# DESIGN AND ANALYSIS OF TELECOMMUNICATION TOWER FOR LATERAL LOADS WITH DIFFERENT BRACING SYSTEMS USING E-TABS

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***Abstract:*** Over the decades, the demand for wireless and broadcast communication has spurred a theatrical increase in communication tower construction and maintenance. The comparative study analysis is being carried out for dissimilar heights of towers using different bracing patterns for Wind and Earthquake.Every Special moment resisting frames undergo lateral displacement because they are susceptible to large lateral loading. The problems associated with this are the P-Δ effect and the ductile and brittle failure at beams and columns connections. As a significance engineers have increasingly turned to braced steel frames as an economical means for earthquake resistant loads. The present study consists of three models. Model 1 is a Single bracing as per IS 800-2007. Model 2 and 3 is Double bracing and portal bracing frame, considered for study.Performance of each frame is studied through Equivalent static analysis.

***IndexTerms* - Bracing; Portal frame; Lateral loading; equivalent static analysis.**

## I. INTRODUCTION

Provide an adequate background, context of the problems based on the literature review. State In the present time, Steel structure plays a vital role in the edifice industry. Prior earthquakes in India confirm that not merely non-engineered structures except engineered structures need to be deliberate in such a way that they perform well beneath seismic loading. Structural retort can be increased in Steel moment resisting frames by introducing steel bracings in the structural organism. Bracing can be applied as concentric bracing or unusual bracing. There are 'n' number of possibilities to dispose steel bracings, such as cross bracing 'X', diagonal bracing 'D', and 'V' type bracing.

Steel moment resisting frames lacking bracing, inelastic response collapse generally occurs at beam and feature connections. They resist tangential forces by flexure and shear in beams and columns i.e. by outline action. Under severe earthquake loading malleable fracture at beams and columns connections are familiar. Moment resisting frames enclose low resilient stiffness.So,to increase the structure response to lateral loading and good ductility properties to perform well under seismic loading concentric bracings can be provided. Beams, columns and bracings are arranged to form a vertical truss and then lateral loading is resisted by truss action. Bracings allow the system to obtain a great increase in lateral stiffness with minimal added weight. They develop ductility through inelastic action in braces. Failure occurs because of yielding of truss under tension or buckling of truss under compression.These failures can be compensated by use of Buckling Reinforced Braced frame (BRBs) or Self Centering Energy Dissipating frames (SCEDs).

## II. METHODOLOGY

- A through literature evaluation to understand the seismic appraisal of steel structures and application of Equivalent Static scrutiny.
- Lateral behavior of steel frames with various concentric bracings and eccentric bracing geometrical and structural details.
- Modeling the steel frame with various concentric bracing by computer software ETABS.
- To Carry out Equivalent Static analysis and Response Spectrum analysis on the models and arrive at conclusion.

### 2.1 Types Of Bracing Systems

#### 2.1.1 Single web system

It comprises either diagonals and struts or all diagonals. This system is particularly used for narrowbased towers, in cross-arm girders and for portal type of towers. Except for 66 kV single circuit towers,this system has little application for wide-based towers at higher voltages. **Figure (a)**

### 2.1.2 Double web or Warren system

This system is made up of diagonal cross bracings. Shear is equally distributed between the two diagonals, one in compression and the other in tension. Both the diagonals are designed for compression and tension in order to permit reversal of externally applied shear. The diagonal braces are connected at their cross points. Since the shear preface is carried by two members and critical length is approximately half that of a corresponding single web system. This system is used for both large and small towers and can be economically adopted throughout the shaft except in the lower one or two panels, where diamond or portal system of bracings is more suitable. **Figure (b)**

### 2.1.3 Pratt system

This system also contains diagonal cross bracings and, in addition, it has horizontal struts. These struts are subjected to compression and the shear is taken entirely by one diagonal in tension, the other diagonal acting like a redundant member. It is often economical to use the Pratt bracings for the bottom two or three panels and Warren bracings for the rest of the tower. **Figure (c)**

### 2.1.4 Portal system

The diagonals are necessarily designed for both tension and compression and, therefore, this arrangement provides more stiffness than the Pratt system. The advantage of this system is that the horizontal struts are supported at mid length by the diagonals. Like the Pratt system, this arrangement is also used for the bottom two or three panels in conjunction withtheWarren system for the other panels. It is especially useful for heavy river-crossing towers.

