Study and Analysis on Scope of Tuned Liquid Damper in Reducing of Vibration of Tall Steel Structure using ETABS Software

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Abstract— Current trends in construction industry demands taller and lighter Steel structures, which are 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 TLD is a new concept. The main motive of this study is to determine the effectiveness of structure considering TLD (Tuned liquid damper technique) for controlling vibrations generated over a structure due to lateral forces. In this study we will analyze a tall structure considering seismic zone III & V as per Indian provision, and compare a general conventional structure with TLD assigned structure to prepare a comparative study using Analysis tool ETABS. Designing of the tall structure is done as per IS-800: 2007 (General code for Design of Steel Structure).

Keywords: Cryptography, Encryption, Decryption, Cloud Security, Cloud Storage

I. INTRODUCTION

Controlling Vibrational loading is an important aspect while designing the structure, especially if they are tall. Buildings can get subjected to substantial vibrations due to wind and earthquakes. At the point when a quake waves travel through the structure, it is oppressed huge powers, speeding up and uprooting that makes the structure profoundly insecure and inevitably it breakdown. Furthermore, as current high rises are made tall utilizing adaptable pillars, wind can cause huge influencing of the structure. This rehashed burden cycles can prompt exhaustion into the shafts and furthermore can cause disappointment of the structure. Seismic examination is a subset of basic investigation and is the estimation of the reaction of a structure exposed to seismic risks. It is a piece of the procedure of auxiliary plan, seismic tremor designing or basic evaluation and retrofit in districts where quakes are common.

Liquid dampers is among the various alternatives used to reduce the vibrations on the structures. A liquid damper is water confined in a container that uses the sloshing energy of the water to reduce the dynamic response of the system when the system is subjected to excitation. It has also been found to be very effective in cancelling vibrations caused due to wind.

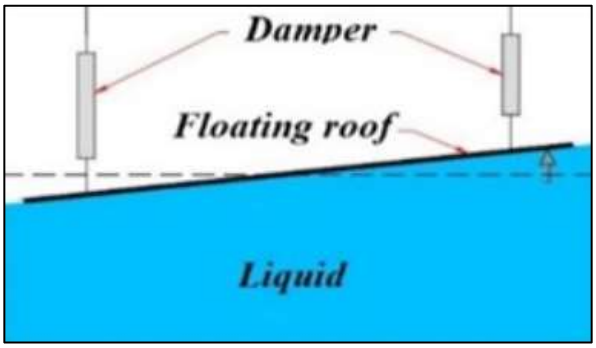

Fig. 1: T.L.D.

II. LITERATURE REVIEW

Ranaet. al. (2018) Authors illustrated that the viability of Tuned Liquid Dampers (TLD) in lessening the seismic vibration of a structure when it is exposed to flat sinusoidal excitation. TLD is a water kept compartment, or just a water tank, which utilizes the sloshing vitality of water to lessen the dynamic reaction of a structure when it is exposed to excitation.

Here analysts embraced a strategy for planning TLD for a structure is recommended and a technique is proposed to demonstrate the TLD in SAP2000 programming. At that point, numerous examinations have been done to break down the impact of various parameters of TLD which may influence its exhibition. Investigations are directed with changing mass proportion, tuning proportion, excitation proportion, number of stories, position of TLD, and so forth.

The auxiliary reaction is looked at dependent on greatest base shear, most extreme relative increasing speed and most extreme uprooting of top story. Regarding the outcomes from these examinations, ends are inferred and proposals are given for an ideal structure of TLD.

Roshni and Ritzy (2015) investigated the performance of a new type of cost-efficient damper for mitigating windand earthquake induced vibrations in tall buildings. Tuned Liquid Damper (TLD) is a kind of Tuned Mass Damper (TMD) where the mass is supplanted by a fluid (typically water). A TLD depends upon the movement of shallow fluid in an unbending tank for changing the dynamic attributes of a structure and dispersing its vibration vitality under symphonious excitation. The viability of TLD is assessed dependent on the reaction decrease of the structure which is a two-celebrated steel building outline. Different parameters that impact the exhibition of TLD are additionally contemplated.

