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SEISMIC EVALUATION OF MULTISTORIED BUILDING WITH FLOATING COLUMNS USING ETABS

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Abstract - *The field of earthquake engineering and design has been significantly changed by the use of seismic protection devices like dampers. Without these devices, structures are typically designed and constructed according to code, which implies significant structural damage, loss of functionality, and most likely replacement in the event of design-level events. In contrast, seismic design that includes earthquake protection devices results in the best design possible and combines best engineering practise with low cost. These tools have a demonstrated exceptional performance history during previous earthquakes, are reliable, and are economical. Most of the time, the initial cost of using them is offset, at least in part, by the lower cost of other structural components. With the aid of ETABS software, buildings have been examined in the current study under the influence of seismic loads and viscous dampers. In addition, the configurations' story displacement, story drift, and base shear at foundations were compared to the seismic parameters derived from the analysis.*

1.INTRODUCTION

The most abominable and fleeting wonder of nature is seismic load. Whenever a structure is exposed to seismic forces, it doesn't necessarily endanger human lives; rather, it causes damage building collapses and endangers the lives of its residents and property due to damage to the structures. Structures that are subject to seismic or quake forces are inherently vulnerable to damage, with the off possibility that it occurs on an inclined surface, such as slopes that are inclined due to increasing horizontal stresses on the more challenging smaller sections, the possibility of damage to the ground rises noticeably, necessitating the placement of plastics pivots. Because they are unpredictable both horizontally and vertically, structures on inclines differ from those on fields.

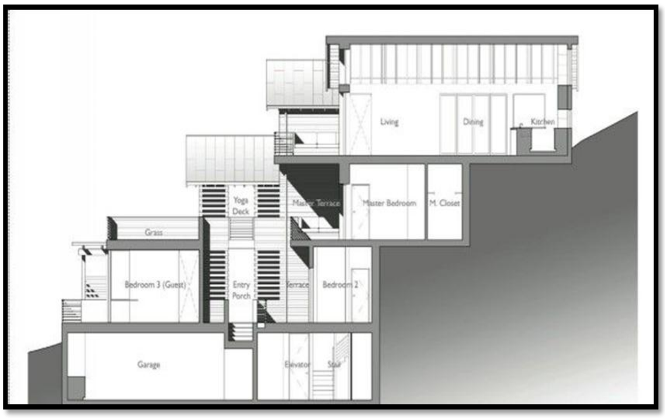


Fig-1 Sloped Building

1.1 Fluid Viscous Dampers

The main purpose of FVDs is to dampen a structure, which reduces structural response to seismic stimulation. From a lateral standpoint, FVDs can reduce displacement and narrative drift, which reduces the strain placed on structural elements. FVDs have capacity to lessen the base shear/overturning moment and the inter-story shear by reducing the floor accelerations.

FVDs are also frequently simpler to install, use, and monitor than other devices. Design elements like internal fluid reservoirs and cutting-edge sealing techniques prolong the life of damper designs. To help extend damper life and reduce the likelihood of leaving a structure exposed without the necessary dampening in the case of a seismic event, a thorough health evaluation program includes monitoring alternatives like fluid indications and cycle counts.

And, long-term preventive maintenance strategy that includes FVDs can frequently be affordable. When structural damage expenses are included, the original purchase price represents only a small part of the damper's total worth, minimizing the customer's entire installation expense.

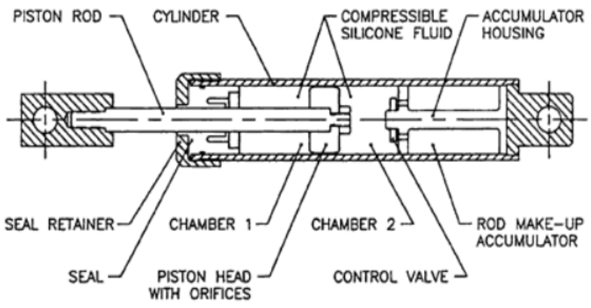


Fig-2 Fluid Viscous Damper

2.LITERATURE REVIEW

P. Manjunath and Yogeendra R. Holebsgilu In this test, a ten story 3D display with four bayous in the Y direction and six straights in the X direction is shown. The angle of the ground's slope ranges from 0° to 30°. The model is broken down and planned using ETABS 2015 programming for different soil compositions and seismic zone V. They concluded that increasing the incline at the base causes the seismic weight to decrease and increasing the firmness of the ground causes the building's execution to increase.