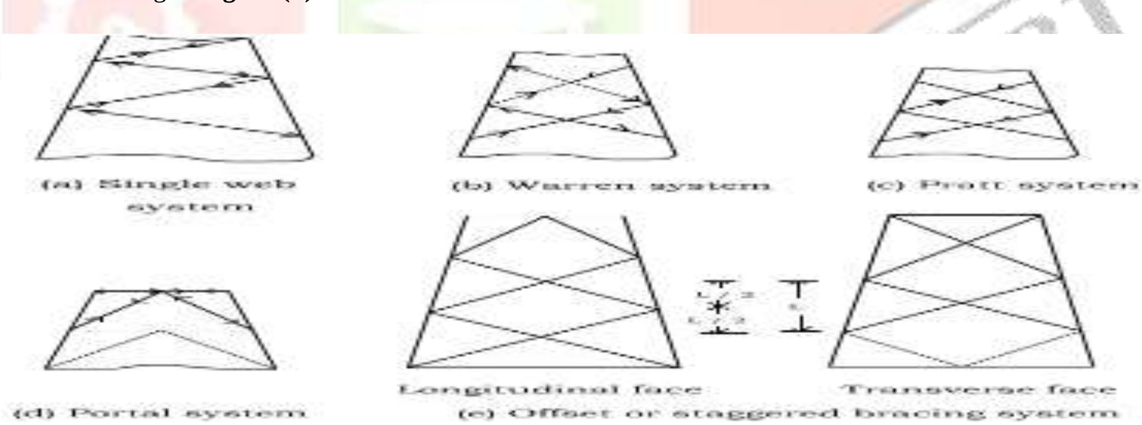
Where

p = longitudinal spacing (stagger), that is, the distance between two successive holes in the line of holes under consideration,

g = transverse spacing (gauge), that is, the distance between the same two consecutive holes as for p, and

d = diameter of holes.

For holes in opposite legs of angles, the value of 'g' should be the sum of the gauges from the back of the angle less the thickness of the angle. **Figure (d)**




## III. RESULTS AND DISCUSSION

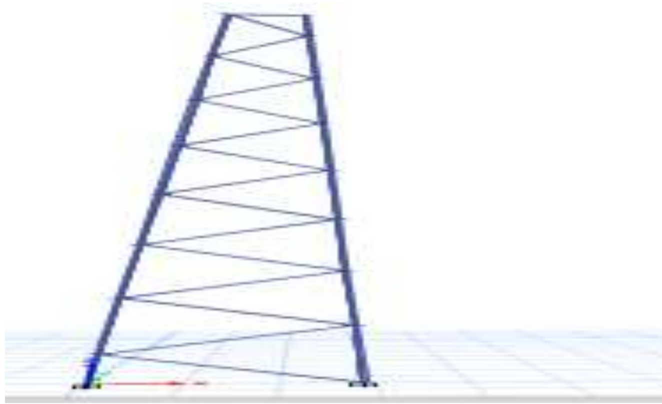


Fig 1 shows the single web system - 2D

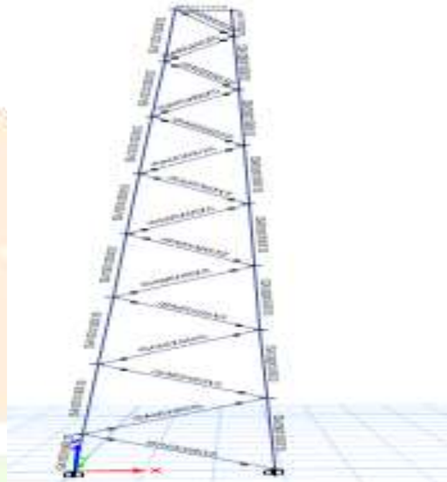


Fig 2 shows the single web system - 2D Loading Pattern.

