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Comparative Study of RC Building with Different Bracing System and Friction Damper

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Abstract - *The present study focuses on the study of the structural performance of building with different bracing systems. The effectiveness of various types of bracing system on the structure has also been investigated. For this study, 10 storied commercial RC building has been designed, and then analyzed under lateral loading. The structural performance of the RC building has been investigated using different types of bracing system such as crossed bracing, V-type bracing, and eccentric bracing. A comparative study has been done on story displacement, story drift and story shear. Finally, it can be said that cross diagonally braced structure shows better structural performance among all the structures considered here under similar circumstances, and then compared with X bracing RC building with friction damper. Result from present work we can say that the displacement of RC building with X Bracing and friction damper decreases by 63% compared to RC building with X bracing and story drift is decreased by 70%. Base shear also increases by 20% using building with X bracing and damper.*

Key Words: **Base Shear, Lateral Displacement, Storey Drift, Friction Dampers.**

1. INTRODUCTION

Earthquakes are the most destructive and life damaging phenomenon of all the times. Earthquakes are caused due to the large release of strain energy by the movement of faults, which causes shaking of ground as the seismic waves travel in all directions inside the earth layer. These seismic waves will carry different levels of energy, have different amplitudes and arrive at various instants of time to the surface. Earthquakes create vibrations on the ground that are translated into dynamic loads which cause the ground and anything attached to it to vibrate in a complex manner and cause damage to buildings and other structures. Civil engineering is continuously improving ways to cope with this inherent phenomenon. Conventional strategies of strengthening the system consume more materials and energy. Alternative strategies such as bracing systems and dampers are found to be effective in reducing the seismic and other dynamic effects on civil engineering structures. Bracings and dampers are most widely used lateral load resisting systems in multi-storied buildings.

2. BRACINGS:

Bracing systems are classified depending on whether the braces are connected at column beam joint or away from column beam joint.

3. FRICTION DAMPER:

Friction damper is an energy dissipating device. Passive control systems are mainly used for dissipation of earthquake energy. Friction damper are designed in such way that they have a moving part that will slide over each other during a strong earthquake. When part slide over each other they create friction which uses some of the energy from earthquake that goes into the building.

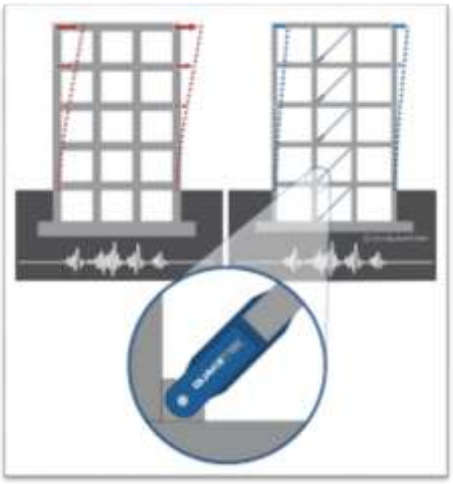

Fig 1: Friction Damper

4. LINEAR STATIC ANALYSIS:

Here the total design lateral force or design base shear along any principal direction is given in terms of design horizontal seismic coefficient and seismic weight of the structure. Design horizontal seismic coefficient depends on the zone factor of the site, importance of the structure, response reduction factor of the lateral load resisting elements and the fundamental period of the structure. The procedure generally used for the equivalent static analysis is explained below.

5. OBJECTIVES

1. To perform Response spectrum analysis of G+9 story RC building with different bracing systems and friction damper.

2. To study the seismic responses like story shear, story drift and story displacement of RC building with and without bracing systems.

4. To study the seismic responses like story shear, story drift and story displacement of RC building with friction damper.

5. To Choose the Optimum braced structure and compare the results of story drift, story shear and story displacement of building with friction damper.

6. Checking for the results, Suggest which structure model is better to consider for the construction.

6. METHODOLOGY AND MODELLING:

6.1 ETABS

The entire analysis has done for all the 3D models using ETABS 15 non-linear version software. The results are tabulated in order to focus the parameters such as story shear, story drift and lateral displacement.

6.2 Model Description

Grade of steel	Fe 500
Grade of concrete	M30
Beam	300mmX700mm
Column	700mmX700mm
One way slab	200mm
Bracing	ISMB450
Height b/w the floor	3.0 m
Wall thickness	230 mm
Density of brick masonry	19 KN/m3

