Analysis of Blast Loading With And Without TMD

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Abstract- *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. From the study it was found that, Base isolation can be effectively used for vibration control of structures. G+25 MODEL in ETABS provided with shear walls, Base isolation and TMD is proposed at top with regular building subjected to surface blast.*

Keywords- TMD, ETABS, Base isolation, Shear wall, surface blast

I. INTRODUCTION

1.1 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 account 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.

1.2 AIM:-

Earthquake Analysis of RCC Building with Tuned Mass Damper & Base Isolation to study effects of different types of damping systems on structure.

1.3 OBJECTIVES:-

1. A tuned mass damper (TMD) is placed on its top and through it to study its effects on Storey drift, storey displacement and base shear and analysis with and without the tuned mass damper (TMD) and using base isolation in ETABS.

In model 2 base isolators are added at plinth level as a spring mass model

1.1. Analysis of symmetrical moment resistance frame (MRF) Without Tuned Liquid Damper three-dimensional model by using software ETABS.

1.2. Analysis of symmetrical moment resistance frame (MRF) With Tuned Liquid Damper three -dimensional model by using software ETABS.

2. To find the blast loading response (storey drift, storey displacement and base shear) of a symmetrical MRF building with Base Isolation using ETABS.

3. A friction damper is used to study the energy dissipation capacity of dampers and find out effective position to setup.

II. LITERATURE REVIEW

Tuned Liquid Dampers For Control Of Earthquake Response, PradiptaBanerji , Earlier studies have shown that a tuned liquid damper (TLD) is effective in controlling the response of a structure to small amplitude and narrow-banded motions. However, since it is a tuned damper it has been implicitly assumed that a TLD is effective only for such excitations. A preliminary paper co-authored by the present author showed, through a few numerical simulations, that if the TLD is properly designed, it also has the ability to be effective in controlling response of structures to broad-banded excitations, such as ground motions generated by earthquakes. A selection of numerical simulations and experiments, done here over the past couple of years, are presented in this paper to conclusively show that a TLD is effective in controlling the response of a structure to broad-banded, long duration earthquake ground motions. It is shown that a TLD water particle motion formulation based on a shallow-wave theory proposed by earlier researchers is reasonable for predicting the response of a structure with a TLD attached to it and subjected to large amplitude earthquake type motions at its base. It is, however, interesting to note that experiments show that the above theory consistently under-predicts the reduction in structural response for a wide variety of structures and ground motions. This is possibly due to energy being dissipated by breaking waves, which is seen to occur during the excitation phase in the experiments and is only approximately modeled in the numerical simulations. The TLD parameters such as the ratio of water depth to tank length (called the depth ratio) and the ratio of water mass to the structure mass (called the mass ratio) are shown to control the effectiveness of a TLD. The response of a typical single degree-of-freedom (SDOF) structure is typically reduced by about 30% if a TLD has a depth ratio of 0.15 and mass ratio of 4%.

Tuned Liquid Damper,JitadityaMondal, HarshaNimmala, Shameel Abdulla, Reza Tafreshi , is to show the effectiveness of a tuned liquid damper (TLD). TLD can be used in building structures to damp structural vibrations. A Tuned liquid damper is water confined in a container, usually placed on top of a building that uses the sloshing energy of the water to reduce the dynamic response of the system when it is subjected to excitation. The experimental setup models a building using PASCO beams and trusses and uses moveable base, powered by a motor, to simulate an earth quake. The sensor used in the experiment is an accelerometer that measures the acceleration at the top of the structure when subjected to vibrations in the presence and absence of a TLD. Vernier DAQ in conjecton with Lab VIEW was used for data acquisition from the accelerometer. Frequency range around the resonant frequency (first natural frequency) was considered for excitation in both the cases. The outcome of the experiment was that the TLD effectively dampened the vibrations (up to 80% reduction in vibration) when excited and the dampening effect was found to be maximum around the resonance frequency. An attempt has also been made to theoretically model the system in the absence and presence of TLD.

III. METHODOLOGY

3.1 FLOWCHART

The entire flow of activities involved in achieving the objectives of the project involves following crucial stages:

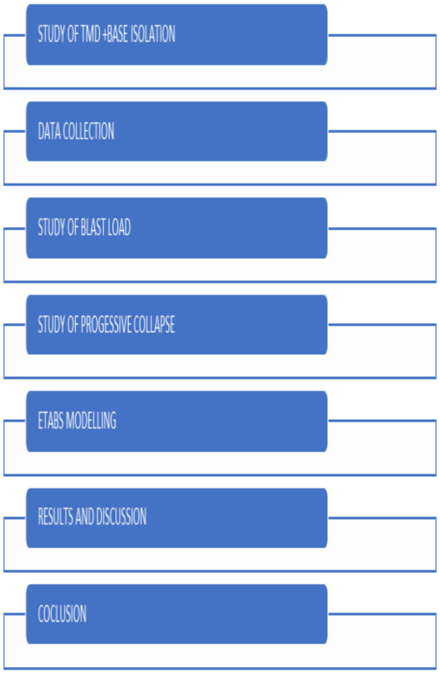

Fig no 1: Flowchart

3.2 BLAST LOADING

An explosion is a rapid release of stored energy characterized by a bright flash and an audible blast. Part of the energy is released as thermal radiation (flash) and part is coupled into the air as air-blast and into the soil (ground) as ground shock, both as radially expanding shock waves

To be an explosive, the material will have the following characteristics.

