A COMPARATIVE STUDY ON ANALYSIS OF RCC FRAMED STRUCTURE USING VISCOUS DAMPER, TUNED MASS DAMPER AND FRICTION DAMPERS

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Abstract Every multi-story building structure that is subjected to ground motion in daily life has to have its behaviour studied since it is a common issue for development. The structure's foundation is trembling due to the earthquake. Buildings oscillate as a result of these vibrations, which might seriously harm the structure. These vibrations generated at the ground level are transmitted to the top of the building due to the bulk of the structure, which creates lateral stresses on the frame and ultimately lowers the moment resistance capacity of building components including columns, beams, and other structural elements. The paper provides an overview of several studies done on multistory buildings while taking various factors into consideration. Reaction spectrum approach is beneficial for determining structure response in specific circumstances of ground vibrations, according to all prior studies, observations, and conclusions. This paper presents the findings of an investigation into the seismic response of the G+15 structure both with and without a damper. Practically all multi-story structures must be studied as three-dimensional systems, according to the current edition of the IS: 1893-2002. Buildings' floor plans may be seen as asymmetrical. India's hilly terrain is largely seismically active.

In the current work, response spectrum analysis is used to compare friction damper systems, viscous dampers, and mass tuned dampers. Results for the G+15 building are compared in terms of drift, shear, bending, torsion, time period, and frequency values.

1. INTRODUCTION

Earthquakes are natural phenomena, which cause the ground to shake. The earth„s interior is hot and in a molten state. As the lava comes to the surface, it cools and new land is formed. The lands so formed have to continuously keep drifting to allow new material to surface. According to the theory of plate tectonics, the entire surface of the earth can be considered to be like several plates, constantly on the move. These plates brush against each other or collide at their boundaries giving rise to earthquakes. Therefore regions close to the plate boundary are highly seismic and regions further from the boundaries exhibit less seismicity. Earthquakes may also be caused by other actions such as underground explosions. The study of why and where earthquakes occur comes under geology.

The study of the characteristics of the earthquake ground motion and its effects on engineered structures are the subjects of earthquake engineering. In particular, the effect of earthquakes on structures and the design of structures to withstand earthquakes with no or minimum damage is the subject of earthquake resistant structural design. The secondary effects on structures, due to floods and landslides are generally outside its scope.

The recent earthquake in Kutch, Gujarat on 26 Jan 2001 has not only exposed the weaknesses in the Indian construction industry but also the lack of knowledge about earthquake engineering among all concerned. Taking advantage of the fear caused by the earthquake in the minds of both the common people and the engineering community, a number of people who have no knowledge about earthquake engineering have made totally absurd statements with regard to earthquake resistant design. Earthquake load differs from other loads in many respects, which makes it more difficult to design for it.

DAMPERS

In seismic systems upgrading, one of the lateral pressure discount due to the earthquake is find of dampers. During an earthquake, excessive electricity is implemented to the shape. This electricity is implemented in forms of kinetic and potential (strain) to shape and it's far absorbed or amortized. If shape is freed from damping, its vibration could be continuously, however because of the cloth damping, vibration is reduced. Input energy caused by earthquake to structure is presented in the following equation:

$$E = E_k + E_s + E_n + E_d \qquad (1)$$

In this equation, E is earthquake enter strength, Ek is kinetic strength, Es is reversible stress strength withinside the elastic variety and Eh is the quantity of wasted strength because of inelastic deformation and Ed is the quantity of amortized strength with the aid of using extra damper. In seismic isolation systems, use of strength dissipation systems, allotted a unique region to their selves. Damping growing is viable with the aid of using the usage of diverse techniques inclusive of the glide of a gentle steel, steel friction on every different and a piston movement inside a slimy substance or viscoelastic conduct in substances such rubber-like substances.

Using rotational friction dampers in retrofitting

Damping Effect on Structural Response

Damping growing reduces structural reaction (acceleration and displacement) damping impact at low frequency (near zero) don't have any impact on spectrum quantity and at excessive frequency, it has low impact on reaction acceleration. Figures 1 and a couple of display the maximum impact of damping growing withinside the frequency of 0.three to 2.5 seconds.

