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COMPARISON OF CO-CENTRIC BRACING SYSTEM SUBJECTED TO WIND LOADING

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Abstract – *Any structure is made to resist different types of loading. The loads like dead load and live load acts vertically downward direction and hence helps to stabilize the structure, where as the structure is not only subjected to vertical forces but they may also be subjected to horizontal forces due to Earthquake, wind load, etc. Due to this horizontal forces structure is manly subjected to overturning or twisting. These horizontal forces are dynamic in nature. To resist this horizontal forces bracing plays vital role in case of steel structure. In current paper, analysis on effect of wind load on steel structure is evaluated. For evaluation different types of bracing systems are compared on basis of story displacement, story drift, base shear and force in bracing members.*

Key Words*: Dynamic load, Bracing, *Story displacement, Story drift, Base shear.

1. INTRODUCTION

As structural system subjected to different types of loading there are 'n' number of solutions are available to resist or to transfer the load from structure to ground. Bracings are one of the best solutions to resist lateral force transfer the lateral force to resist or to provide lateral stability to the structure. Bracings are axial member that is they are made to carry lateral forces. They are subjected to either compression or tension.

1.1 Types of bracings

Bracings are mostly a diagonal member which connects either beam-column junction or mid-point of beam or column span or length. On basis of that there are two types of bracing systems. First is eccentric and another is co-centric, as shown in figure.

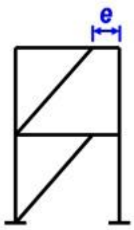


Figure 1: Eccentric bracing

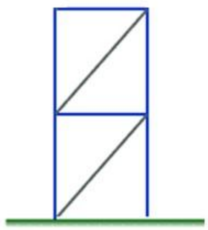


Figure 2:Co-ccentric bracing (Diagonal bracing)

In current paper different types of co-centric bracings were analyzed that is; diagonal bracing, V – bracing, Inverted V bracing.

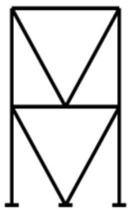


Figure 3:Co-ccentric bracing (V bracing)

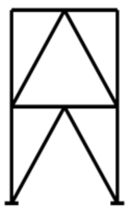


Figure 4:Co-ccentric bracing (Inverted V bracing)

2. PROLEM 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.

2.1 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

2.2 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
Member Size - 200 mm * 200mm

