# Analysis of Steel Framed Structure with Different Structural Steel Braces using ETABS

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***Abstract*—Steel frames are widely used in the country in this fast modernization era.They are easy to build,maintain&retrofit if needed.Due to the cost factor and time for construction steel frames with steel floorings can be used compared to RCC buildings.But saying that we need to check the structural stability of steel framed structures.As the height increases the risk increases.Steel bracings are an additional strength increasing structures that can be adopted while constructing steel frames.This paper studies the impact of adding different types of braces on steel framed structure and their structural changes like maximum story displacement,maximum story drifts,maximum story shear,story overturning moment etc on high rised building under various load conditions in csi etabs software under Indian Standards.**

***Keywords—ETABS; braces; Steel framed structures***

## I. INTRODUCTION

India is a very fast developing country especially in the urban areas. The demand for dwelling as well as commercial buildings are rapidly high. Cost of construction and time for construction are the major factors affecting the decision of selecting the type of construction. For the increasing demand in land multistory buildings are only the wisest option. When the height of the buildings increases the risk also increases.In order to prevent the building from these risk factors such as wind load, seismic load we provide extra bracings to the structure. Bracings can be provided on RCC structures as well. But for a cost effective consideration and easy fabrication Steel framed structures are ideal.

There are 5 major types of bracings we can adopt in the structure.They are X braced,V braced,Inverted V,Eccen Forward,Eccen Back.We have adopted trying all types of braces on a 7 story building on external sides.Later on various attributes of the structures have been input to the software.The result has been analysed and studied.It is found that the building has high energy dissipating capacity and less damage to the building.

## II LITERATURE SURVEY

Masood Ahmed Shariff, Owais M, Rachana C, Vinu , AshishDubay B

The analysis of the H shaped Reinforced Concrete framed building subjected to the seismic loads with and without the consideration of X bracings under the seismic zone consideration was carried out in ETABS software. The maximum storey displacement of the building is reduced by the use of X type bracing system. Displacement value decreases from top storey to base. It is found that the reduction in the displacement along X direction is about 45.66% and similarly along y direction the reduction is about 37.21%.

B.NAGA NIRANJAN KUMAR, DR.M.ASHOK KUMAR

By providing the bracings the stiffness of the structure is increased and storey shear is decreased with increase in height of structure. In the present research 23 storied building was designed using ETABS software to assess the seismic zones. From above discussions the following conclusion are made. The structural performance is analyzed in two different models. By providing the bracings the stiffness of the structure is increased and storey shear is decreased with increase in height of structure. Time History analysis is performed for all the models i.e. without bracings & with bracings. Base Shear is increased with respect to time for the models with bracings. By providing lateral systems in the framed structures the reduction in the displacement, drift, storey shear, thereby increasing the stiffness of the structure for resisting lateral loads due to earth quakes.

Safvana P and Anila S

The effectiveness of various types of steel bracing is examined. The effect of the distribution of the steel bracing along the height of the RCC structure on the seismic performance of the rehabilitated building is studied. Provision of conventional x braced, zipper braced and SBS is provided in each stories. The percentage reduction in lateral displacement is found out. It is found that deformation and base shear is lower for SBS with double spring bracings in case of RCC structures but for the steel structures, deformation value is lower for zipper braced frame and base shear value is lower for SBS with double spring bracing.

## III. OBJECTIVE OF WORK

This study aims to understand the behaviour of the structure under lateral loads.

- To provide the seismic resistant bracings to the Steel structure and carry out the analysis.
- To know the maximum story displacement,maximum story drifts,maximum story shear,story overturning moment displacement, base shear and story stiffness of the structure.

And the comparison of the same is made between bare frame and braced frame and various braced models.