**3.1 Single web system- 3 D**

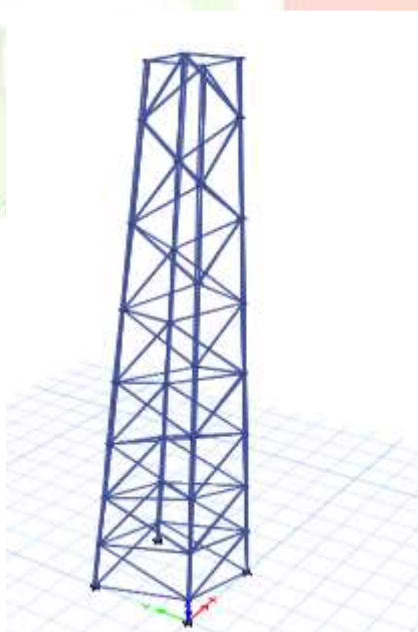


Fig 3 shows the single web system -3 D

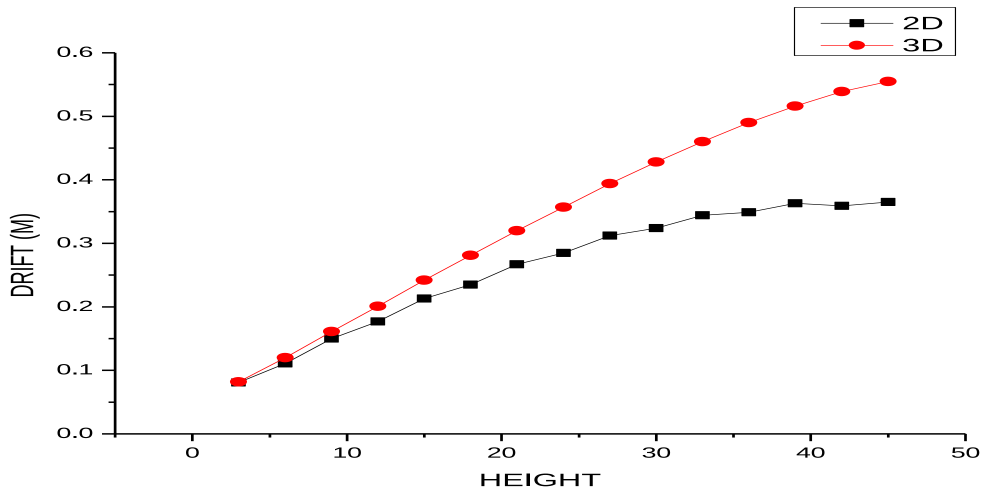



Fig 4 shows the single web system -3 Dand 2D

**3.1.2 BASE SHEAR**

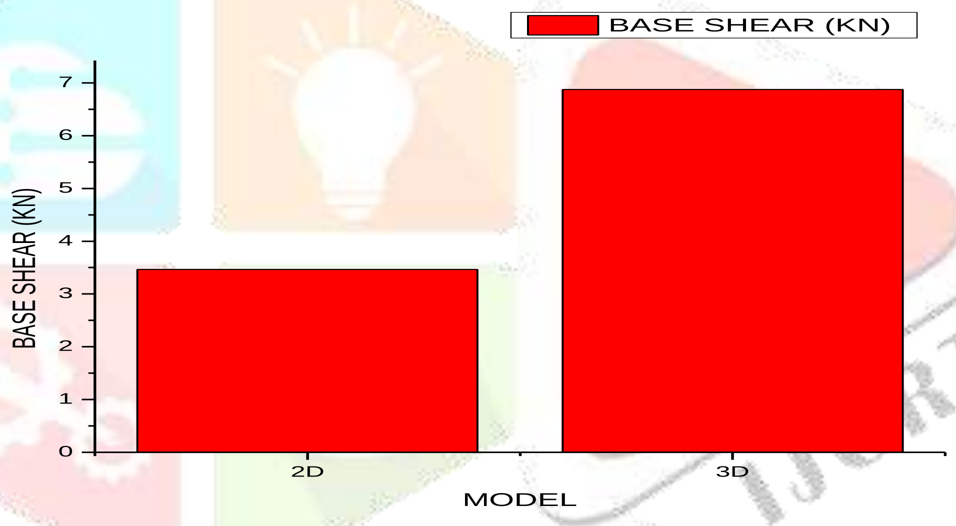



Fig 5 shows Base shear Comparison between 2D & 3D Single web system

Base shear Comparison between 2D & 3D Single web system

The above graph displays the difference between the base shears of two different models in which the 3d model has more base shear compared 2d model.

**3.2 Double Web System**

**3.2.1Double Web System -2D System**

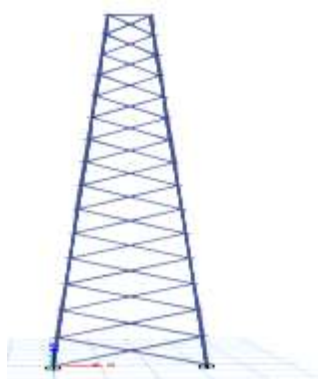


Fig 6 shows the 2D system of Double web System.