Surekha Bhalchandra and Sandip Doijad (2015). In this study, they took into account the earthquake behaviour of RC buildings on level and sloping terrain with varied shear divider configurations. They thought about the G+8 story RCC being used for an investigation. 9o, 18o, and 27o are the angles at which the slanting ground and level ground are examined. Utilizing SAP2000 programming for Zone II and medium soil, the examination was completed.

Chandrasekaran and Rao (2002); multi-story RCC constructions' earthquake analysis and design were explored. It is quite challenging to model multi-story strengthened concrete buildings as structural components for study. They are frequently depicted as slanted, in a plane, two- or three-dimensional frame systems with varied angles of 5°, 10°, and 15°. Compare the instant, axial force, shear force, nodal movement, stresses in the beam, and supporting reaction to the most recent edition of the IS:1893-2002 to the earlier version IS:1893-1984 when analysing multistory buildings across the country for seismic forces.

Birajdar and Nalawade (2004); researched "the seismic response of structures lying on sloped terrain." We took into account 24 RC building frames in three different arrangements: Step back building, Step back Set back building, and Set back building. The structures were positioned at a slope of 27 degrees. They looked into the seismic response of buildings in seismic zone III that had three bays along the slope direction and one bay across the slope, and had storey levels ranging from 4 to 11 (15.75m to 40.25m). They performed a 3D analysis that considered the torsional effect using the Response spectrum approach.

Ravikumar C. M et al (2012); focused on the "study of performance of irregular configuration of RC buildings". They examined two distinct arrangements of structures resting on sloping ground: structures sitting on sloped grounds in the X-direction and structures lying on sloping ground in the Y-direction. Inconsistencies in a building's geometry and buildings that were perched on slopes were also examined. Each structure has 5 bays in the X and Y directions, 3 stories in the harsh zone V, and 4 bays in the X direction. ATC 40 nonlinear analysis and IS 1893 (part-1) 2002 linear analysis were both used to analyse the performance of these buildings. They discovered that structures on sloping ground are more susceptible to damage because they are drawn to powerful forces causing them to moderately deform. The building perched on a hillside had a base shear of 6019.2 kN, that is approximately 25–55% greater compared to other structures. Displacement was 83.4 mm, that was slightly more than comparable buildings' measurements.

Liya Mathew and C. PrabhaTitle: Effect of Fluid Viscous Dampers in Multi-Storied BuildingYear: 2014 This essay discusses how different loading conditions can affect buildings. Some new and efficient protective techniques are created with the goal of preventing building damage from natural disasters like earthquakes. Here, the fluid viscose damper (FVD) is significant. In order to reinforce concrete frames, this paper explains how to identify the most harmful properties. Using SAP2000 softwares, analysis was carried out in a symmetrical squares building. Results are graphically contrasted.

3.OBJECTIVE

1 To identify the structure's displacement fluctuations both with and without a fluid viscous damper.

2 To determine base shear variations in the structure by using fluid viscous damper in RC buildings.

3 To compare other parameters such as story drift, shear and displacement.

4 Comparing the results along and concluding the effect of viscous damper over the building in slope.

4.METHODOLOGY

4.1 Gravity analysis

In the design of a constructive building, loads are divided into dead loads and live loads. There were applied seismic loads, etc.

Dead load

Building designs take into account dead weight, which is specified as a material's unit weight. For the purpose of calculating loading, the total weight of many other substances that can be housed in structures is also taken into account. Dead loads are seen as being included in IS 875 Part 1.

Live load

Building designs take the live load into account. It adds to the physical contribution made by people, the weight of the furniture, and other pieces of equipment. Moving parts, distribution-focused loads, impact, and vibration loads make up this load; air, earthquake, snow, and other loads are not included. Live Loads, Part 2 of IS 875.