## IV. METHODOLOGY

- Selection of materials
- Modelling using etabs
- Analysis
- Designing of steel frame
- Result
- Comparison study

**MODEL DETAILS:**

**1. Geometrical Data**
1. Type of Building: Commercial building
2. Building Dimensions:16 m along x & 16 m along y directions
3. Typical storey height: 3 m
4. No. of Storey: G+7
5. Beam size: 0.45 m x 0.25 m
   Top flange thickness:25mm
   Bottom flange thickness:25mm
   Web thickness:25mm
7. Column size: 0.45 m x 0.30 m
   Web Thickness:50 mm
   Flange Thickness:50 mm
8. Slab thickness: building slabs-0.1m
9. Wall thickness: 25mm
10. Steel brace: ISA (300 X 250 X 15) mm

**2. Seismic Data:**
(Based on Indian seismic code, IS 1893-2002)
1. Seismic zone: Zone 4 (Table 2 of IS1893 – 2002(part1))
2. Seismic Zone factor: 0.24 (Table 2 of per IS 1893:2002(part1))
3. Importance Factor: 1.5 (Table 6 of per IS 1893:2002(part1))
4. Response Reduction Factor: 5 for concentrically braced frames
((Table 7 of per IS 1893:2002(part1))
5. Type of Soil: Medium Type 2

**3. Material data:**
1 Grade of steel =Fe415
2.Wall=Aluminium

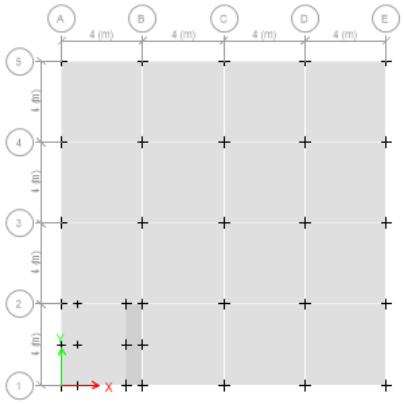
**4. Loading Data:**
1. Dead load: It is defined automatically software defined (Table 2, IS 875 (Part 1):1987).
2. Live load: For this commercial building as per (Table1, IS 875 part 2), live load is taken as 3 kN/m2 on each floor and on roof 2 kN/m².
3. Floor Finish: 1.5kN/m²
4. Earthquake load in X and Y direction i.e. EQX and EQY.

Load combinations based on IS 1893-2002,
General-1. 1.5 (DL + LL )
Auto defined by software.

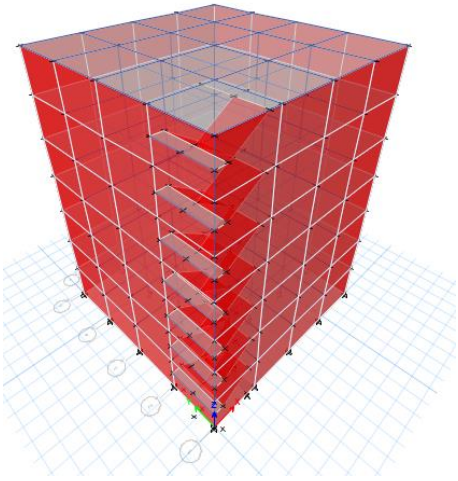
**5. Wind Load**
Wind speed Vb-47m/s (IS 875:2015)
Terrain Category -2
Importance factor-1.3

**6. Models**

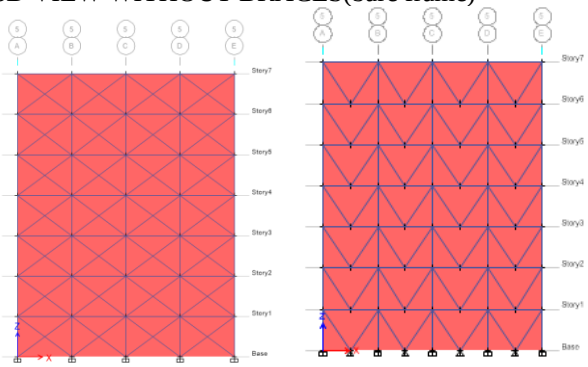
Model 1: Bare frame
Model 2: X braced frame
Model3: V braced
Model4: Inverted V
Model5: Eccen Forward
Model6: Eccen Back