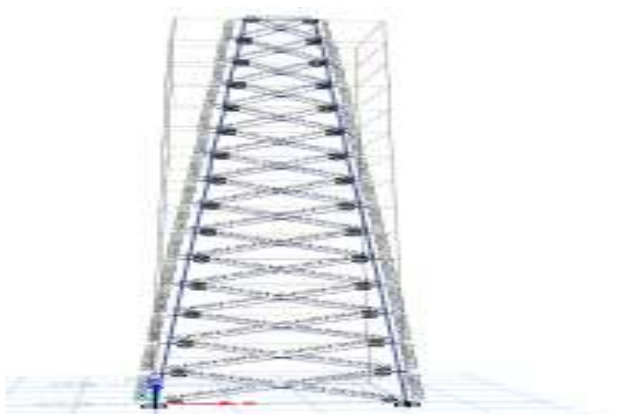


Fig 7 shows the 2D system Loading pattetrn of Double web System.

**3.2.2 Double web System-3D System**

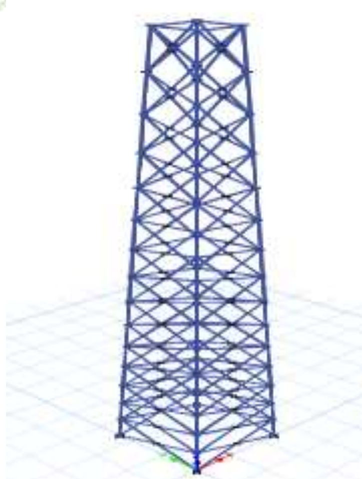


Fig 8 shows the 3D system of Double web System.

**3.2.3 Double 2D and 3D Base Shear**

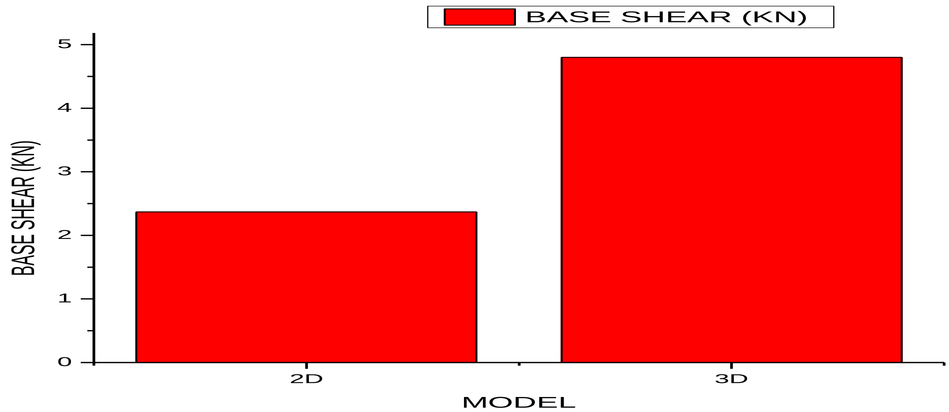



Fig 9 Base shear Comparison between 2D & 3D Double web system.

**3.2.4 Double 2D and 3D Drift**

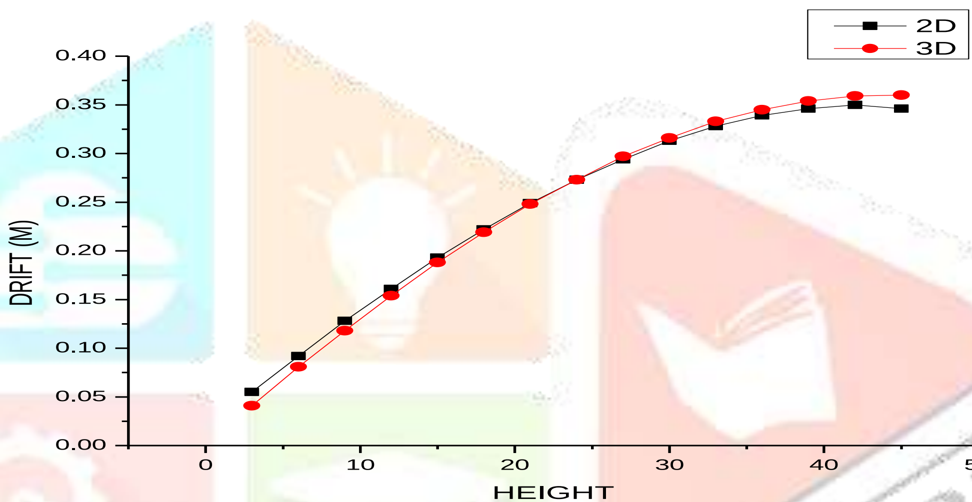



Fig 10 Drift Comparison between 2D & 3D Double web system.