Objectives of the study

The following are the main objectives of the project

1. To study the seismic behavior of building by using IS 1893:2002
2. To design the earth quake resistant structure by using friction pendulum, viscous dampers and mass tuned in zone V.
3. To study the multi story building of G+15 by using response spectrum analysis
4. To compare the results of story drift, shear force, bending moment, building torsion, base shear.
5. To study the multi story buildings in ETABS software.

2. LITERATURE REVIEW

Alireza Heysami et al., (2014) The investigates styles of dampers and their overall performance at some stage in earthquake. Also, they've investigated the tall homes within side the international and quality degree of damper overall performance has been studied. And the outcomes display that no simplest dampers have an appropriate seismic conduct in opposition to lateral forces together with wind and earthquake forces. Dampers are labeled primarily based totally on their overall performance of friction, metal (flowing), viscous, viscoelastic; form reminiscence alloys (SMA) and mass dampers. Among the blessings of the usage of dampers we will infer to excessive power absorbance, clean to put in and update them in addition to coordination to different shape members.

Raheel Kazi, P. V. Muley et.al., (2014) This paper affords the comparative evaluation at the seismic overall performance of constructing structural structures having passive damping gadgets-Visco elastic damper. Dynamic behaviour of the shape for wind and earthquake loading with appreciate to reaction spectrum evaluation is accomplished. Changes withinside the responses of displacement, speed, acceleration and glide for the damped shape are tested illustrating the performance of dampers.

The version changed into analyzed the usage of E-TABS 2013. And end result accomplished for the respective guidelines of wind and earthquake forces in opposition to displacement, glide, speed and acceleration.

3. METHODOLOGY USED

Response spectrum analysis

This method is also known as modal method or mode superposition method. It is based on the idea that the response of a building is the superposition of the responses of individual modes of vibration, each mode responding with its own particular deformed shape, its own frequency, and with its own modal damping.

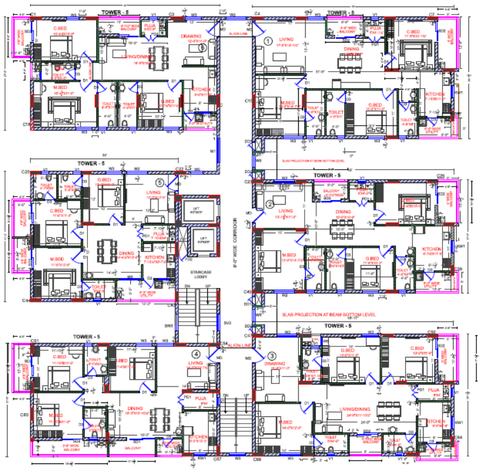
According to IS-1893(Part-l):2002, high rise and irregular buildings must be analyzed by response spectrum method using design spectra shown in Figure 4.1. There are significant computational advantages using response spectra method of seismic analysis for prediction of drifts and member forces in structural systems. The method involves only the calculation of the maximum values of the drifts and member forces in each mode using smooth spectra that are the average of several earthquake motions. Sufficient modes to capture such that at least 90% of the participating mass of the building (in each of two orthogonal principle horizontal directions) have to be considered for the analysis. The analysis is performed to determine the base shear for each mode using given building characteristics and ground motion spectra. And then the Storey forces, accelerations, and drifts are calculated for each mode, and are combined statistically using the SRSS combination.

4. DESIGN CONSIDERATIONS AND MODELS OF THE BUILDING

In the present study, analysis of G+ 16 stories building in Zone V seismic zones is carried out in ETABS.

