# STRUCTURAL PERFORMANCE BASED ON FRICTION AND VISCO-ELASTIC DAMPERS USED FOR MULTY-STOREY BUILDING USING ETABS.

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**ABSTRACT**

Vibration of ground surface due to rapid release of energy from earth's litho sphere gives rise to seismic waves and the phenomenon is called earthquake. At the time of earthquake huge amount of energy applied on multi-story building and the building is damaged and also large deformation is occurred. The increasing growth of infrastructure incurs huge capital investments and big segment of society served by way of them; it's miles vital to cause them to safer against seismic attacks. Dampers are the energy dissipating devices which additionally control displacement of RC structures during earthquake time. These dampers help the structure to control the buckling of columns and beams and also help to increase the stiffness of structure.

The current study deals with the comparison of 3 different cases of building models using ETABS in a G+10 multi-story building located in zone 3 as per IS1893-2016(part 1). The structure is designed as per IS 456-2000 and seismic analysis is conducted by using dynamic analysis like response spectrum and non-linear time history analysis for without dampers and with Friction and Viscoelastic dampers. For earthquake analysis Northridge earthquake data has been taken from PEER and analyzed. The response of the building is discussed in terms of absolute displacement and storey shear. It is concluded that displacement and storey shear are high in multi-story building without dampers as compared to building with dampers.

**Keywords**: Earthquake, dampers, devices, displacements and shear storey.

## 1.0 INTRODUCTION

So the earthquake can be simply defined as the shaking or we can say the vibration at the surface of the ground because of the vibrations coming onto the surface because of the underground movement along the fault plane. The reason for these vibrations is because of the wave that comes because of the earthquake. The most dangerous waves in the world is non other than the earthquake or the seismic waves. But the thing is, the modern building that is the modern high rise buildings cannot resist and they can even collapse if they are subjected to these earthquake vibrations. That's why it is said that the safety of the¸ structure decreases with the high in the elevation of the building or the structure. So according to the code, the building or the structure which has got the capacity to resist the highest earthquake or seismic vibrations in that. The most efficient way of constructing or designing the structure is to keep in mind and design accordingly that there should be minimal deaths or no deaths and there should be minimal damage or destruction.

The most horrifying thing about the earthquake is that we wouldn't know at what time and at what place it would take place. There is no guarantee of its happening or occurrence. These might a great question mark to the economy and also upon the life of people. From the past few decades where in the earthquake has been recorded, the world has seen the most disastrous earthquakes that has caused damages to the buildings and the structure. Due to such kind of severities, during the earthquakes, this explains why there is need for the appropriate design of structure or the buildings which have got the capacity to withstand the vibrations that would be caused on to the structures that may take up human life. Because of the earthquake many residential, public and historical structures have been severely damaged or broken.
There are many structural control devices some of them are as explained below. Dampers types.

- **1.1 Viscous Damper**

Consists of cylindrical structures which contain viscous fluid inside it, that helps in the dissipation of energy that is the seismic energy. The viscous dampers are used in tall buildings which are present in the earthquake prone areas. These dampers will decrease the energy or the vibrations that are caused because of the strong winds or the earthquake forces.

Fig.1.1Viscousdamper

- **1.2 Visco-elastic dampers**

There is one more damper which is known as the visco elastic damp it has got two metals in-between of them there is a elastomer present. Because of the shearing of the metal plates energy is transferred.

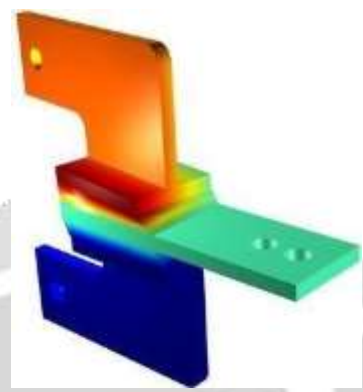


Fig.1.2Viscoelasticdamper

- **1.3 Friction Damper**

They are the types of dampers which use metals or other kinds of materials or the surfaces in friction. The energy coming from the earthquake forces or the vibrations coming because of the seismic forces cause the metals of the damper a friction. In this way the energy instead of going into the structure and causing damages to the structure, the energy is released in the form of friction.. These steel plates are separated from each other by the pads in between them. Such kind of damper dissipates energy that is the earthquake energy by sliding surfaces.