**3.3 portal Web System**

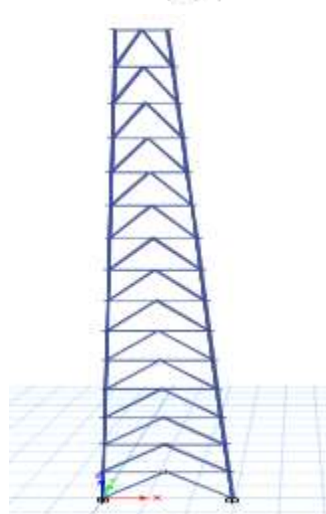


Fig 11 shows the 2D system Portal web System.

**3.3.1 Portal web System-2D  Loading pattern**

Fig 12  shows the 2D system of Loading patter of Portal web System.

**3.3.2 Portal web System-3D  Loading pattern**

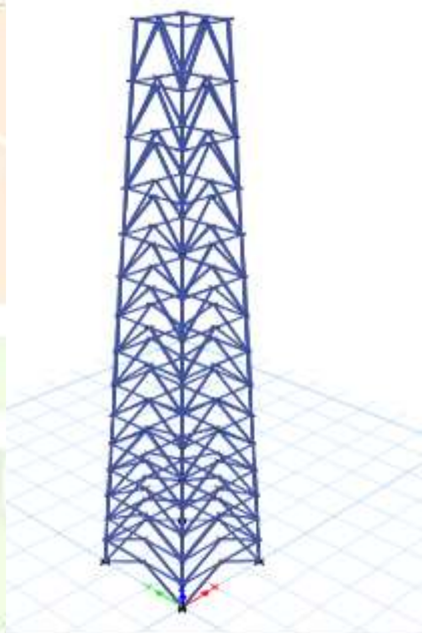


Fig13  shows the 3D system Portal web System.

**3.3.2.1 Portal 2D And 3D Base Shear**

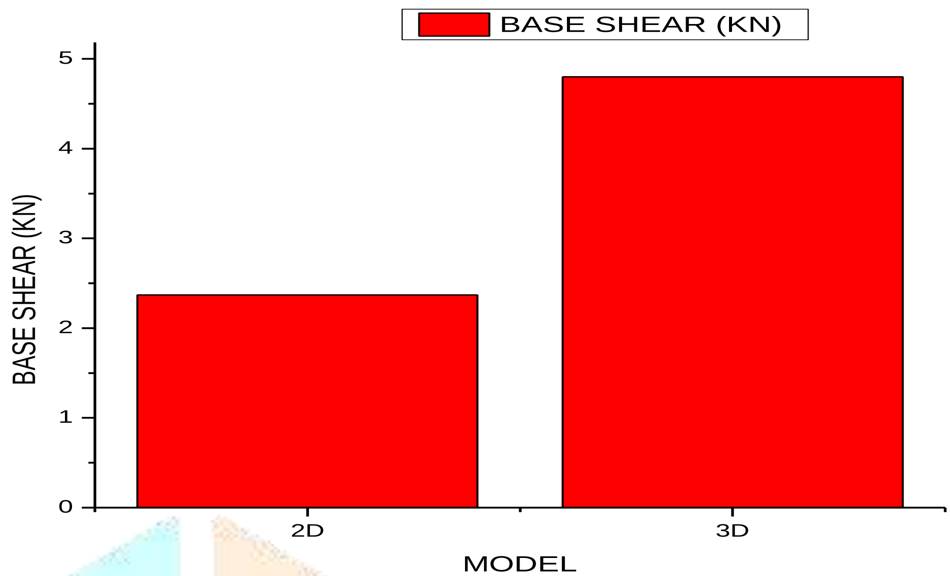



Fig 14 Base shear Comparison between 2D & 3D Portal web system.