3. 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

4. MODELS IN STAAD Pro.

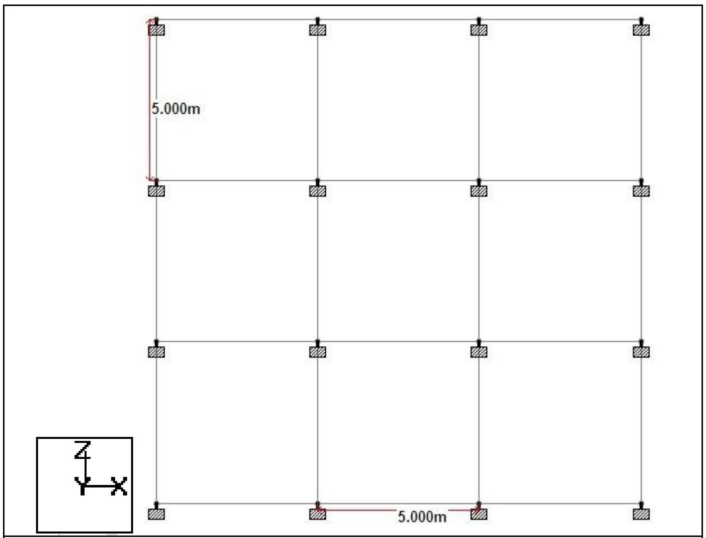


Figure 5 Plan view

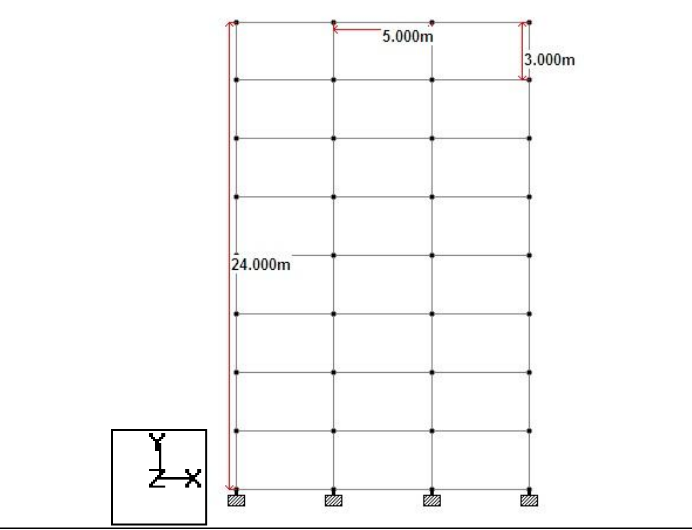


Figure 6 : Front view of Un-braced frame

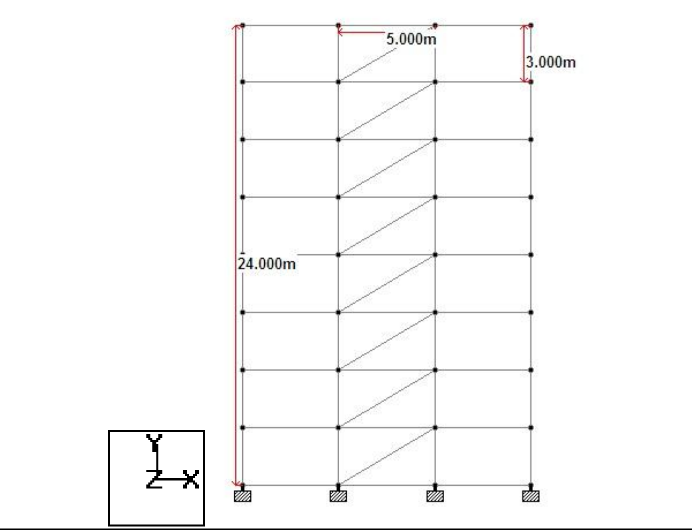


Figure 7 : Front view of Diagonal brace frame

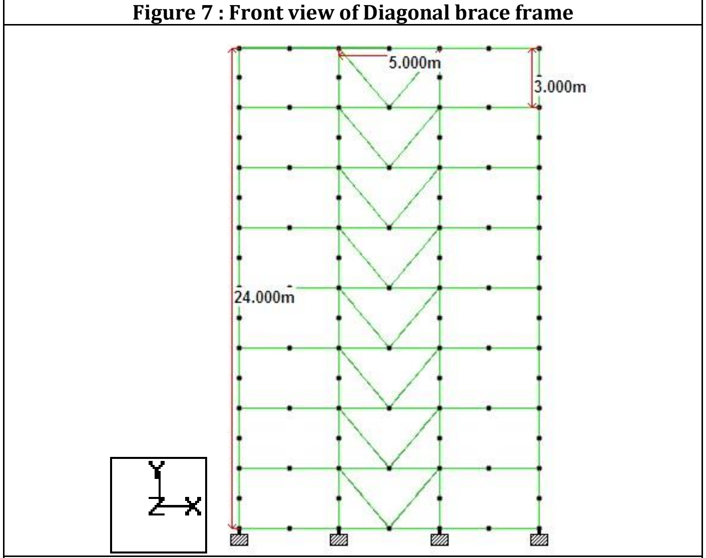


Figure 8 : Front view of V- brace frame

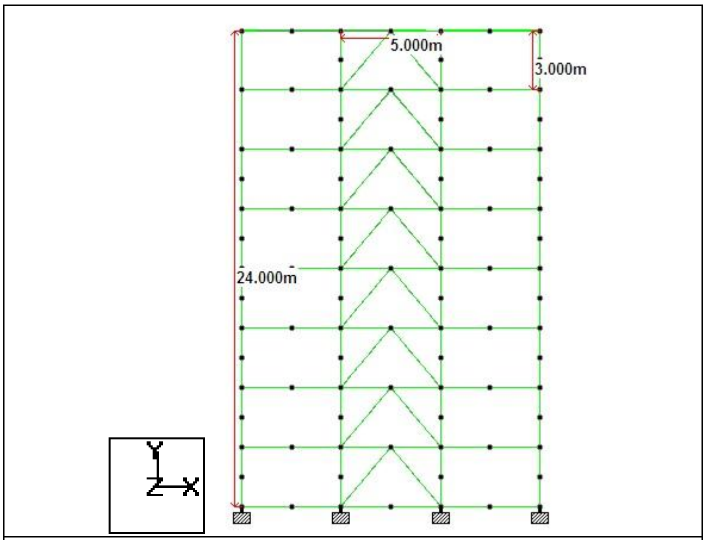
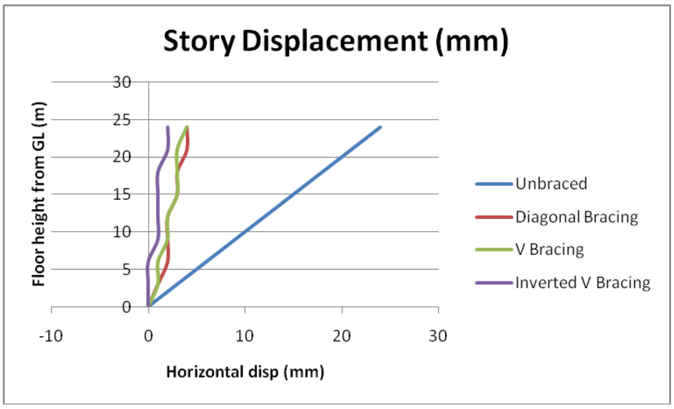