Fig1.3 friction dampers

- **1.4 TMD (Tuned mass Damper)**

Another passive control device that is used for seismic damage control of the buildings is tuned mass damper. This device also like the other passive control devices absorbs energy and reduces the vibration transfer into the buildings. It is attached to the top of the building or the structure which is under vibration because of the earthquake forces. For installing of TMD there is a ratio of the mass to the mass of the structure on which it is installed. These dampers have got various springs that are connected to the structure and when there is vibrations the energy is transferred to the mass through the springs and the energy gets damped into the mass of the of the damper.

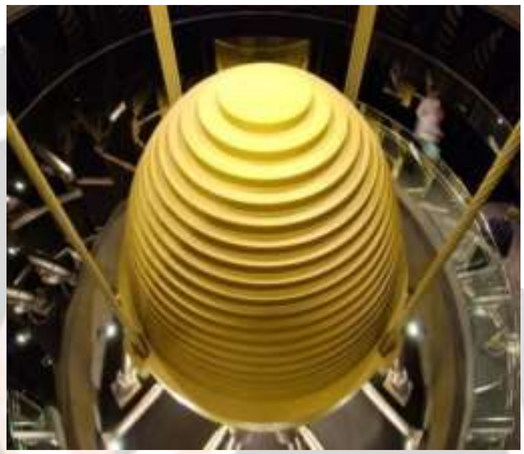


Fig.1.4TunedmassDamper

**OBJECTIVE**

a. To study and carried out seismic analysis of G+7 reinforced cement concrete structure with the help of the software ETABS 2018.

b. To study and differentiate various parameters such as base shear, displacement, drift and the absolute displacement..

c. To select the appropriate type of damper which is more efficient in resisting the earthquake forces.

## 2.0 METHODOLOGIES

**COMPARATIVE STUDY OF FRICTION&VISCOELASTICDAMPERS USED FOR MULTY STOREY BUILDING.**

Table5.1 Multi-storey Building description

| **Geometric details** | |
|---|---|
| Area | 288 $m^2$ |
| building | Special moment resisting frame |
| The structure type | Asymmetric |
| Individual floor height | 3.1 m |
| The structure or the building type | Residential |
| Earthquake zone | Zone3 |
| Material properties | |
| fck | Design mix having compressive strength of 20 |

| | |
|---|---|
| fy | 415yield strength of ferrous material |
| Section properties | |
| Column size | 300×600mm |
| Beam size | 300×450mm |
| Slab-thickness | 125mm |
| Load cases (Primary) | |
| DL | 13.5 kN/M |
| LL | 2 kN/m$^2$ |
| FL | 0.5 kN/m$^2$ |
| EQ in X and Y | IS1893:2016 |
| Seismic properties | |
| (Z) | 0.16 |
| (R) | 5 |
| (I) | 1 |
| Type of Soil | II |
| Damping ratio | 0.05 |
| Link (friction dampers) properties | |
| Link type– Damper's exponential | |
| m | 2200Kg. |
| w | 0.225 kN |
| k | 20,000 kN/m |
| Effective Damping | 4,000kN-s/m |
| Link (Viscoelastic damper) properties | |
| Link type–Damper exponential | |
| m | 2000 Kg |
| w | 0.203 kN |
| k | 30000 kN/, |
| Effective Damping | 10000kN-s/m |