4.2Load combination

The above combinations are taken into account when a structure is subject to earthquake forces according to reinforced concrete structures' limit state design. following IS 1893-2002

1.5(DL±IL)

1.2(DL+IL±EL)

1.5(DL±EL)

0.9DL±1.5LL

The terms dead load, imposed load, and intended seismic load, respectively, stand for the reaction

4.3Building Description

This study was conducted in an eight-story building. The floor plan is the same for all building models.The following information is used for the analysis:

Grade of Concrete:M45

Grade of steel:Fe550

Beam:600mm×450 mm

Column:600mm×600mm

One way slab:200mm

Story Height:3m

4.4Seismic Loads

The IS: 1893:2002 seismic design method must be followed. The building is situated in earthquake zone V. For analysis and design, the following criteria should be utilized (per IS: 1893:2002). (Part I).

Seismic Zone: V

Zone factor: 0.36(Refer Table 2)
Importance factor:1.0 (Refer Table 6)

Response reduction Factor:5.0(Refer Table 7)

Soil Type: Medium

Structure Type: RC Frame Structure

4.5 Layout of Buildings

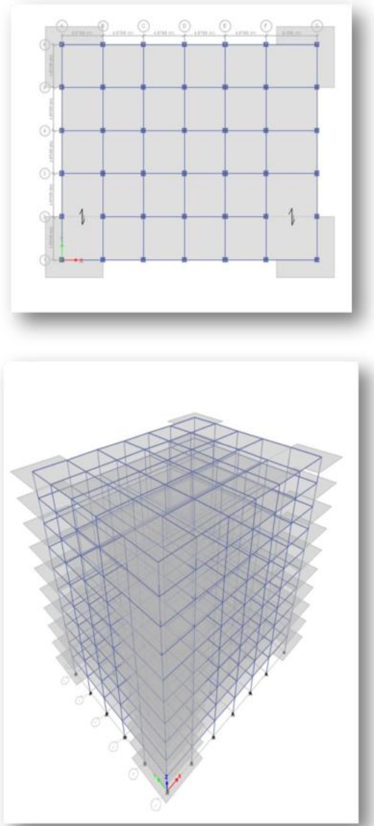
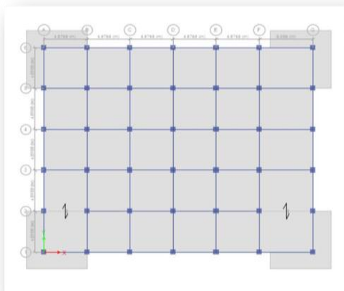