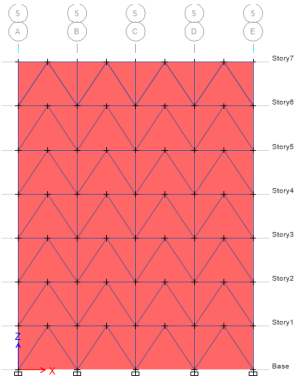
PLAN



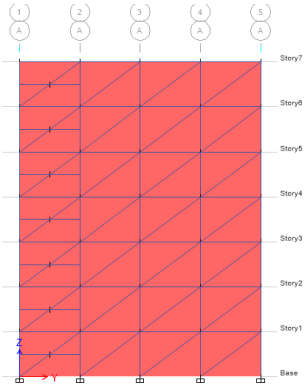
3D VIEW WITHOUT BRACES(bare frame)



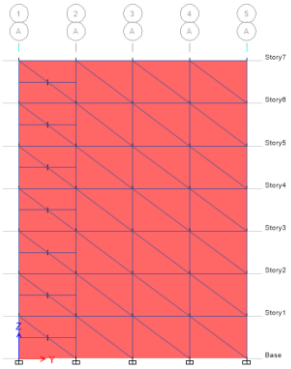
X BRACED V BRACINGS



INVERTED V



ECCENTRIC FORWARD

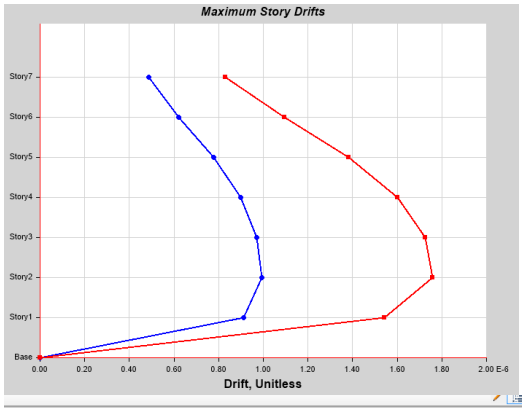


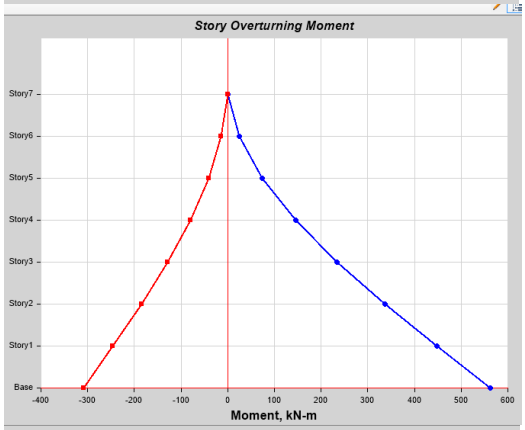
ECCENTRIC BACKWARD

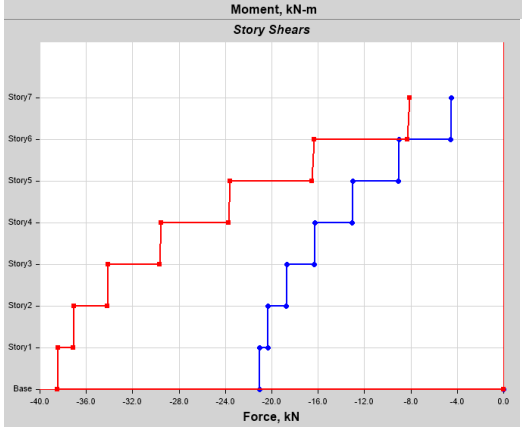
## V. RESULTS AND DISCUSSION

The models are analysed using the etabs software.Each models have been analysed one by one to study and compare the results. The blue line denotes value in X direction and red line donotes value in Y direction.