**3.3.2.1 Portal 2D And 3D Drift**

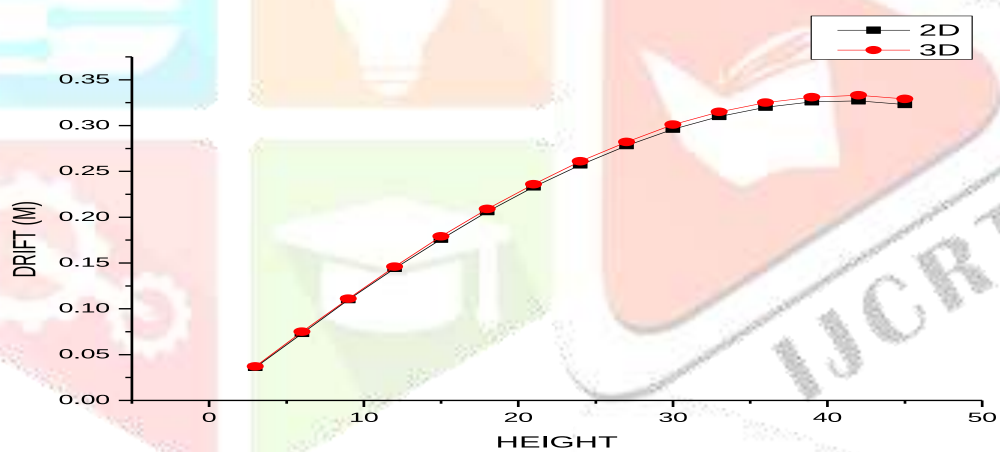



Fig 15 Drift Comparison between 2D & 3D Portal web system.

**3.4 Base Shear Of Single Web, Double Web And Portal System-2D**

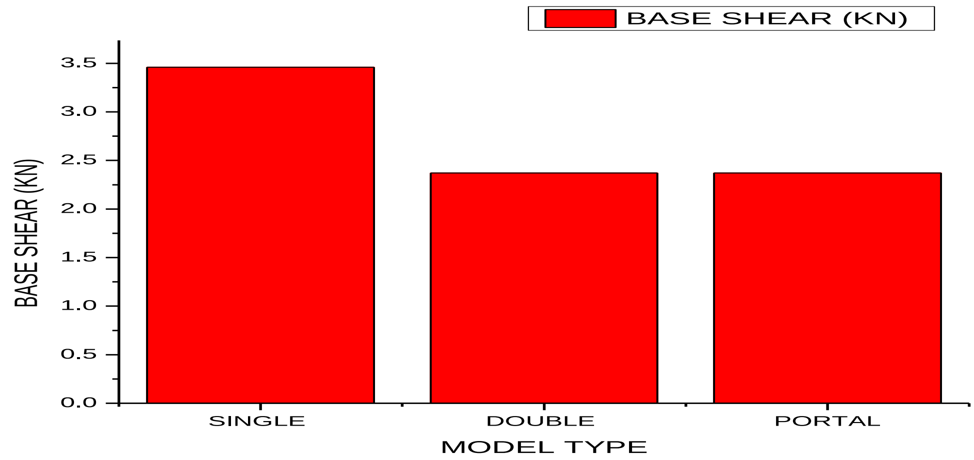



Fig 16 Comparison between 2D- Base Shear of Single Web, Double Web and Portal System.

**3.4.1 Base Shear Of Single Web, Double Web And Portal System-2D-Total Weight**

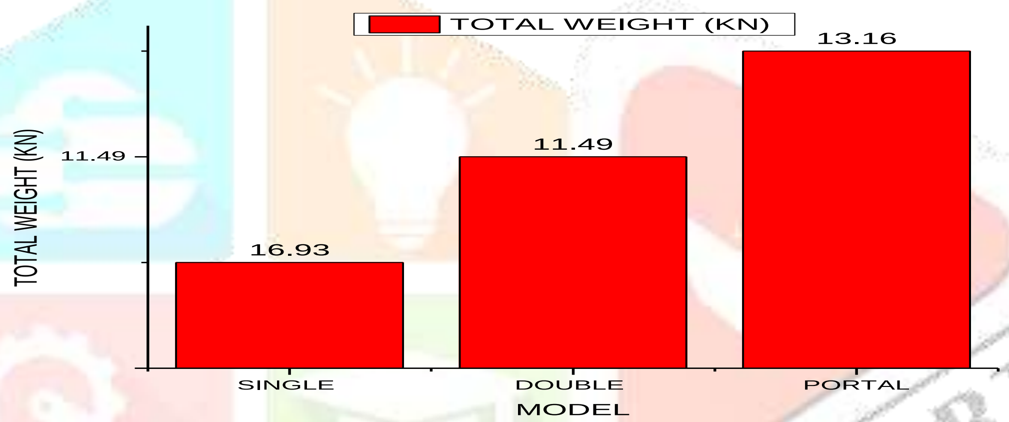



Fig 17 Comparison between 2D-Total weight of Single Web, Double Web and Portal System.