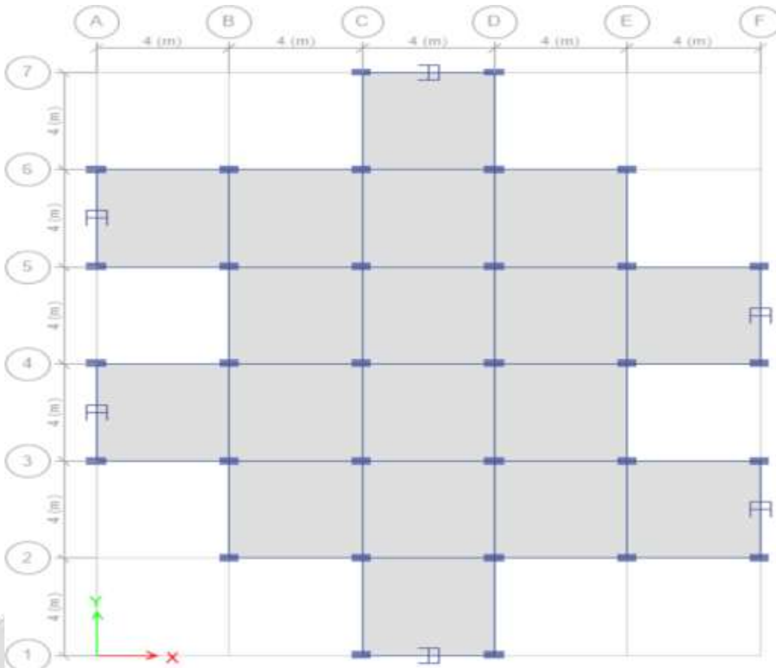



Fig.5.1Plan view of building.

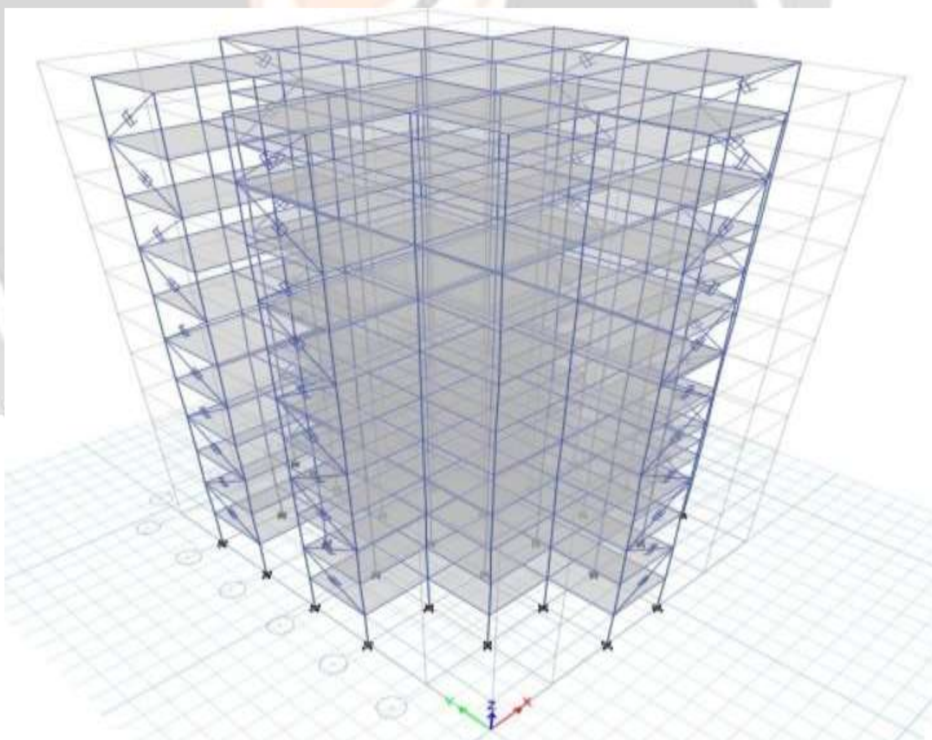


Fig.5.2 Asymmetric building with friction damper and viscoelastic damper

**2.1 Response-Spectrum Method:**

**Displacement:** It is the change in the position of the structure or a material or a thing from the state of restor from its original position due to application of some force. The deformed position of the structure or the material is called as displacement.

