PARAMETRIC ANALYSIS OF STEEL BRACING IN STEEL STRUCTURE SUBJECTED TO WIND LOAD

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Abstract— A structure is designed to resist all types of loads. To resist lateral loads building must be stifferand stronger. To achieve stiffness and to resist lateral loads cross sectional size of the bottom member gets increase because of which there is a restriction to height of the structure. Otherwise the section of the bottom storey will yield larger, hence in case of steel structure it will become tiresome to handle and installation become uneconomical. Several systems are there to resist lateral forces, more familiar are shear walls and bracings. This paper gives effect of wind as a lateral load on different co-centric bracing system. The bracing systems compared are Diagonal, V- bracing and Inverted V Bracing. For analysis purpose STAAD Pro V8i SS6 software used and several parameters were compared.

Index Terms— Lateral load, Shear wall, Bracing.

I. INTRODUCTION

The structure is subjected to different types of loading mainly gravity loads and horizontal loads. The gravity loads acting vertically downwards which includes dead load of the structure and live load. The horizontal loads are acting parallel to ground surface either in transverse direction or in lateral direction which includes loads due to Earthquake, wind loads etc.

Steel use inRCC structure increases the ductility of the section or member. In case of steel structures, the sizes of the section become lighter. Due to this vertical downward force gets reduced significantly. As vertical downward force reduces structure gets more susceptible to lateral loads, to resist this lateral loads different systems or structural components were used. In case of RCC structure very commonly shear wallsare provided and in case of steel structure bracings.

Bracings are member of the structure they are either eccentric or co-centric. Bracings are said to be co-centric if they are jointed at center of beam with column beam junction or direct column beam junction and eccentric if above condition not gets satisfied.

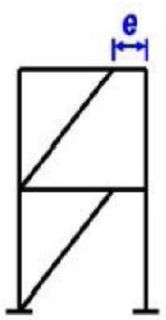

Figure 1: Eccentric bracing.

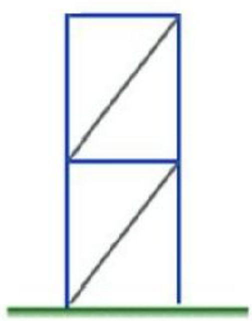

Figure2:Co-ccentric bracing

In current paper different types of co-centric bracings were compared under wind loading.

II. POROBLEM STATEMENT

For comparing the data assumed is as listed below. On basis of which only wind load as a lateral load applied on structure and analysis were carried out.

A. Geometrical Data

No. of bay in X – dir.:3
No. of bay in Z – dir.: 3,
Plan Dimension: 15m X 15 m,
Typical Storey Height: 3.0 m,
Bottom Storey Height: 3.0 m
Height of structure: 24 m
Number of storey: G + 7
Type of Building: Steel Structure

B. Loading Data

Slab thickness =200mm.
Live Load: 3kN/m^2
Basic wind speed: 44 m/sec
Terrain category: IV
Class: B
Location: Mumbai
Life of Structure: 50 years
Plain Terrain
Load combinations: 1.2DL+1.2LL+1.2WL

C. Member Size

All members having size of 200 mm * 200mm

III. LOAD CALCULATION

A. Dead Load calculations

Density of concrete =25kN/m^3
Hence, self-weight of Slab = 5 kN/m^2
Dead load on the outer beam =8.33 kN/m
Dead load on the inner beam=2 * 8.33=16.67 kN/m

B. Live load calculations

Since live load = 3 kN/m^2

Live load on the outer beam=5 kN/m
Live load on the inner beam=5*2=10 kN/m

C. Wind load calculation-

From IS 875(part 3)-1987
k_2 at 18m=0.76
k_2 at 21m=0.777
k_2 at 24m=0.828
Using $Vz=k_1 * k_2 * k_3 * V_b$
Where, Vz=design wind speed at any height z in m/s
k_1= probability factor(risk coefficient) =1.0
k_2= terrain, height and structure size factor and
k_3= topography factor =1.0
V_b= basic wind speed in m/s
Therefore, Vz at 18m=33.44 m/s
Vz at 21m=34.188 m/s
Vz at 24m=36.432 m/s
Using $Pz= 0.6 * Vz^2$
Where, Pz= design wind pressure in N/m2
$P_z$at 18m = 0.6709 kN/m^2
$P_z$at 21m = 0.7013 kN/m^2
P_z at 24m= 0.7937 kN/m^2