**3.4.2 Base Shear Of Single Web, Double Web And Portal System-2D-Drift**

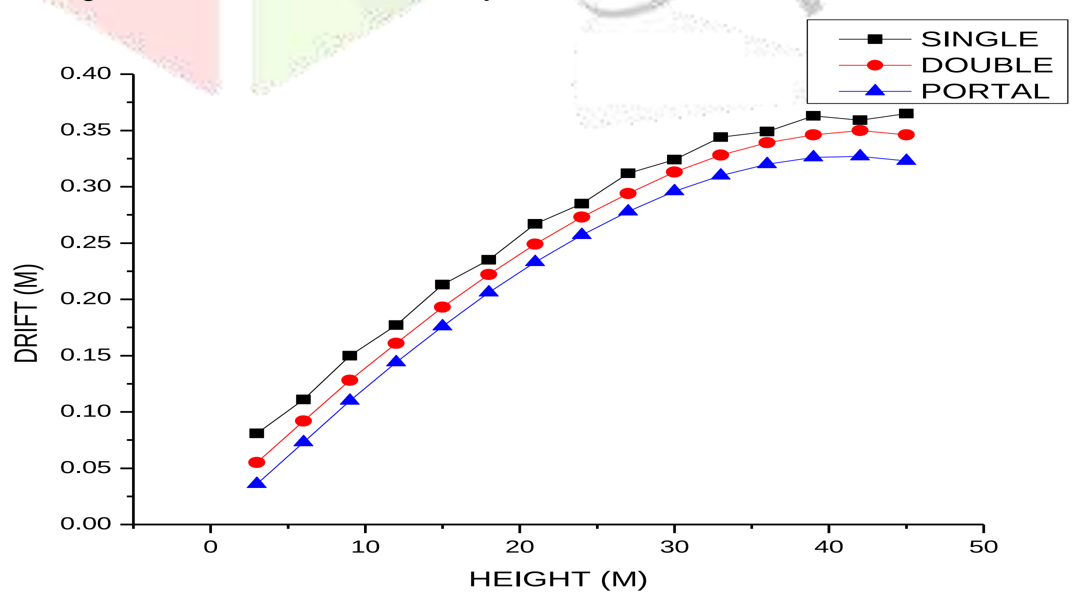


Fig 18 Comparison between 2 D-Drift of Single Web, Double Web and Portal System.

**3.5 Base Shear Of Single Web, Double Web And Portal System-3D**

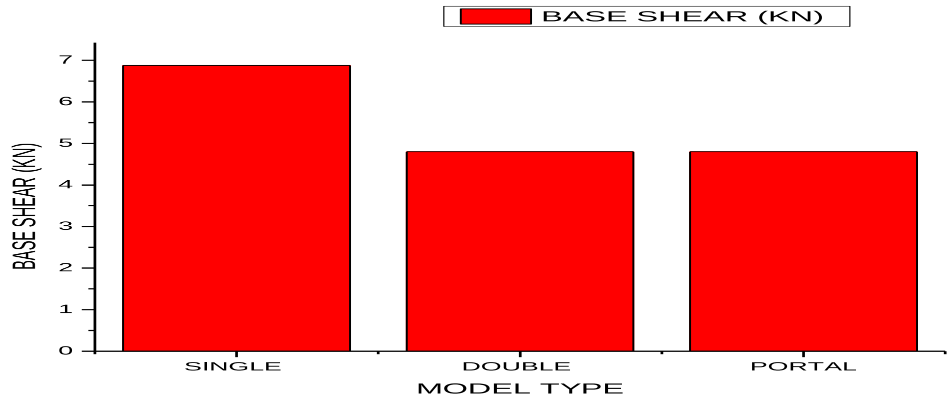



Fig 19 Comparison between 3D Total weight of Single Web, Double Web and Portal System.