Pardeshiet. al. (2014) Surveyed new sort of TLD introduced with unbending perplex divider and fluctuating water profundity for example 50mm, 70mm, 90mm and 110mm. Trial tests are directed on scaled model (G+5 story) exposed to sinusoidal excitations utilizing shaking table examination. The primary goal behind introducing such astound divider is to lessen the basic vibrations exposed to quake excitation. From this investigation it is discovered that TLD with 90mm water profundity and single perplex end up being increasingly powerful prompting 80% decrease in speeding up. It is likewise discovered that just TLD which were appropriately tuned to common recurrence of structure is increasingly compelling in controlling the vibration. The damping impact of TLD forcefully diminishes with mistuning of TLD.

III. OBJECTIVES

The primary objectives of this study is as follows:

1) Modeling and Analysis of a tall steel structure considering tuned liquid damper using ETABS software.
2) To determine the effectiveness of liquid dampers steel structure comparing to general steel structure under vibrational load.
3) To determine the Cost of operating and constructing liquid damper as per S.O.R.
4) To develop a concept of structural designing with considering Concept of assigning dampers.

IV. METHODOLOGY

1) Step-1 Literature Survey related to Seismic assessment and tuned dampers.
2) Step-2 Selection of building boundary conditions and its utility.
3) Step-3 Assigning Liquid Dampers.
4) Step-4 Assigning Sectional Properties and materials
5) Step-5 Analysis of liquid dampers and compare it with general structure.
6) Step-6 Problem formulation and loading calculation.
7) Step-7 Comparative study of results as Max bending moments, Maximum Axial force, Max displacements, story wise displacement, Maximum shear force, Maximum Axial force, Support reactions.

Geometrical Data	
Plan dimension	14 x 18 m
Length (m)	14 m
Width (m)	18 m
Height each floor(m)	3.2 m
Number of floors	G+10
Tuned damper	3.5m X 4.5m
Column Size	I.S.M.B.200
Beam Size	I.S.M.B.200

Table 1: Tuned liquid dampers

Seismic Weight Calculation								
S.No.	Category	no.	length	breadth	height	volume m^3	density (T/m^3)	weight (T)
1	columns	30	0.35	0.3	3.2	0.336	78.5	26.376
2	beams	96	0.3	0.2	0.3	0.018	78.5	1.413
3	slab		17.8	13.5	0.125	30.0375	2.5	75.0938
4	brick wall		120	0.2	3	72	1.8	129.6
Total building weight								232.4828

Table 2: Weight of Composite Structure

V. SEISMIC DEFINITION

Earthquake zone – III & V (Z=0.16 & 0.36)
Response reduction factor – 5
Importance Factor – 1
Damping - 5%
Soil Type: As per site
Natural Time Period (T_a) - $0.075h^{0.75}$ (T_a = 2.145 sec)

h = Height of building, in m. This excludes the basement storeys, where basement walls are connected with the ground floor deck or fitted between the building columns. But it includes the basement storeys, when they are not so connected.