Fig -3: Plan and3D Model of Wire Building



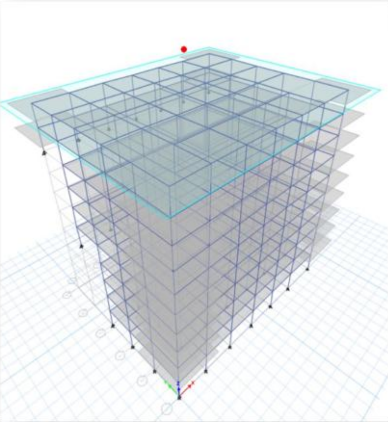


Fig -4: Plan and 3DModel of Sloped Building

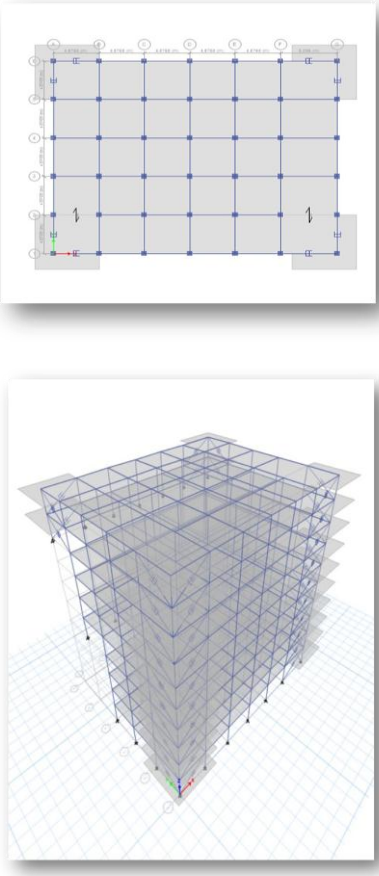


Fig -5: Plan and3D Model of Sloped Building with FVD

4.6Response spectrum analysis

In order to determine the dynamic behaviour of a structure, this approach measures pseudo spectral acceleration, displacement, or velocity using damping level and time history. This method is related to the kind of structure selection and is beneficial for making decisions regarding the design of a certain structure. For each structural period that the structure experiences, there is a smooth curve that gives the pressure wave in a spectra for the dynamic response.

With the exception of basic or complicated structures, this strategy necessitates several building codes. The combination of a few modes inside a thread that vibrate in response to the matching harmonics is a straightforward definition of a structure's reaction. Software can therefore be used to determine these approaches for a particular structure. The response is determined by reading the modal mass or frequency for each mode from the design's spectrum. Consequently, x, y, and z directions should be examined before the impact on the structure. The following are examples of the combination method:

- Adding together the absolute-peak values
- Square root of the sum of the squares
- Combination of complete quadratic.

5.RESULTS AND DISCUSSIONS

ETABS is software used for analysis purpose and also in design of buildings. ETABS is characterised by powerful graphical interface coupled with common database which is integrated with unmatched modelling, analysis, design and detailing procedures.

5.1 Wire Frame

Displacement

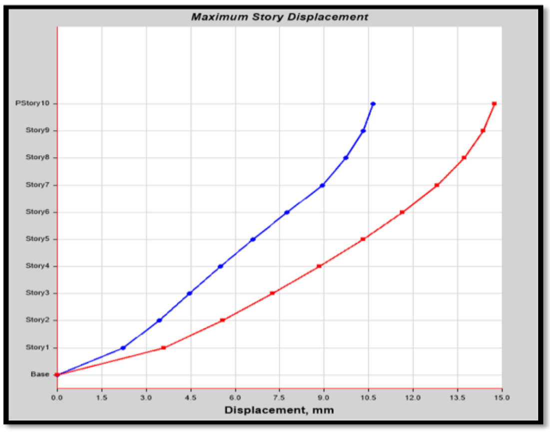


Chart -1: Storey Displacement for EQX & EQY

The maximum displacement occurred in the top story of building. For Eqx=22.741mm and Eqy=23.659mm

When compared with the Eqx and Eqy load there is 3.88% increased.

Story Shear

The maximum story shear occurred in the bottom story of building. For Eqx=4682.561kN and Eqy=4761.579kN

When compared with the Eqx and Eqy load there is 1.7% increased.

Auto Lateral Loads

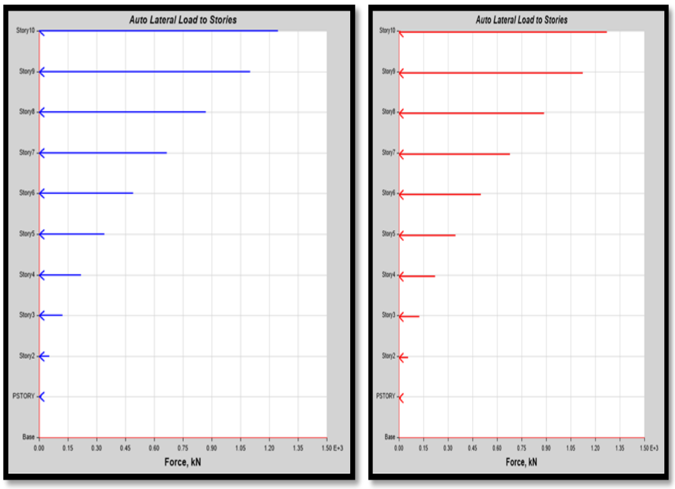


Chart -2: Auto Lateral Loads for EQX & EQY

The maximum auto lateral load occurred in the top story of building. For Eqx=1246.71kN and Eqy=1271.86kN

When compared with the Eqx and Eqy load there is 2.0% increased.

