structures response.

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