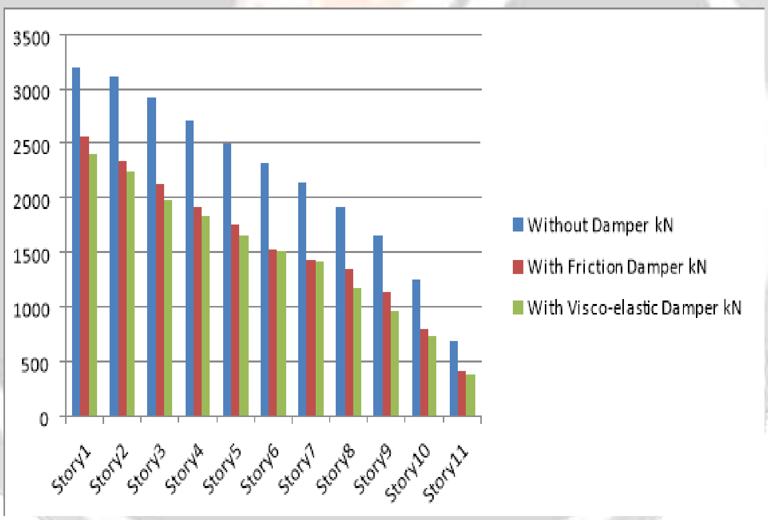
### 3.0 DISCUSSIONS AND RESULTS

A. By analyzing the results (Gphno5.1and5.2) it is evident that displacement for RC building installed with

- Friction damper is reduced by17.15%inthedirection of x and24.30% in the direction of y.
- Visco-elasticdamperisreducedby36.69%inthedirection of xand57.137%inthedirection of y.

B. By analyzing the results (Gphno5.3and5.4) it is evident that storys hear values for RC structure installed with

- Frictiondamperisreducedby39.43 %in the direction xand37.56%in the direction of y.
- Visco-elasticdamperisreducedby44.73%inthedirection of xand48.13%in the direction of y

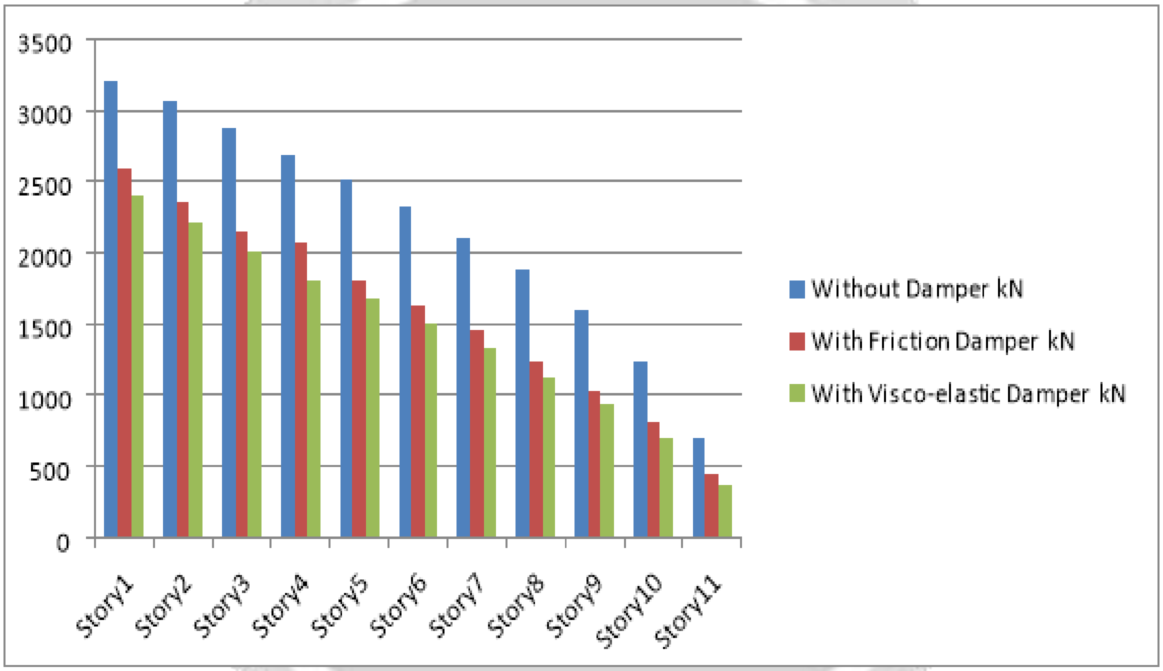



Graph5.3Story shear in the direction of X(RS)