1. Must contain a substance or mixture of substances that remains unchanged under ordinary conditions, but undergoes a fast chemical change upon stimulation.
2. This reaction must yield gases whose volume under normal pressure, but at the high temperature resulting from an explosion is much greater than that of the original substance.
3. The change must be exothermic in order to heat the products of the reaction and thus to increase their pressure. Common types of explosions include construction blasting to break up rock or to demolish buildings and their foundations, and accidental explosions resulting from natural gas leaks or other chemical/explosive materials.

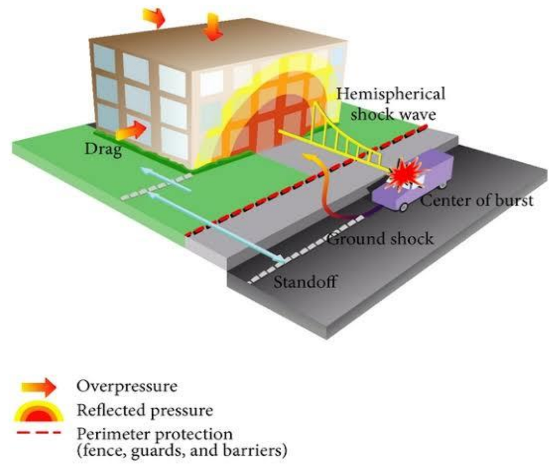

Fig no 2: Blast Loading

IV. PROBLEM STATEMENT

The model of multi-storied G+25 storey RCC structure considered for the analysis. The building is symmetrical in plane. The building has bay width of 3m in X and Y direction with 3.3 m storey height. Base floor height is 3.3 m. Tuned mass damper is installed at the top of building. Analysis is carried out in ETABS software by Response Spectrum Analysis and Equivalent static analysis. A G+8story multi-storied building is situated in Zone III on medium grade soil is analyzed and the displacement and acceleration with and without TMD of the structure due to different load combination are obtained. Seismic analysis is performed using response spectrum method given in IS1893:2002. For the modeling of the G+25storey structure, following parameters are considered shown in below table I

Table No 1: **Parameters to be consider for rectangular geometry analysis**

SR.NO.	CONTENT	DESCRIPTION
1.	Number of storey	G+25
2.	Floor height	3.3m
3.	Base floor height	3.3m
4.	Wall thickness	230mm
5.	Imposed load	3Kn/m2
6.	Size of column	300mm×450mm
7.	Size of beam	300mm×300mm
8.	Depth of slab	150mm
9.	Types of soil	Medium soil
10.	Seismic zone	III
11.	Zone factor	0.16
12.	Response of spectra As per IS1893(Part1): 2002	For 5% damping
13.	L.L. On top	1.5 Kn/m^2

V. MODELLING IN ETABS

Table No. 2 Modelling

MODEL 1	Normal Building
MODEL 2	Building+base isolation+WT+SW+EQ
MODEL 3	Building+base isolation+ WT+SW+BL

1) Normal Building

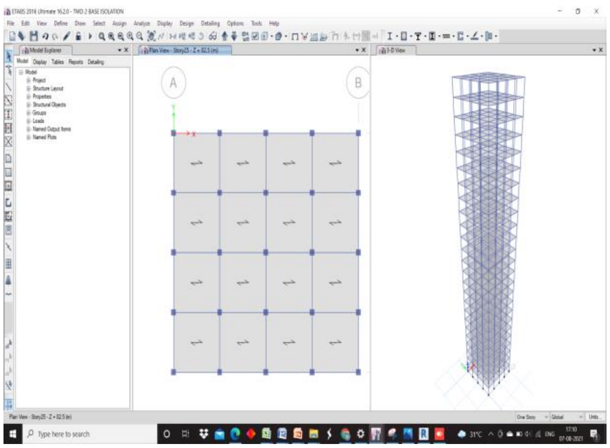

Fig no 3: Normal building

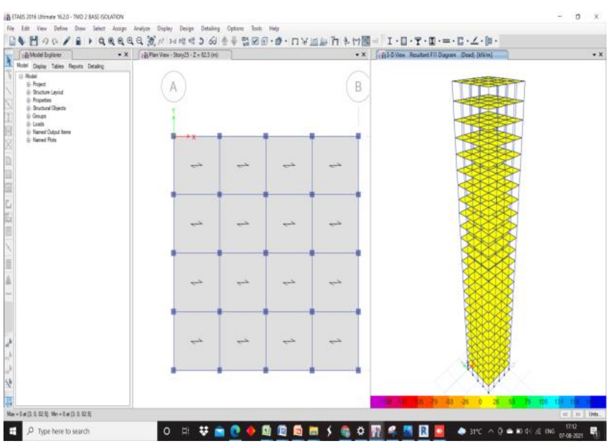

Fig no 4 : Normal building with stress

VI. BLAST LOAD

Table No 3: Maximum Moments (Mz) in N mm

Fmax (KN/m)		
	For 200Kg at 10m	For 400Kg at 10m
Without TMD	2.1	3.82
With TMD	2.1	13
With TMD Shear wall	1.1	1.8