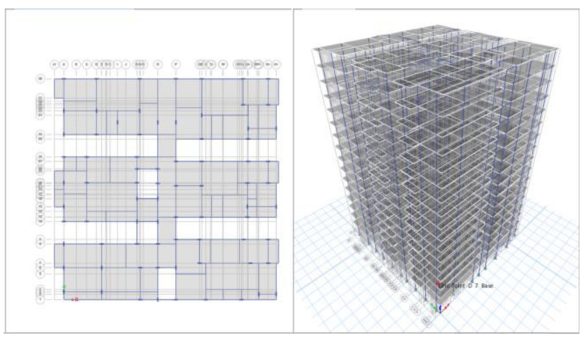
Basic parameters considered for the analysis are

1. Utility of Buildings : Residential Building
2. No of Storey : 16 Stories (G+15 Building)
3. Grade of concrete : M30
4. Grade of Reinforcing steel : HYSD Fe415
5. Type of construction : RCC framed structure
6. Dimensions of beam : 230mmX600mm
7. Dimensions of column : 230mmX600mm
8. Thickness of slab : 150mm, 200mm
9. Thickness of Shear wall : 230mm
10. Height of bottom story : 4m
11. Height of Remaining story : 3m
12. Building height :78m
13. Live load : 5 KN/m^2
14. Dead load : 2 KN/m^2
15. Density of concrete : 25 KN/m^3
16. Loads considered in Buildings : Dead load, Live load, Floor load Earthquake ,Wind load
17. Seismic Zones : Zone V
18. Site type : III
19. Importance factor : 1.5
20. Response reduction factor : 5
21. Damping Ratio : 5%
22. Structure class : B
23. Basic wind speed : 44m/s
24. Method of Analysis : RESPONSE SPECTRUM ANALYSIS
25. Wind design code : IS 875: 1987 (Part 3)
26. RCC design code : IS 456:2000
27. Steel design code : IS 800: 2007
28. Earth quake design code : IS 1893 : 2002 (Part 1).

