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COMPARATIVE STUDY OF "INVERTED V" and "V" TYPE RCC BRACING SYSTEM IN RCC MULTISTORY BUILDING

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Abstract —Due to the present increase in world population, people in this world tend to occupy available locations present in any zone which also include zones falling in the high seismic zone categories. The buildings constructed in such zones must be analyzed and designed to withstand these earthquakes. Bracing systems is very efficient and unyielding lateral load resisting system. Bracing systems serves as one of the component in buildings for increasing stiffness and strength to guard buildings from incidence caused by natural forces like earthquake. Braced frames widen their resistance to lateral forces by the bracing action of inclined members. The braces stimulate forces in the associated beams and columns so that all works like a truss which results in smaller sizes of beam and column sections that turns out to be economical. In this study, G+14 storey building model has been analyzed considering "Inverted V" and "V" type RCC bracing system under seismic loadings using STADD PRO for analysis. Results are concluded by comparison of storey displacement, storey drift and base shear for fixed base building.

Keywords- Braced Structural System; "Inverted V" and "V" Bracing; Earthquake resisting structure; Braced Structure; RCC Bracing;

I. INTRODUCTION

A building must have a complete structural system capable of carrying all gravity loads to its foundation in life span of building. An ideal multi-story building which is designed to resist lateral loads due to earthquake would be symmetric in distribution of mass and stiffness in plan at every story and as well as along the height of the building. In order to make multi-story structures stronger and stiffer, which are more susceptible to earthquake and wind forces, the cross sections of the member increases from bottom to top this makes the structure uneconomical owing to safety of structure. Therefore, it is necessary to provide special mechanism that improves lateral stability of the structure. Bracing is a highly efficient and economical method of resisting lateral forces, which stimulate forces in the associated beams and columns so that all work as one like a truss with all members subjected to stresses that ultimately results for minimum member sizes in providing stiffness and strength.

II. ANALYSIS OF RCC BRACED AND BARE FRAME STRUCTURE

2.1 Geometrical Data

No. Of bay in X – dir.:6,	Bottom Storey Height: 3.0 m,
No. Of bay in Y – dir.: 3,	Height of structure: 45 m,
Plan Dimension: 30 m x 15 m,	Number of storey: G +14,
Typical Storey Height: 3.0 m,	Type of Building: Residential building,
Grade of concrete :M25	Fe :415

2.2 Loading Data

2.2.1 Dead Load :

a. Self weight of Slab = 4.75 kN/m^2

b. Floor Finish load = 1 kN/m^2

c. Wall Load in X -Z direction= 11.75 kN/m

2.2.2 Live Load: 2 kN/m^2

2.2.3 Earthquake load in X direction and Y direction

Zone factor: IV, Importance factor : 1, Response reduction factor : 5

2.2.4 Wind Load

Basic wind speed: 47 m/sec, Terrain category : II, Class : C, Risk coefficient factor : 1.0, Topography factor k3 : 1.0

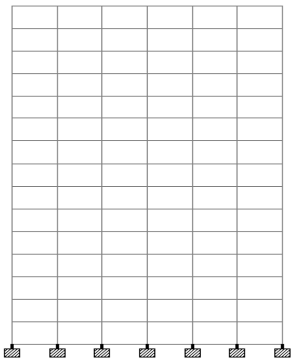
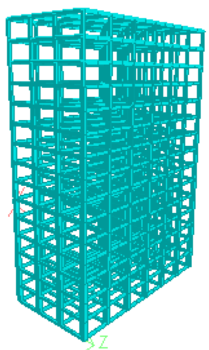
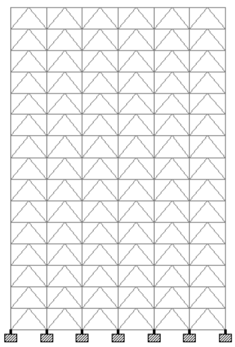
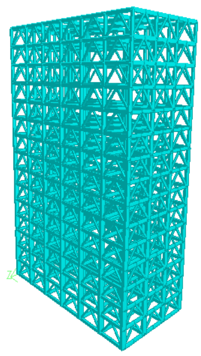
2.3 Member Size Data

Table 1 G + 14 Story RCC Building Section Size

G + 14 Story RCC Building			
Storey	Column Size (mm)	Beam Size (mm)	Bracing Size (mm)
Story 1 to Story 3	900 X 450	300 X 450	230 X 230
Story 4 to Story 6	750 X 450	300 X 450	230 X 230
Story 7 to Story 9	600 X 450	300 X 450	230 X 230
Story 10 to Story 12	600 X 300	300 X 450	230 X 230
Story 13 to Story 15	450 X 300	300 X 450	230 X 230

2.3 Model Details :

The effectiveness of bracing system is evaluated to find out the most effective bracing system. This bracing system are use to resist the lateral forces and their orientation is done by using STAAD Pro. The gravity loads and lateral loads acting on the structure are considered as per Indian Standard Codal provisions.