5.2 Sloping Ground

Displacement

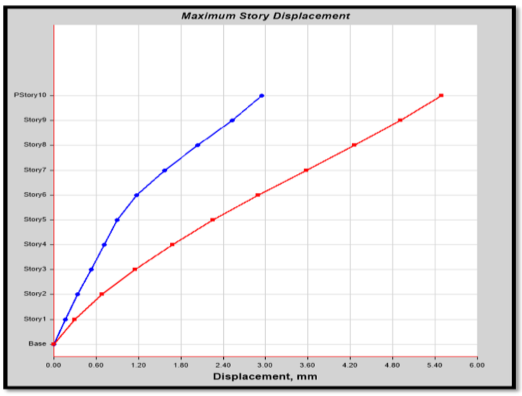


Chart -3: Storey Displacement for EQX & EQY

The maximum story displacement occurred in the top story of building. For Eqx=21.206mm and Eqy=19.553mm

When compared with the Eqx and Eqy load there is 7.80% decreased.

Story Shear

The maximum story shear occurred in the story-5 of building. For Eqx=2073.627kN and Eqy=2484.594kN

When compared with the Eqx and Eqy load there is 16.54% increased.

Auto Lateral Loads

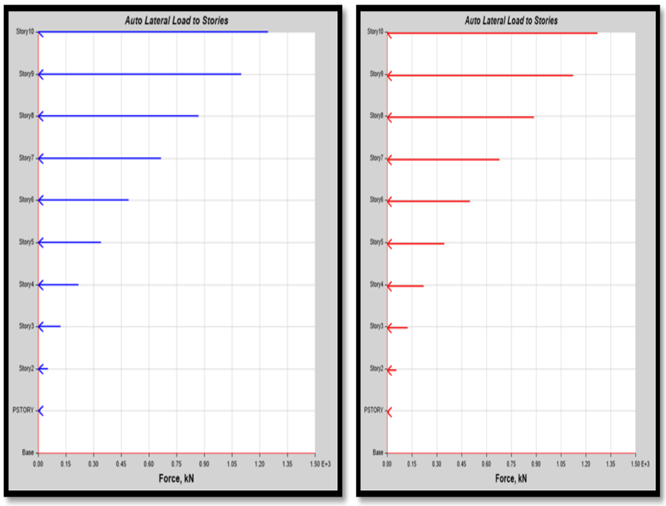


Chart -4: Auto Lateral Loads for EQX & EQY

The maximum auto lateral load occurred in the top story of building. For Eqx=1341.212kN and Eqy=1682.409kN

When compared with the Eqx and Eqy load there is 20.28% increased.

5.3 Sloping Ground with FVD

Displacement

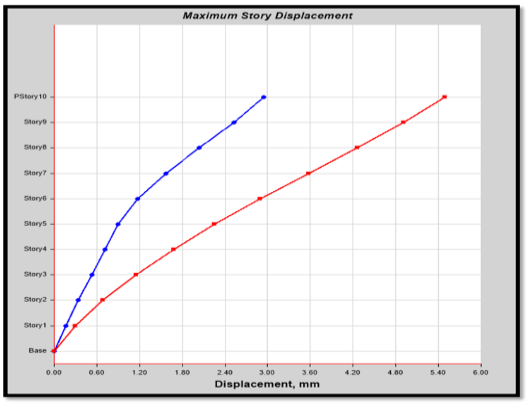


Chart -5: Storey Displacement for EQX & EQY

The maximum story displacement occurred in the top story of building. For Eqx=9.401mm and Eqy=12.497mm

When compared with the Eqx and Eqy load there is 24.77% increased

Story Shear

The maximum story shear occurred in the story-5 of building. For Eqx=1004.74kN and Eqy=2140.146kN

When compared with the Eqx and Eqy load there is 53.052% increased.