Figure 9 : Front view of Inverted V- brace frame

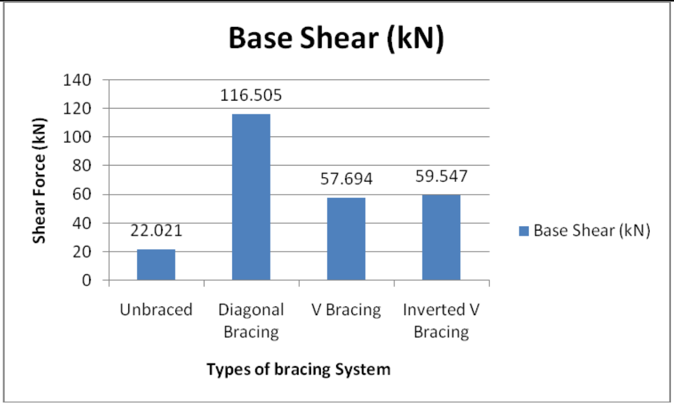
5. RESULTS AND GRAPHS

Story Displacement (mm)				
Height (m)	Unbraced farme	Diagonal Bracing	V Bracing	Inverted V Bracing
24	20	4	4	2
21	19	4	3	2
18	18	3	3	1
15	16	3	3	1
12	13	2	2	1
9	10	2	2	1
6	7	2	1	0
3	3	1	1	0
0	0	0	0	0



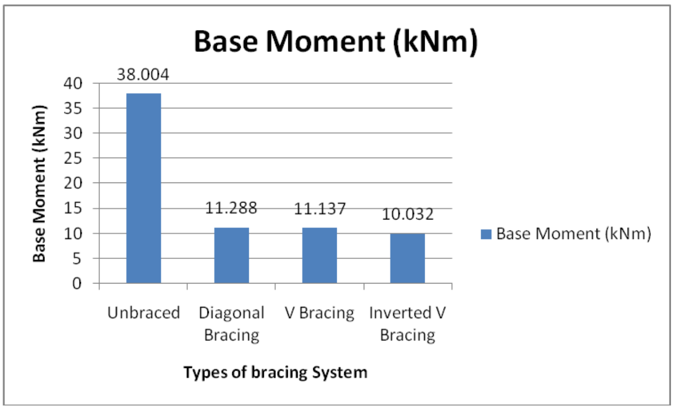
Graph 1: Story displacement

Base Shear (kN)			
Unbraced farme	Diagonal Bracing	V Bracing	Inverted V Bracing
22.021	116.505	57.694	59.547



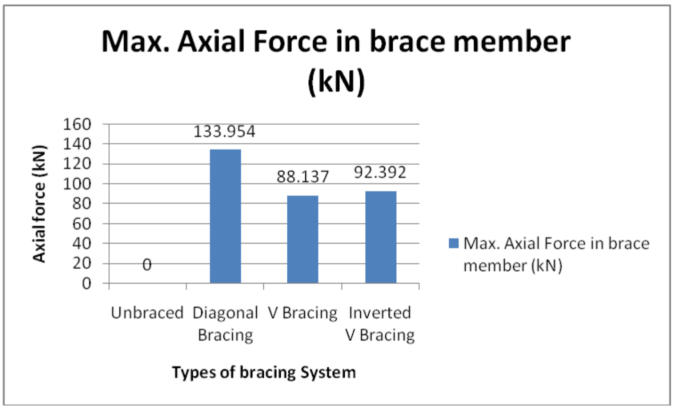
Graph 2: Base Shear

Base Moment (kNm)			
Unbraced farme	Diagonal Bracing	V Bracing	Inverted V Bracing
38.004	11.288	11.137	10.032



Graph 3: Base Moment

Max. Axial Force in brace member (kN)			
Unbraced farme	Diagonal Bracing	V Bracing	Inverted V Bracing
--	133.954	88.137	92.392



Graph 4: Base Moment

Story Drift (mm)				
Height (m)	**Unbraced farme**	**Diagonal Bracing**	**V Bracing**	**Inverted V Bracing**
24	1	0	1	0
21	1	1	0	1
18	2	0	0	0
15	3	0	1	0
12	3	0	0	0
9	3	1	1	1
6	4	0	0	0
3	3	0	1	0
0	0	0	0	0

6. CONCLUSIONS

1. Displacement due to wind loading were effectively resisted by bracing in which inverted v bracing were reduce more displacement than other type of bracings.
2. Due to bracing horizontal shear force at base of footing increases and base moment reduces.
3. Axial force in diagonal bracing is more as compare to other type of bracings.
4. Due to bracing indeterminacy of the structure increases also base shear is increases. On other side structure gets stiffer to resist horizontal displacement.

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