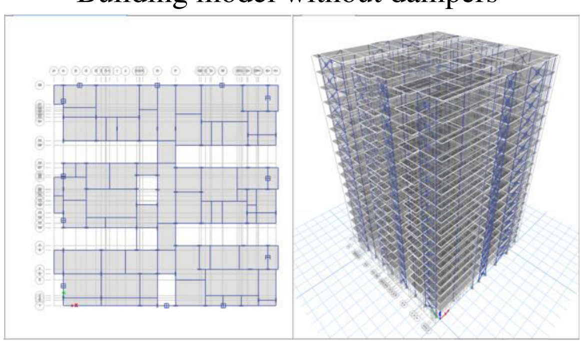


Building plan

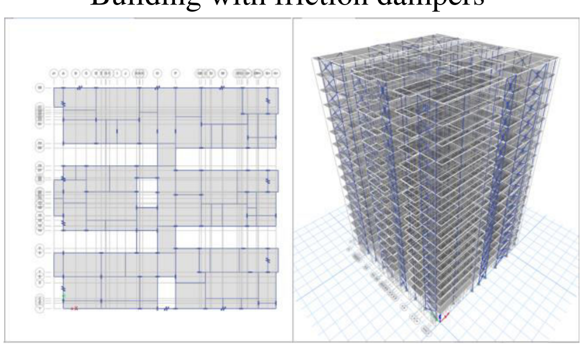
Models in ETABS



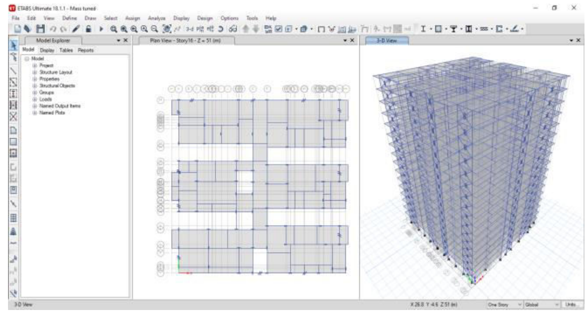
Building model without dampers



Building with friction dampers



Building with viscous dampers

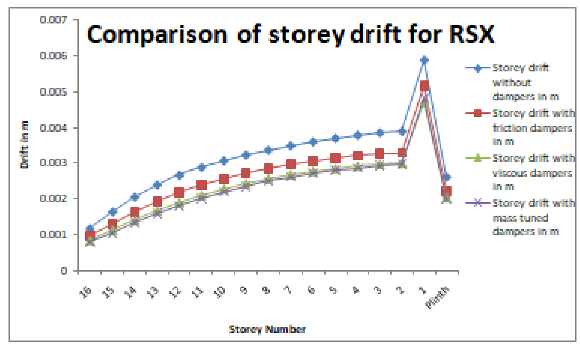


Building with mass tuned dampers

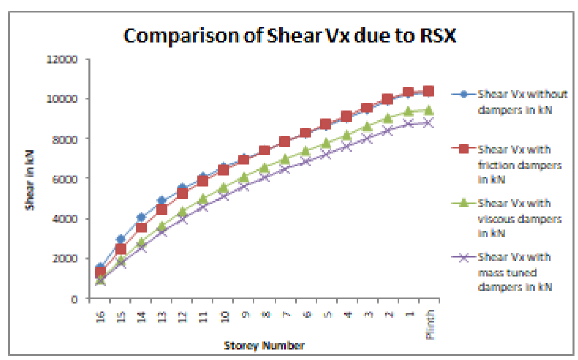
5. RESULTS AND ANALYSIS

RSX Results

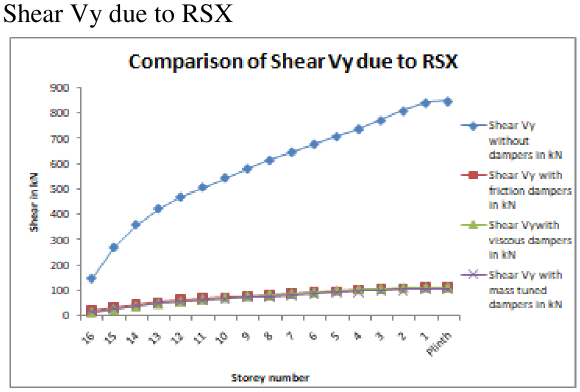
Storey Drift for RSX case



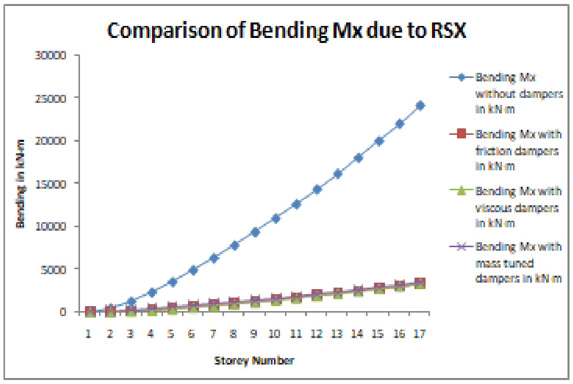
Shear Vx due to RSX



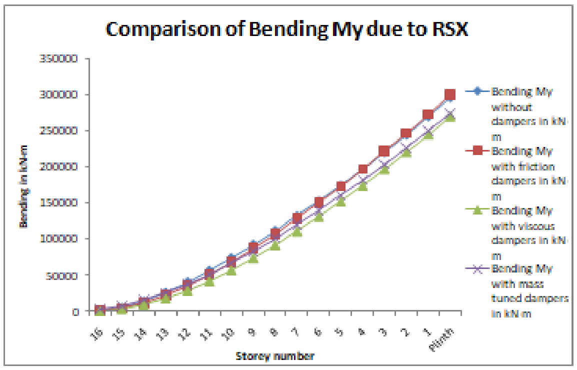
Shear Vy due to RSX



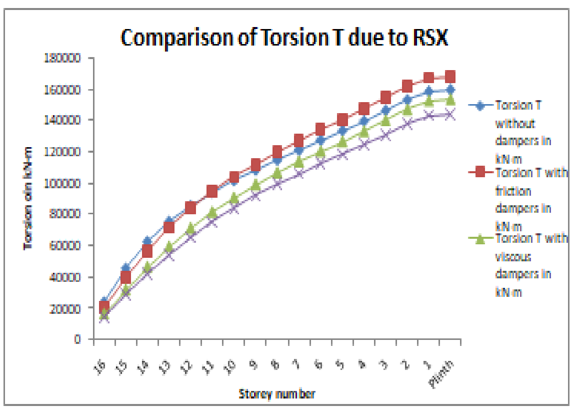
Bending Mx due to RSX



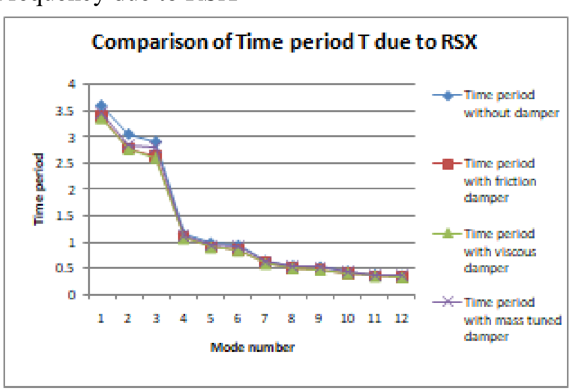
Bending My due to RSX



Torsion T due to RSX

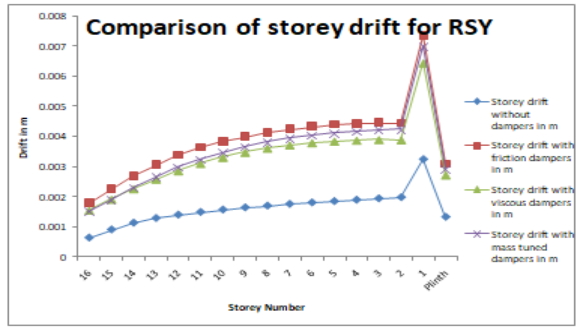


Frequency due to RSX

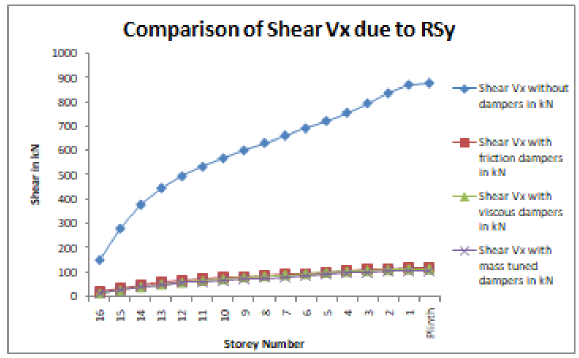


RSY Results