Auto Lateral Loads

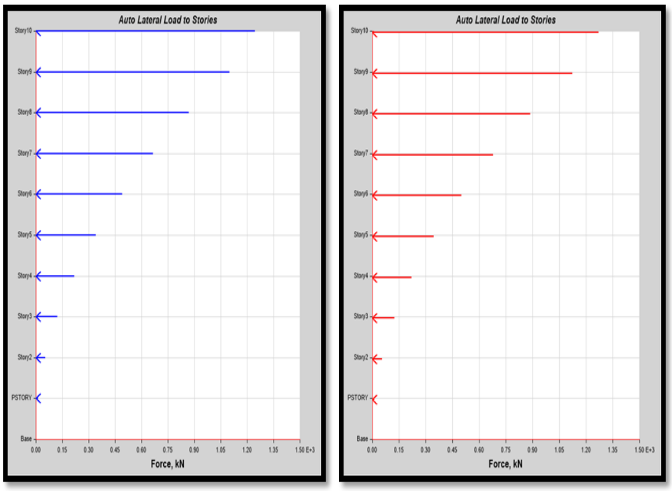


Chart -6: Auto Lateral Loads for EQX & EQY

The maximum auto lateral load occurred in the top story of building. For Eqx=1222.711kN and Eqy=1222.711kN

Both Eqx and Eqy load having the same auto lateral loads.

5.4 Comparison of Wire frame Building, Sloped Building and Sloped Building with Viscous Dampers

Displacement

Table -1: Displacement for EQX

MODEL	X in mm
RCC	22.741
SLOPE	21.206
FVD	9.401

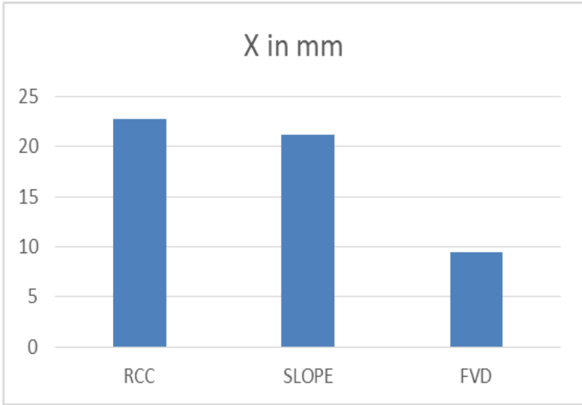


Chart -7: Storey Displacement for EQX

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 55.66%

When compared with the normal and sloped building there is 6.74% decreased.

Table -2: Displacement for EQY

MODEL	Y in KN
RCC	23.659
SLOPE	19.553
FVD	12.497

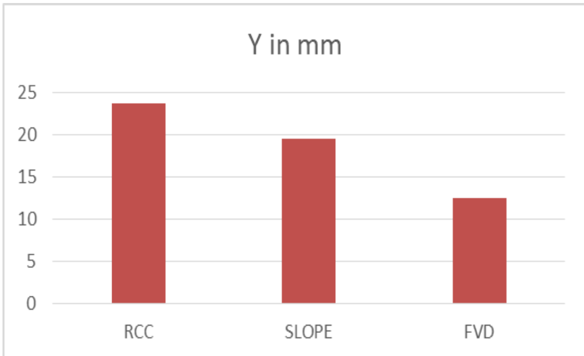


Chart -8: Storey Displacement for EQY

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 36.08%

When compared with the normal and sloped building there is 17.35% decreased.

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Story Shear

Table -3: Shear for EQX

MODEL	X in KN
RCC	691.1896
SLOPE	648.8819
FVD	509.2761

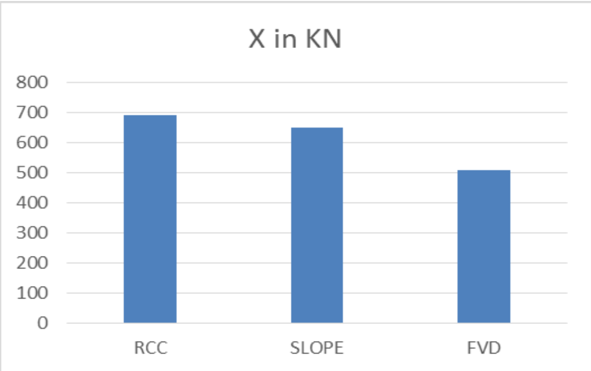

Chart -9: Storey Shear for EQX

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 21.51%

When compared with the normal and sloped building there is 6.12% decreased.