Table No 4 Maximum Moments (Mz) in N mm

Mmax (KN/m)		
	For 200Kg at 10m	For 400Kg at 10m
Without TMD	0..76	0.76
With TMD	0.68	12.1
With TMD Shear wall	1.9	3.5

Table No 5: Maximum Moments (Mz) in N mm

Vmax (KN/m)		
	For 200Kg at 10m	For 400Kg at 10m
Without TMD	29	29
With TMD	29	6.1
With TMD Shear wall	0..22	0.28

WITHOUT TMD

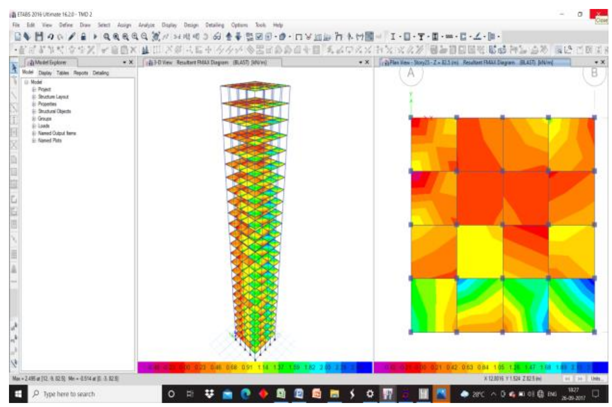

Fig no 5: shows normal building after applying stress

WITH TMD

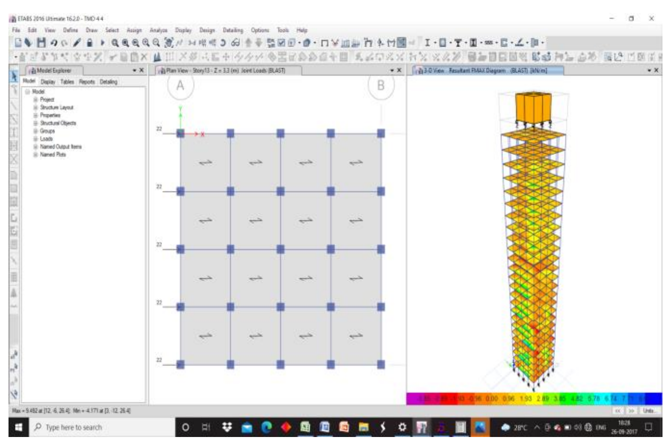

Fig no 6: shows normal building with water tank after applying stress

WITH TMD SHEAR WALL

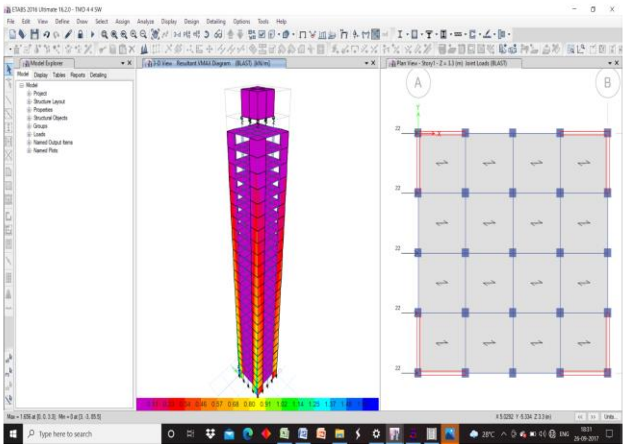

Fig no 7: shows normal building with shear wall and water tank after applying stress

VII. CONCLUSIONS

- Maximum Absolute Stress for Without TMD is greater than Maximum Absolute Stress for With TMD Shear wall
- Maximum Moment(Fy)for Without TMD is greater than Maximum Moment(Fy)for With TMD Shear wall
- Maximum Moment(Fz)for Without TMD is greater than Maximum Moment(Fz)for With TMD Shear wall
- Maximum Moment(Mx)for Without TMD is greater than Maximum Moment(Mx)for With TMD Shear wall
- Maximum Moment(My) for Without TMD is greater than Maximum Moment(My)for With TMD Shear wall
- Maximum Moment(Mz) for Without TMD is greater than Maximum Moment(Mz) for TMD Shear wall
- Use of TMD at top with shear wall & base isolation is beneficial to control vibration of the structure.

VIII. FUTURE SCOPE

- Analysis of model can be done with different locations of TMD for blast load.
- Analysis of model can be done with different locations & sizes of shear walls for blast load.

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