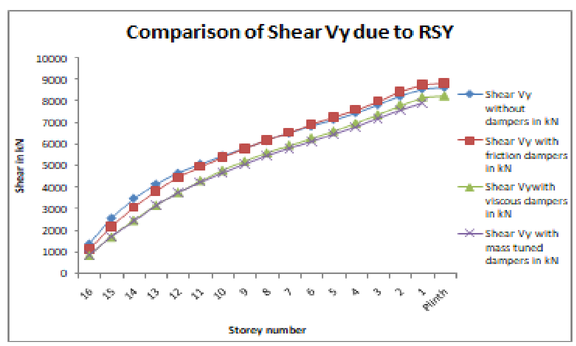
Storey Drift for RSY case



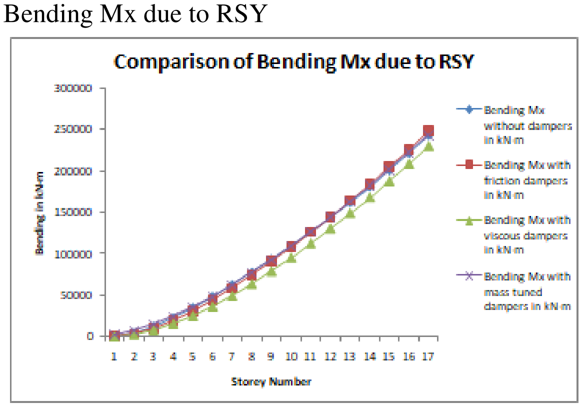
Shear Vx due to RSY



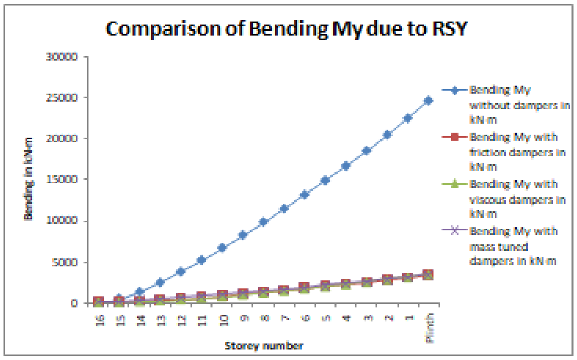
Shear Vy due to RSY



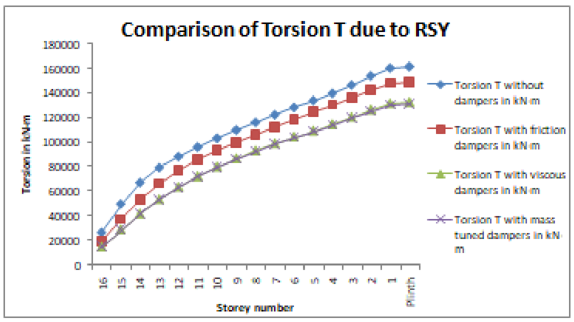
Bending Mx due to RSY



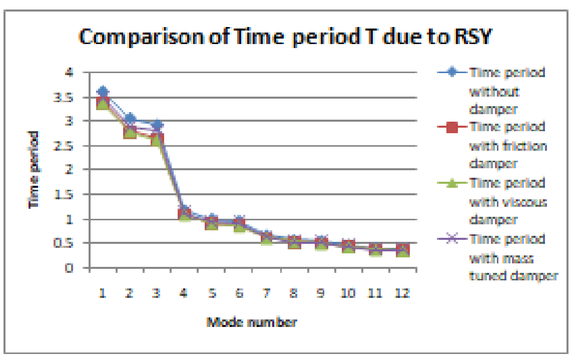
Bending My due to RSY



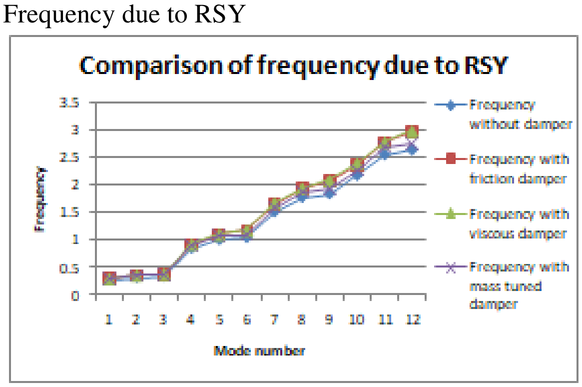
Torsion T due to RSY



Time period due to RSY



Frequency due to RSY



6. CONCLUSIONS

From the above study the comparison is made between the without dampers building, friction and viscous dampers

1. By Response spectrum analysis for the G+15 Building by using dampers the value of Drift is more for the building without dampers case than with dampers. And less values of drift are observed in the case of mass tuned dampers.
2. The value of story shear (Shear force, Bending moment, Building torsion) by Response spectrum analysis for G+15 building by using dampers has higher value for without using dampers case and less values of drift are observed in the case of mass tuned dampers.
3. Time period values decreases from mode 1 to mode 12 and less values are obtained for general building case.
4. The friction devices limit the amount of energy that is input into the structure.
5. The amplitude of displacements, natural time periods, storey drifts and accelerations is considerably reduced.
6. The result shows that, the buildings with mass tuned dampers are more vulnerable compared to other buildings.
7. The building can be tuned for optimum response without resorting to expensive devices.
8. From above it can be concluded that the viscous damper devices perform a vital role in reducing and controlling the seismic response of the structure as compared other types of dampers.

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