Table5.5Story shear in the direction of y(RS)

| floor | height | Without Damper | With Friction Damper | With Visco-elastic Damper |
|---|---|---|---|---|
| | m | kN | kN | kN |
| Story11 | 34.1 | 707.6103 | 441.832 | 367.0374 |
| Story10 | 31 | 1240.8445 | 806.548 | 694.8729 |
| Story9 | 27.9 | 1603.4633 | 1026.2165 | 930.01 |

| | | | | |
|---|---|---|---|---|
| Story8 | 24.8 | 1879.2257 | 1240.2889 | 1127.53 |
| Story7 | 21.7 | 2107.2309 | 1452.989 | 1327.55 |
| Story6 | 18.6 | 2316.9389 | 1621.8572 | 1506.01 |
| Story5 | 15.5 | 2506.5903 | 1804.745 | 1679.4155 |
| Story4 | 12.4 | 2691.9349 | 2072.789 | 1807.755 |
| Story3 | 9.3 | 2876.2954 | 2157.22 | 2013.406 |
| Story2 | 6.2 | 3065.0947 | 2360.131 | 2206.8682 |
| Story1 | 3.1 | 3198.6675 | 2590.92 | 2399 |

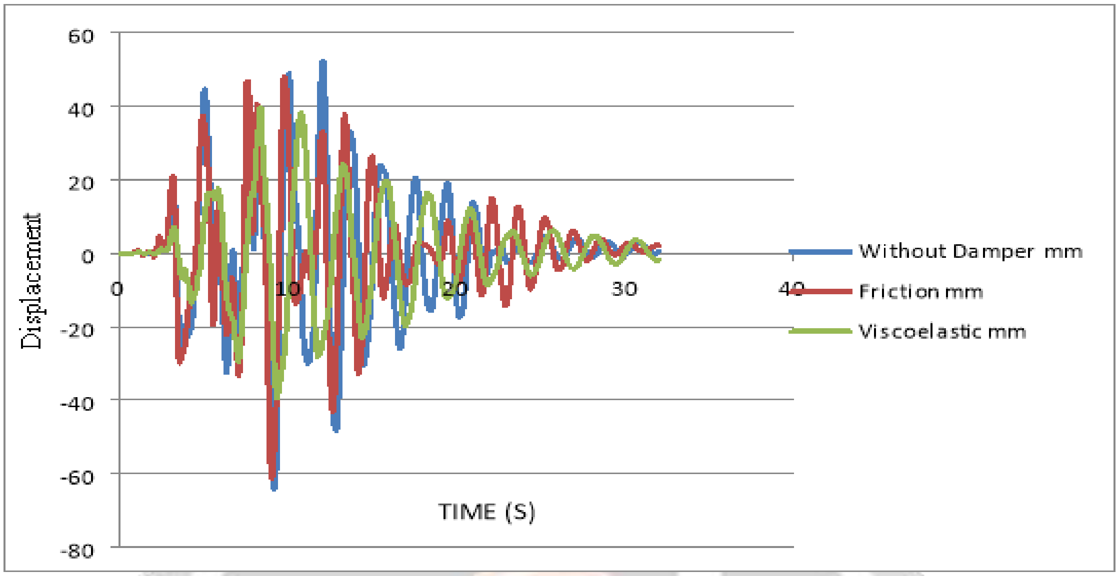



Graph5.4Story shear in y direction (RS)

**1] Time history analysis**

Table5.6 Displacement in X direction (THA)

| Type | Time (s) | Displacement(mm) |
|---|---|---|
| Without | 12.1 | 52.263 |
| With friction damper | 9.8 | 49.71 |
| With viscoelastic damper | 8.4 | 39.80 |




Graph5.5Displacement in the direction of X(THA)

**4.0 CONCLUSION**

The following can be concluded by carrying out the analysis in ETABS 2018 software

i. By analyzing the results of graph 5.1and graph 5.2, it is observed that the lateral deflection for multi-story structure with viscoelastic damper is minimum.

ii. By analyzing the results of graph 5.3 and graph 5.4, it is concluded that the base shear values of the viscoelastic damper are minimum compared to others.

iii. By analyzing the results of graph 5.5 and Graph 5.6 obtained by non-linear time history analysis, it is concluded that the displacement obtained while using viscoelastic dampers is minimal.

iv. By comparing the results of graph 5.7 and graph 5.8 obtained by THA, it is concluded that the base force obtained using viscoelastic damper is minimum compared to others.

From the above we can conclude that the visco elastic dampers devices plays an vital role in decreasing and reduce the seismic attacks to the structure.

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