IV. RESULTS

Table 1 : Displacement in X-Direction

Height form Ground (m)	X-direction Displacement (mm)			
	Unbraced frame	Diagonal Bracing	V Bracing	Inverted V Bracing
24	17.577	1.268	0.37	0.318
21	17.077	1.532	0.322	0.282
18	16.377	1.442	0.274	0.244
15	15.555	1.286	0.226	0.205
12	13.306	1.091	0.177	0.161
9	10.307	0.859	0.126	0.116
6	6.702	0.595	0.078	0.071
3	2.761	0.305	0.033	0.026
0	0	0	0	0

Base shear	Unbraced frame	Diagonal Bracing	V Bracing	Inverted V Bracing
X - Direction	27.406	43.506	54.361	45.649
Z - Direction	27.393	45.157	63.21	54.841

Table 1 : Displacement in Z-Direction

Height form Ground (m)	Z-direction Displacement (mm)			
	Unbraced frame	Diagonal Bracing	V Bracing	Inverted V Bracing
24	19.356	3.249	1.119	1.053
21	18.794	3.322	1.169	1.121
18	17.611	3.237	1.16	1.124
15	15.843	3.039	1.108	1.082
12	13.439	2.739	1.022	1.005
9	10.406	2.319	0.887	0.879
6	6.785	1.702	0.671	0.67
3	2.809	0.823	0.333	0.338
0	0	0	0	0

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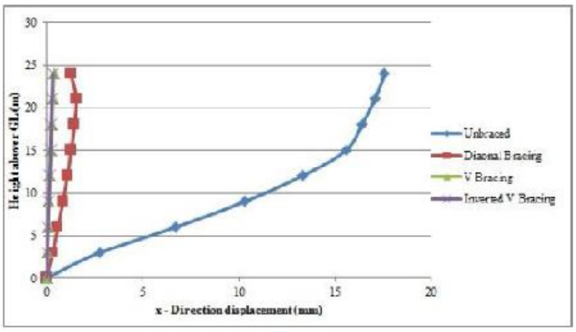
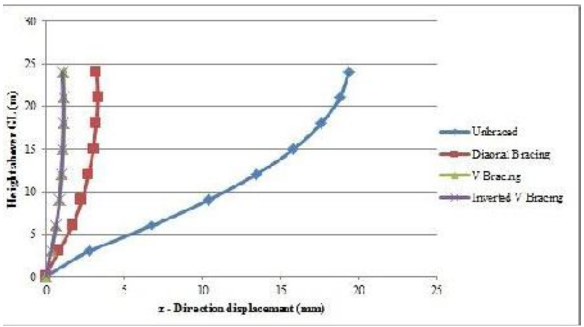


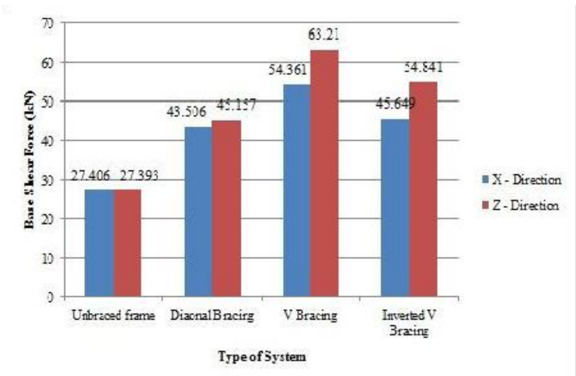
Graph 1 : X- Direction Displacement

- From above graph it is clear that due to diagonal bracing system reduction in displacement in X- direction is approximately 93%.
- In case of inverted V and V Bracing the reduction in displacement is about 98% and 97% respectively.



Graph 2 : Z- Direction Displacement

- From above graph it is clear that due to diagonal bracing system reduction in displacement is approximately 83% in case of diagonal bracing system.
- In case of inverted V and V Bracing the reduction in displacement is about 95%.



Graph 3 : Base shear

- Base shear increase due to bracings.
- Increase in base shear due to diagonal bracing is about 58%.
- In case of V – Bracings the base shear is more as compared to inverted V bracings.

CONCLUSION

1. Bracings increased the base shear of the frame.
2. Due to bracing indeterminacy increase which makes the structure tedious to solve.
3. Due to bracing the stiffness of the frame increases.
4. The V and Inverted V- Bracings are more effective as compared to Diagonal bracings
5. Diagonal bracings are require less material and less workability to install and hence preferable.

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