Table -4: Shear for EQY

MODEL	Y in KN
RCC	701.7673
SLOPE	970.7936
FVD	521.7406

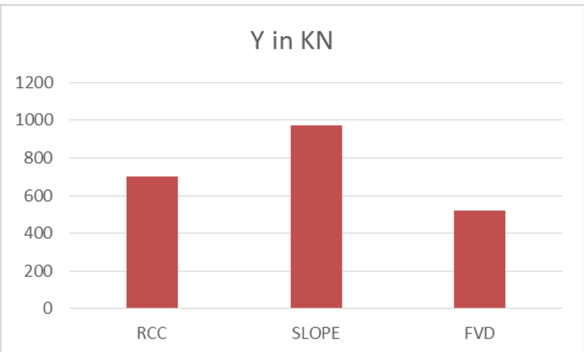

Chart -10: Storey Shear for EQY

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 46.25%

When compared with the normal and sloped building there is 27.71% increased.

Auto Lateral Loads

Table -5: Auto Lateral Loads for EQX

MODEL	X in KN
RCC	1246.711
SLOPE	1246.711
FVD	1222.711

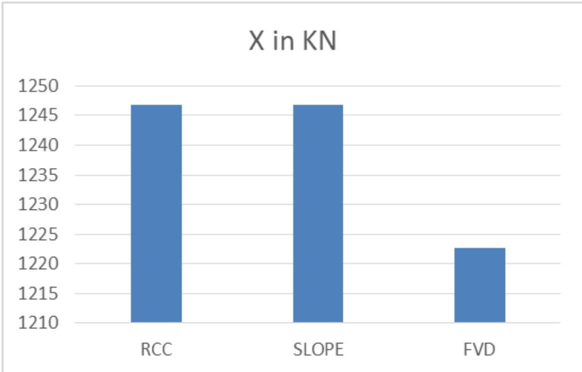

Chart -10: Auto Lateral Load for EQX

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 1.92%

When compared with the normal and sloped building there is no change occurred

Table -6: Auto Lateral Loads for EQY

MODEL	Y in KN
RCC	1271.86
SLOPE	1271.86
FVD	1222.711

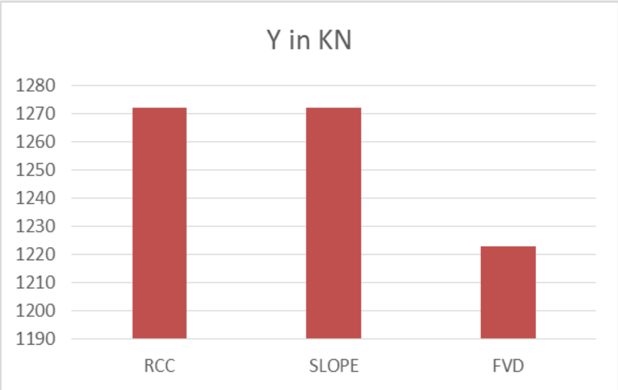

Chart -11: Auto Lateral Load for EQY

When we introduce the FVD in the structure in the sloped areas there is maximum reduction of 3.86%

When compared with the normal and sloped building there is no change occurred.

6. CONCLUSION

1. By checking the final comparison for displacement, drift and shear the final values obtained for the all the three reserves holds good for damper model.

2. Considering all the tables and respective graph we found that cement damper and share wall performs better when compared with all other models which is having less value and holds good to consider the damper and shear wall model model performs better.

3. Considering the forces values the damper performs better as well as in drift analysis also the model performs better.

4. Consider in the share forces the RCC model which is the performs better damper and the normal model appears to be a better choice hence in consideration model of damper performs well in consideration.

5. Finally seeing all the three results displacement drift and story share values we can conclude that the damper model is better in slope construction of multistory when compared with all other model

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