6.3 Plan and 3d View of Models

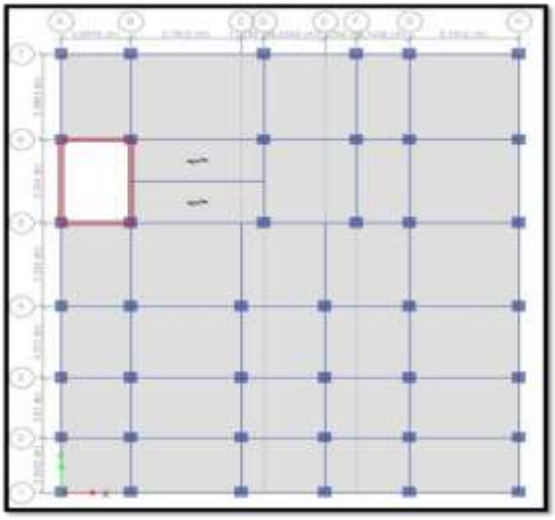

Fig 2: Floor Plan

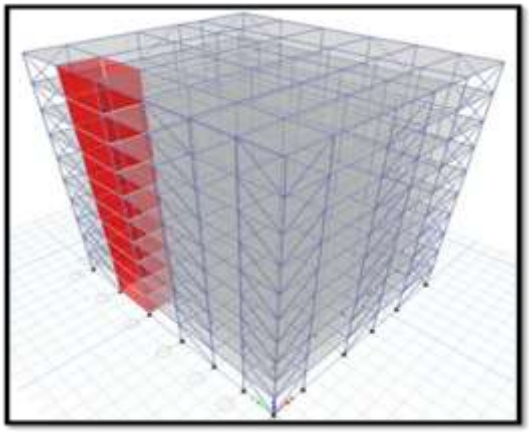

Fig 3: 3D view of RC Building with X bracing

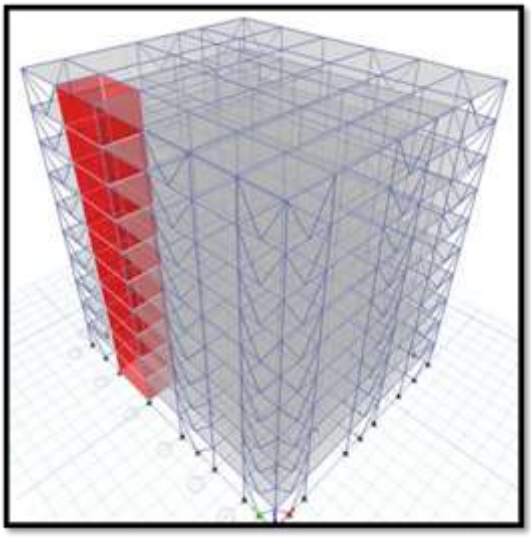

Fig 4: 3D view of RC Building with V bracing

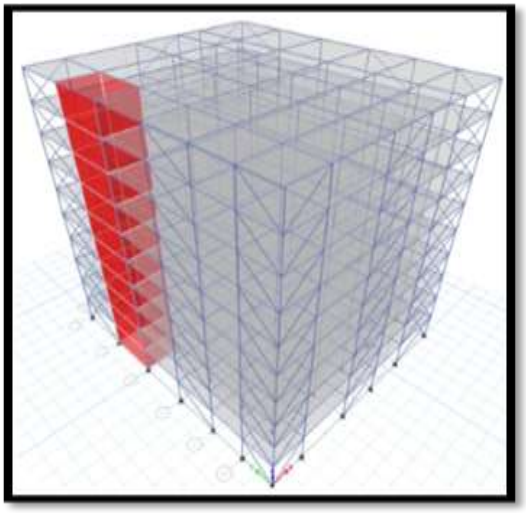

Fig 5: 3D view of RC Building with E bracing

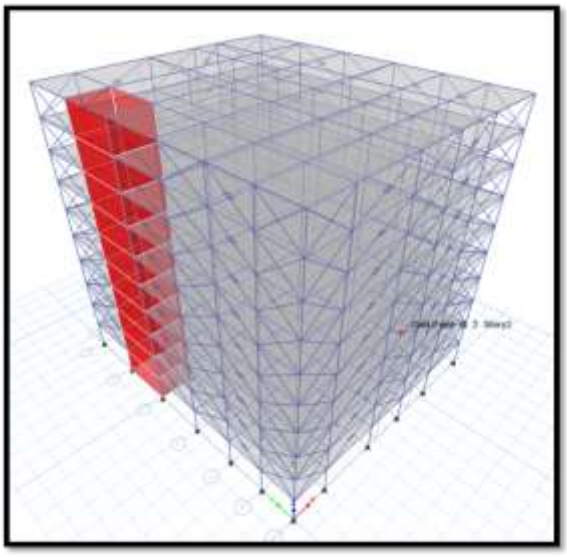

Fig 5: 3D view of RC Building with X bracing and Friction Damper

7. RESULTS AND DISCUSSIONS

7.1 Maximum story Displacement

Table1: maximum story displacement

MODEL	X- Direction	Y -Direction
Model 1	14.216	14.216
Model 2	8.915	8.119
Model 3	9.443	9.327
Model 4	9.001	8.937