1. Bare bracing

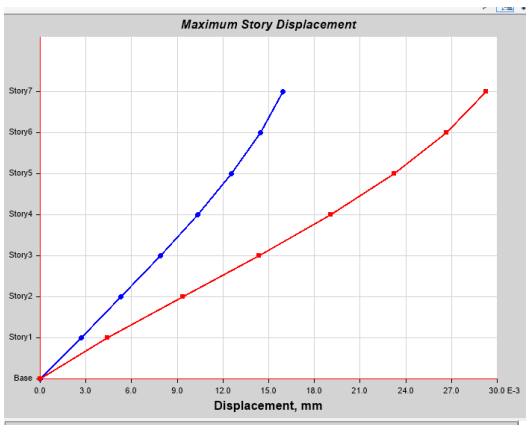



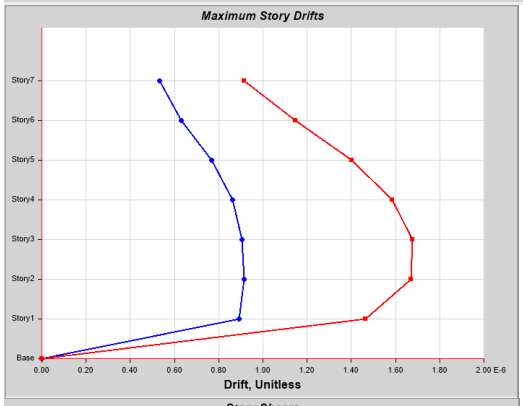





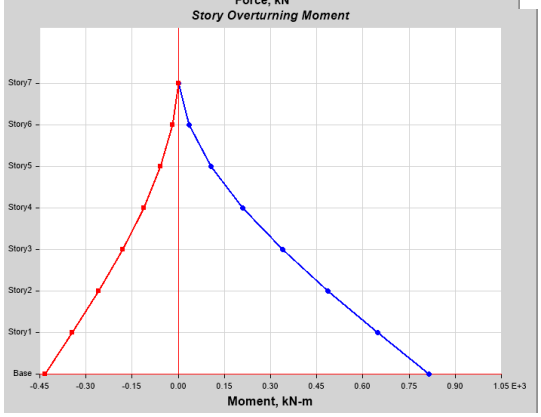
Deflection on top beam

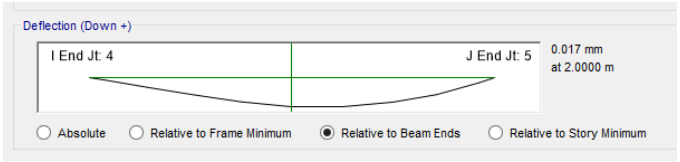
2.X Braced



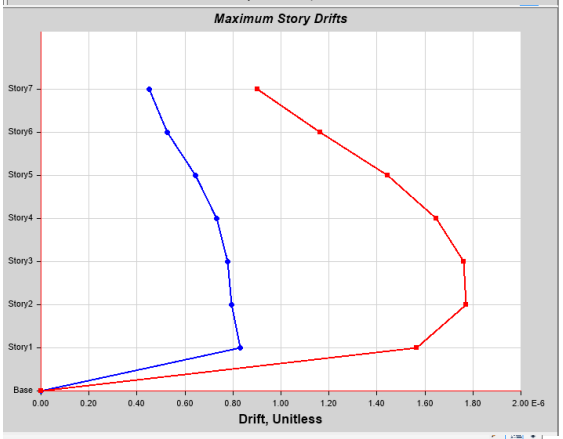



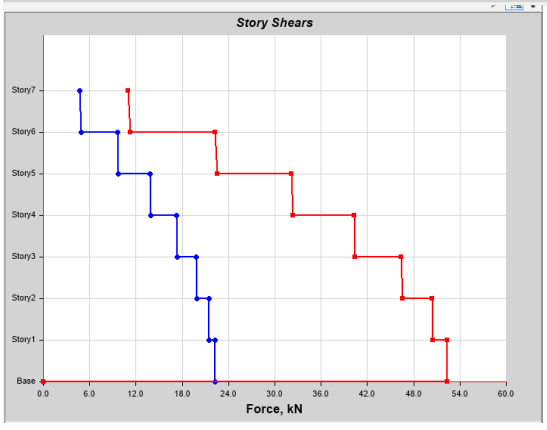


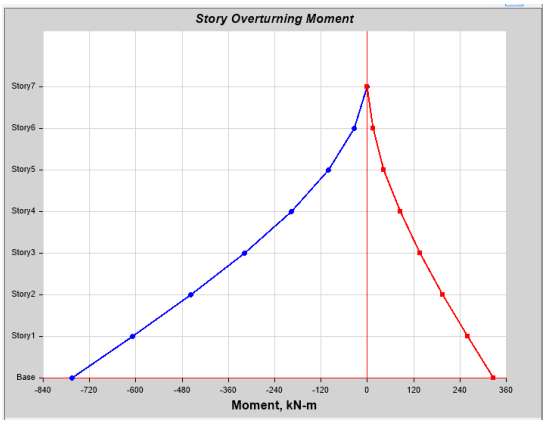


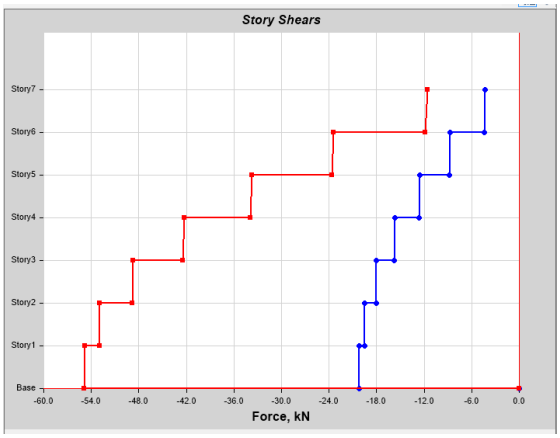




3.V bracing

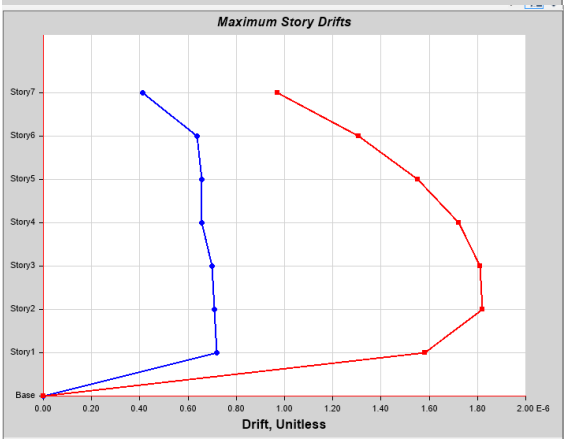



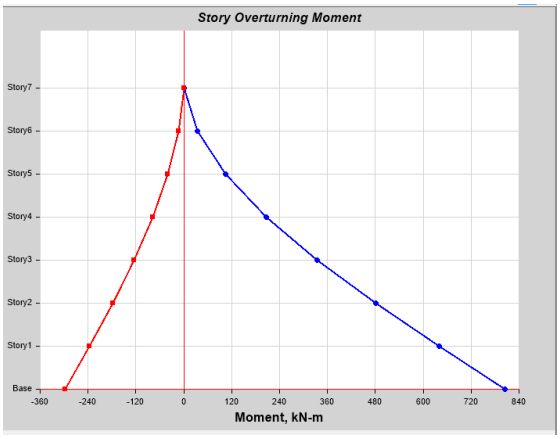





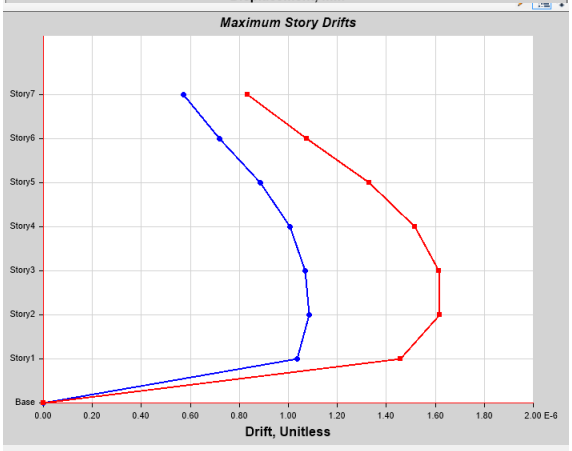



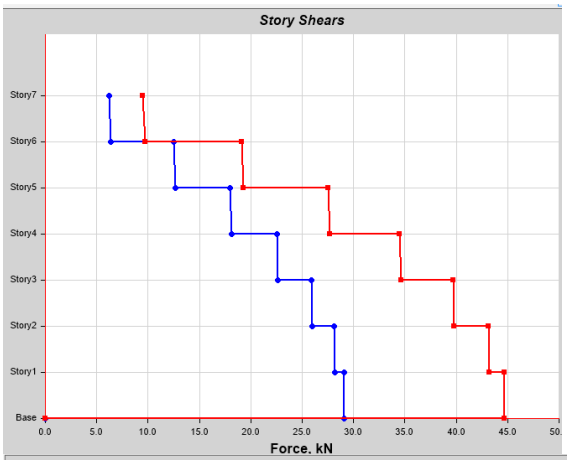

4.Inverted V bracing