A. *Analysis results:*

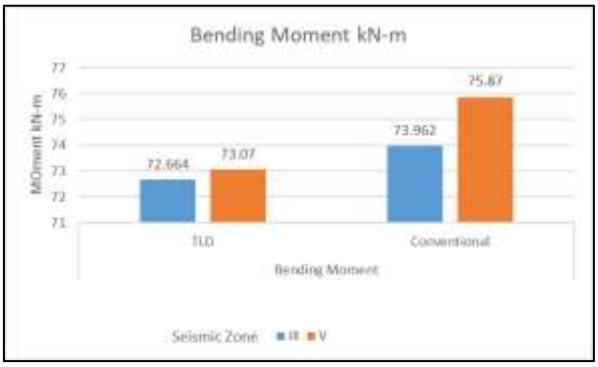

Fig. 2: moment

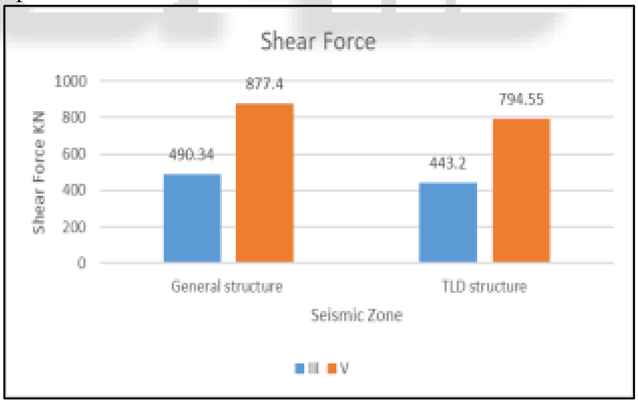

Fig. 3: Shear Force

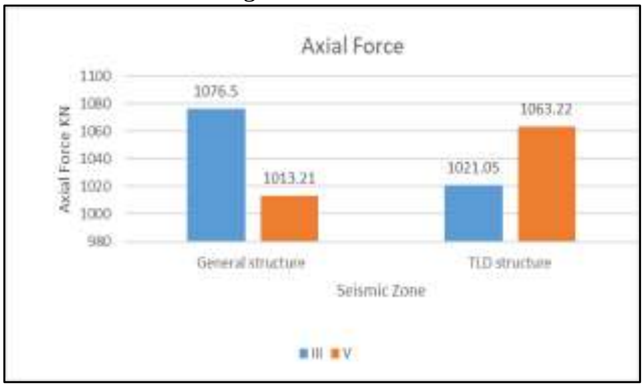

Fig. 4: Axial Force

Case	Quantity (Kg)	S.O.R. Rate/Kg	Total Cost (Rs)
General Structure Zone III	142800.67	48	6854432.16
TLD Structure Zone III	134220.21	48	6442570.08
General Structure Zone V	157004.00	48	7536192.00
TLD Structure Zone V	146000.54	48	7008025.92

Table 2: Cost Analysis

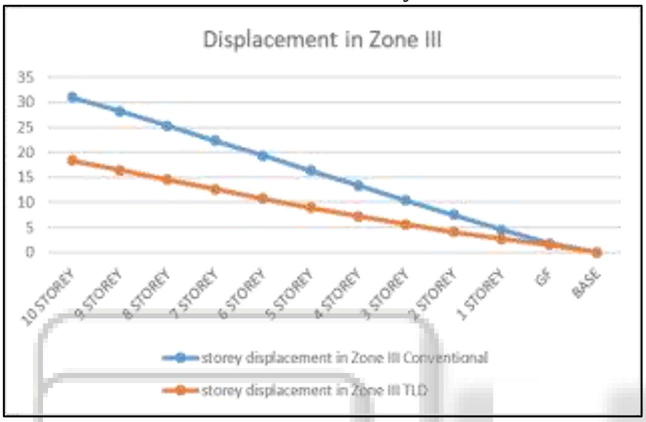

Fig. 5: Displacement in Zone III

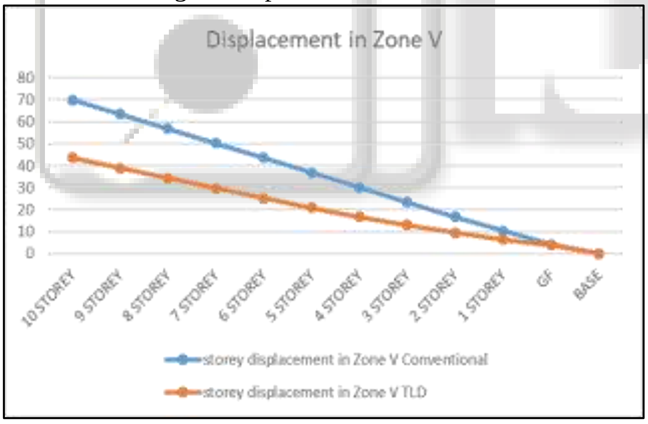

Fig. 6: Displacement in Zone V

VI. Conclusion

A. Storey Displacement:

It is observed that tuned liquid dampers are fit for opposing the general removal of the structure because of seismic forces, in contrast with general structure it is 37.4 % increasingly steady and opposing uprooting which outcomes in keeping up structure in reasonable point of confinement.

B. Bending Moment:

Tuned liquid damper structure is efficient in contrast with general structure as it has limiting twisting minute which will cause decrease in bending moment and large steel requirement.

C. Forces:

It is seen that the dispersion of burden become uniform and linear it instance of tuned liquid dampers. As far as hub forces the vertical circulation of forces become steady and flat forces produced

D. Cost:

As observed in cost analysis TLD structure is cost effective than general structure in both the seismic zone with cost reduction of 8%.

E. Future Scope of the work:

1) In the proposed work high rise steel building is considered which can be increased to some more floors in future with variation in floor to floor height.
2) In this study seismic analysis is considered whereas in future study wind load or blast load can be consider.
3) In this study analysis is done using ETAB whereas in future SAP2000 can be prefer for P-delta analysis

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