MODEL-1= RC Building **MODEL-2= X Bracing**

MODEL-3=V Bracing **MODEL-4= E Bracing**

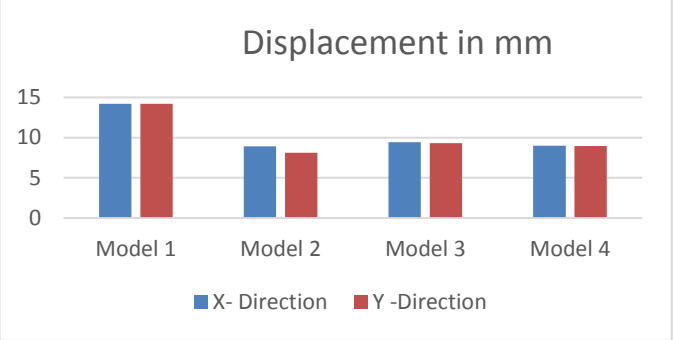

Chart 1: Maximum Story Displacement

- The above table shows the values of displacement for model 1, model 2 model 3 and model 4 with and without different bracings using response spectrum method of analysis.
- For model 2 max lateral displacement decreases by 37% with using of X bracing.
- For model 3 max lateral displacement decreases by 33% with using of V bracing.
- For model 4 max lateral displacement decreases by 35% with using of E bracing.
- When compered in all models it can be say that model 2 has less displacement compared to other models.

7.2 Maximum story Drift

Table2: maximum story Drift

MODEL	X- Direction	Y -Direction
Model 1	0.001	0.001099
Model 2	0.000387	0.000408
Model 3	0.000956	0.000408
Model 4	0.000468	0.000488

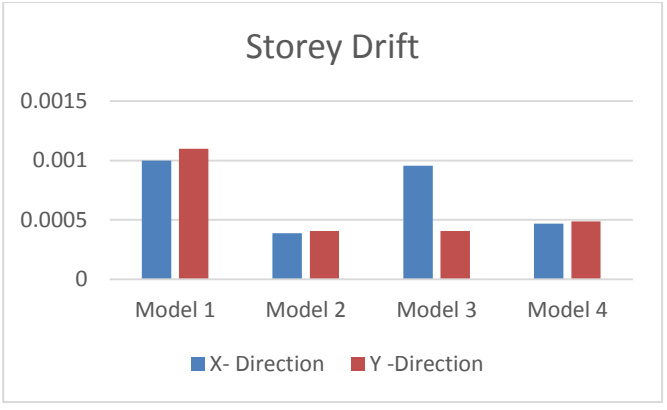

Chart 2: Maximum Story Drift

- The above table shows the values of drift for model 1, model 2 model 3 and model 4 with and without different bracings using response spectrum method of analysis.
- For model 2 max story drift decreases by 61% with using of X bracing.
- For model 3 max story drift decreases by 5% with using of V bracing.
- For model 4 max story drift decreases by 53% with using of E bracing.
- When compered in all models it can be say that model 2 has less story drift compared to other models.

7.3 Maximum base shear

Table3: maximum story shear

MODEL	X- Direction	Y -Direction
Model 1	4310.5258	3707.0944
Model 2	4405.0107	3855.1369
Model 3	4258.9431	3730.9308
Model 4	4056.7191	3997.8904

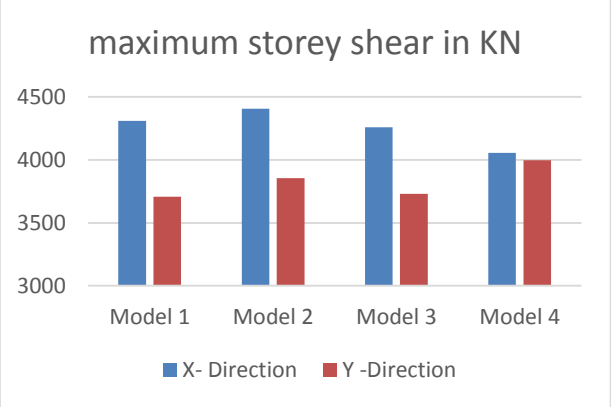

Chart 3: Maximum Story shear

- The above table shows the values of story shear for model 1, model 2 model 3 and model 4 with and without different bracings using response spectrum method of analysis.
- When compered in all models it can be say that model 2 has more story shear compared to other models.

8. COMPARISON OF RC BUILDING WITH X BRACING AND FRICTION DAMPER

Bracing Provided For Three Models On X Bracing, V Bracing And Eccentric Bracing. And Out Of Which an Optimum Performed Bracing Is Chosen. From above results we say that RC building with X bracing is more effective than other bracing systems. Hence X bracing building is considered for further analysis.