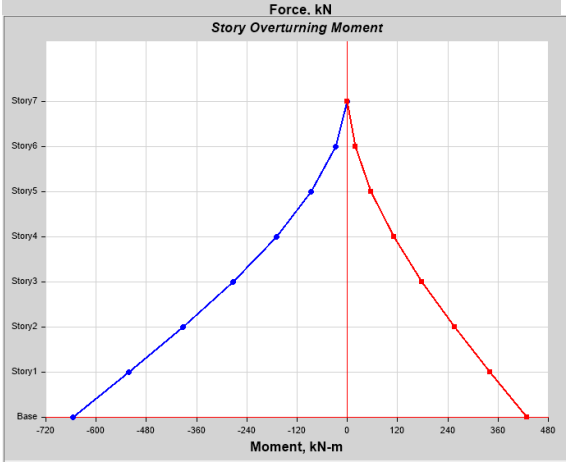



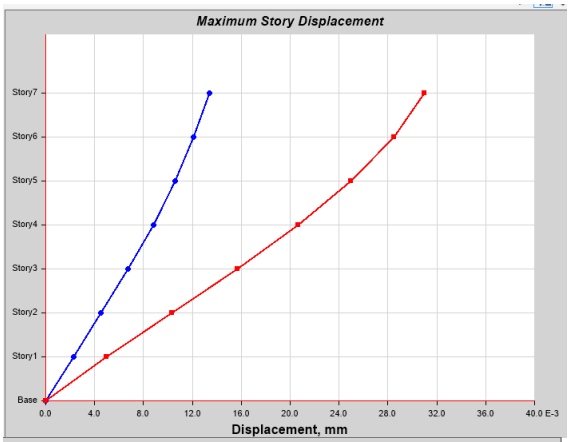

5. Eccen forward bracing

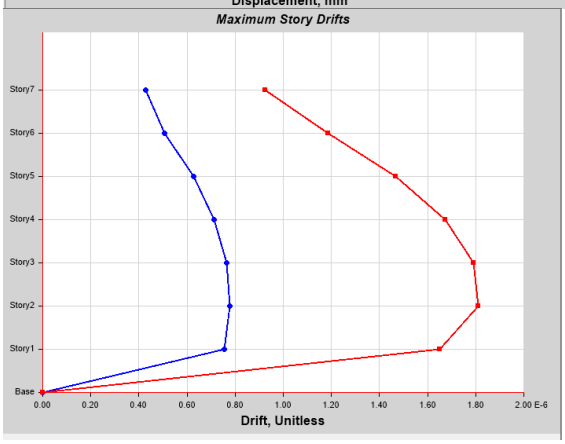



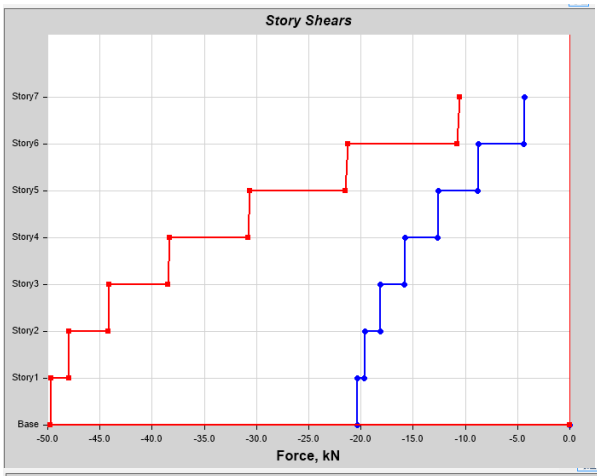


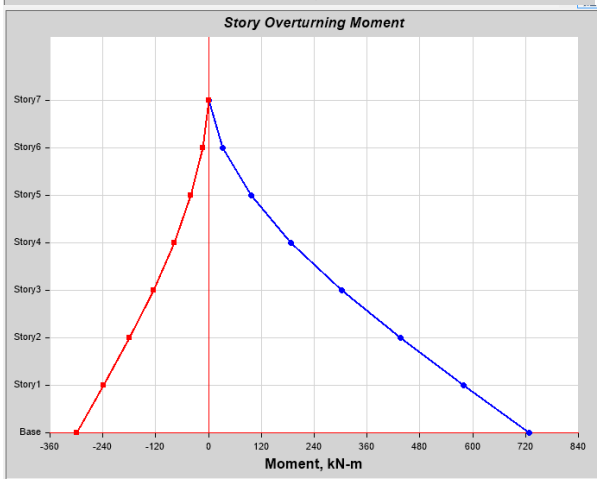




6.Eccen backward bracing




## VI. CONCLUSION

Story displacement is the absolute value of the displacement of the story under the action of lateral force.Story shear is the graph showing how much lateral load,beit wind or seismic is acting per story.Story drift is the lateral displacement of a floor relative to the floor below.Overturning moment at any horizontal plane is the momemt on the structure as a whole resulting from the dynamic earthquake forces above the plane,giving due regard to signs of the modal forces.
Various models have been analysed and results are found.

- Maximum story displacement is found less in inverted v bracings type.
  It is found increasing from base to top story.
- Story shear is found less in bare bracings structure.
  Story shear is high in base floors and gradually reduces to top floors.
- Maximum story drift is found less in X bracings and V bracings.
  Story drifts increases from bottom to top stories.
- Story overturning moment is less in bare bracings frame.
  It is found high at base floors the story overturning moments reduces to zero at the top floor.
- Displacement (downward) is found less for X bracing structures.

By providing the bracings on the structure stiffness of the structure is increased.The analysis based on structural

properties were applied on various models with and without braces.It is found that bracings on structure provides more strength and stability.

As per the requirement V type bracings,X type bracings or in case inverted V type bracings can be selected.

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