**3.5.1 Single Web, Double Web And Portal System-3D – Drift**

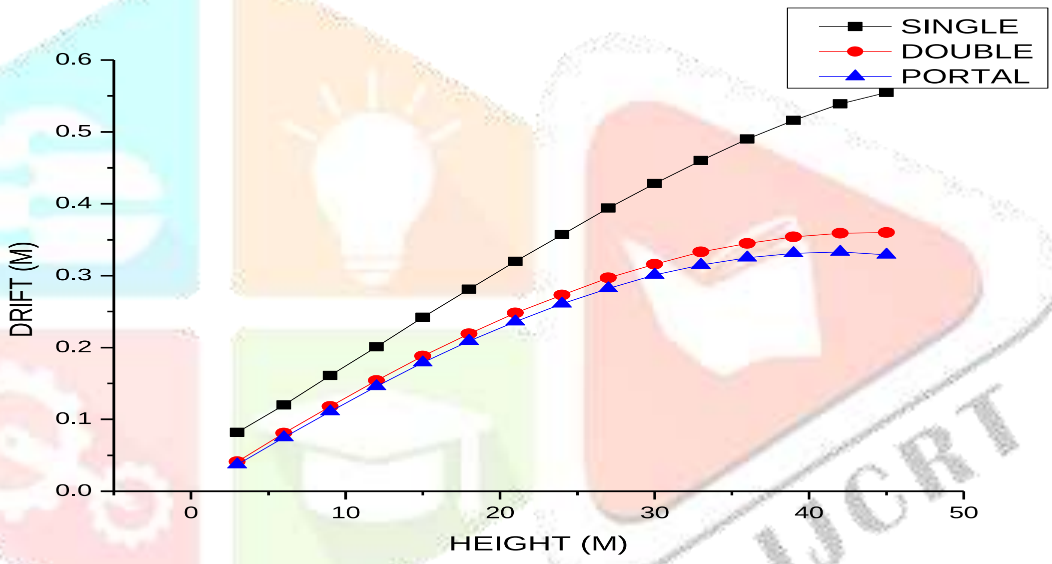



Fig 20 Comparison between 3D Drift of Single Web, Double Web and Portal System.

**3.5.1 Single Web, Double Web And Portal System-3D – Total Weight**

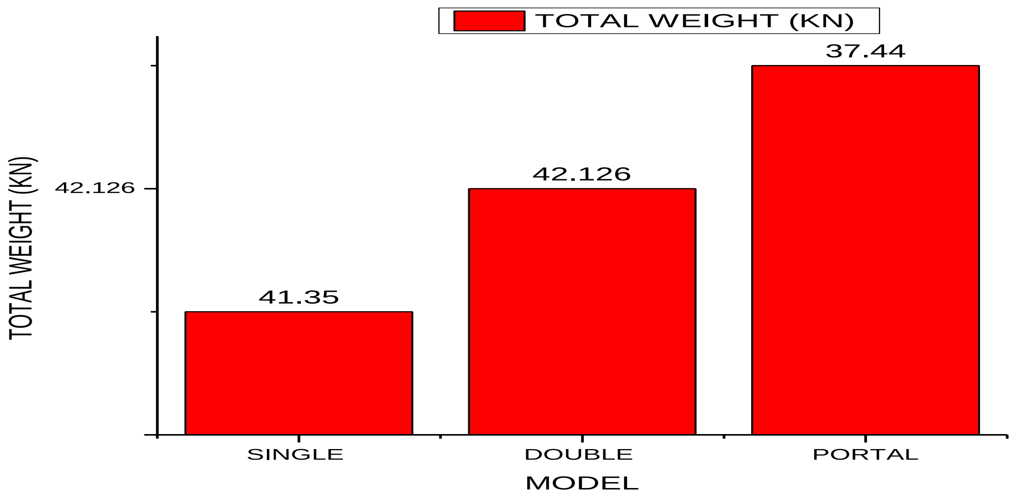



Fig 21Comparison between 3D Total weight of Single Web, Double Web and Portal System.

## IV. CONCLUSIONS

- According to analysis, result the single web type bracing system is seems to be the optimized bracing for lateral loads on steel towers. Results shown above will confirm that the total weight or material consumption for single web type bracing is less compared with other types of bracings.
- The Displacements were compared with EQX and WLX and compared with different systems.
- The portal web system seemed to have had the maximum displacement.
- In the models both 2d and 3d portal web system has the most displacement irrespective to Load pattern.

## V. ACKNOWLEDGEMENT

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