8.1 Maximum story Displacement

Table4: maximum story displacement

MODEL	X- Direction	Y -Direction
Model 1	14.216	14.216
Model 2	8.915	8.119
Model 3	5.233	4.517

MODEL-1= RC Building MODEL-2= X Bracing

MODEL-3 = X- Bracing with damper.

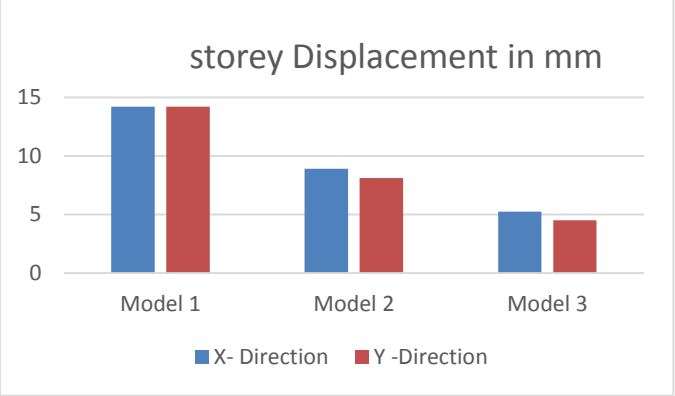

Chart 4: Maximum Story Displacement

- The above table shows the values of displacement for model 1, model 2 and model 3.
- For model 2, max lateral displacement decreases by 37% with using of X bracing.
- For model 3, max lateral displacement decreases by 63% with using of X bracing with damper.
- When compered in all models it can be say that model 3 has less displacement compared to other models.

8.2 Maximum story Drift

Table5: maximum story Drift

MODEL	X- Direction	Y -Direction
Model 1	0.001	0.001099
Model 2	0.000387	0.000408
Model 3	0.000293	0.000272

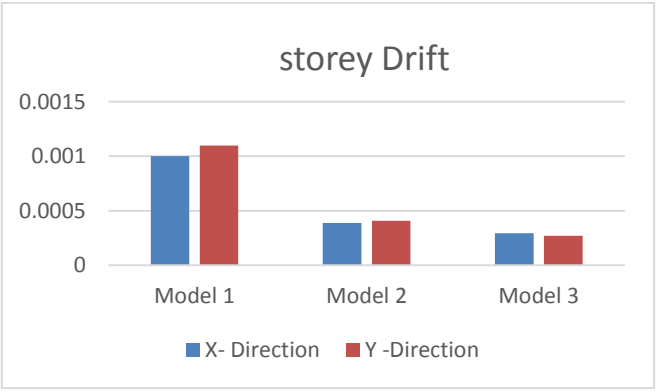

Chart 5: Maximum Story Drift

- The above table shows the values of story drift for model 1, model 2 and model 3.
- For model 2, max story drift decreases by 61% with using of X bracing.
- For model 3, max story drift decreases by 70% with using of X bracing with damper.
- When compered in all models it can be say that model 3 has less drift compared to other models.

8.3 Maximum story shear

Table 6: maximum story shear

MODEL	X- Direction	Y -Direction
Model 1	4310.5258	3707.0944
Model 2	4405.0107	3855.1369
Model 3	5259.3467	4187.0774

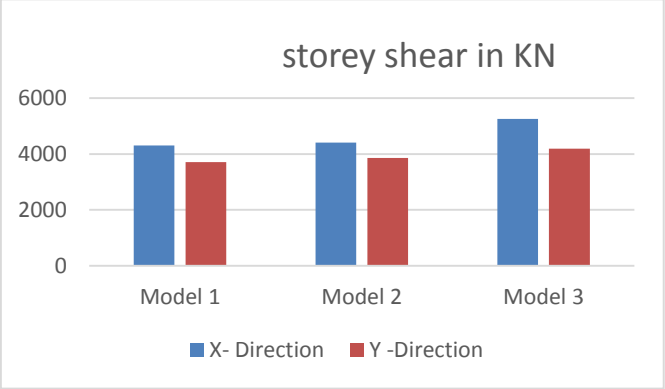

Chart 8: Maximum Story shear

- The above table shows the values of story shear for model 1, model 2 and model3.
- Max base shear increases with using of X bracing with damper.
- When compered in all models it can be say that model 3 has more story shear compared to other models.

CONCLUSIONS

The following conclusions are made from the present work

1. From above results we found that the building with X Bracing and Damper performs well as that of the Normal RCC and X braced building.

2. The lateral displacement of building with X bracing and friction damper decreases by 63% compared to that of building with X bracing.

3. Base shear increases with using of X bracing with damper compared to the building with X bracing.

4 Presence of friction dampers in the building reduces the inter storey drift by 70% of the building.

5. Taking out the Average Results for RC building with Bracing and the Damped model. The damped model shows better Performance as that of the other models and it will remains as the better choice.

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