Type	Front view	3D
Bare Frame		
Model I Inverted V RCC Braced		

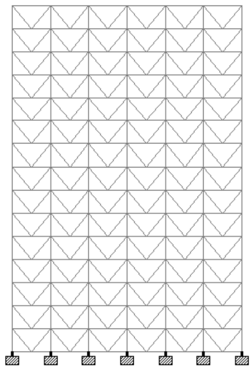
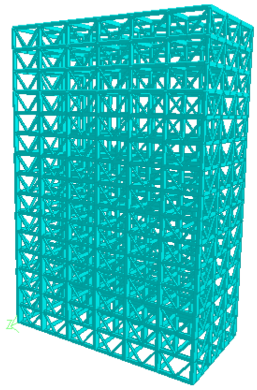
Model II V RCC Braced		

Fig. 2 Models

III. Analysis And Results

The static and dynamic analysis is carried out considering wind loads and earthquake loads on structures. Wind analysis of structure is performed as per IS: 875(III) -1987 using STAAD Pro. V8i.

Comparative analysis of conventional RCC structural system and RCC braced RCC structural system is compared in terms of base shear storey displacement, and storey drift are presented for all buildings.

Table 2 Base Shear

Base Shear (kN)			
Model of Structure	Bare Frame	Inverted V Model I	V Model II
ESA X Dir	2520.04	2635.96	2635.96
ESA Y Dir	1776.1	1857.73	1857.73
RSA X Dir	2530.4	2632.47	2632.4

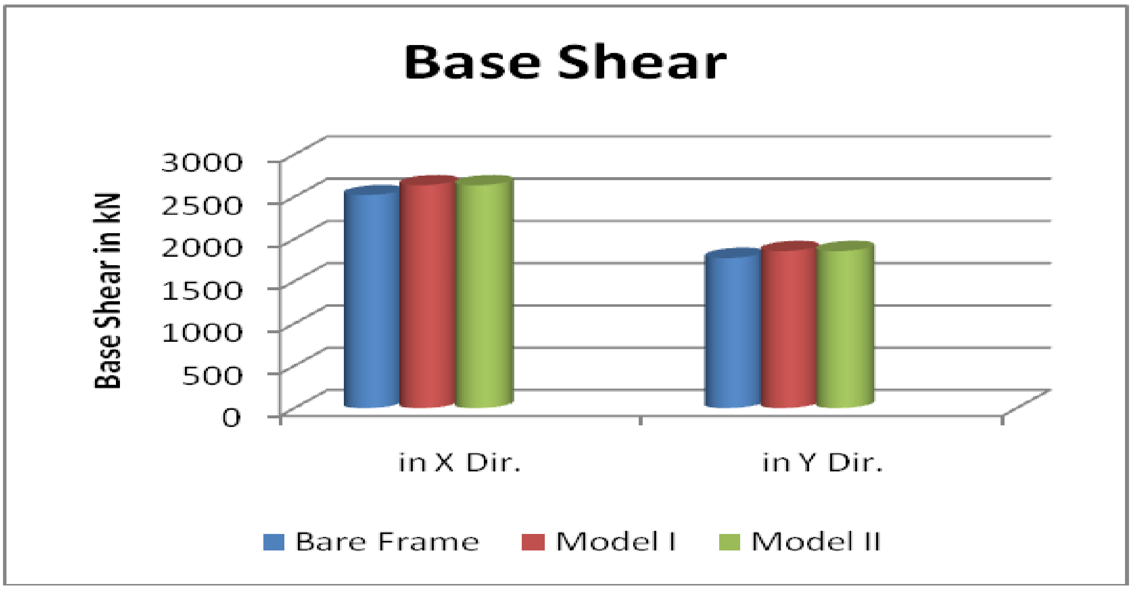
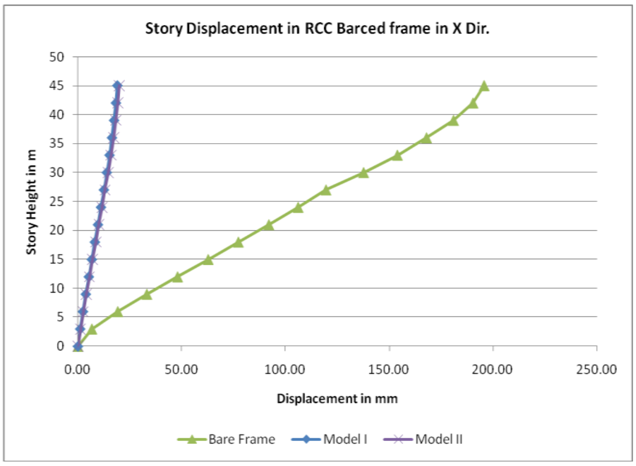


Fig. 3 Base Shear

Table 3 Story Displacement

Story Displacement (mm)							
Story	Height (m)	Bare Frame		Model I		Model II	
		X Dir.	Y Dir.	X Dir.	Y Dir.	X Dir.	Y Dir.
Story 15	45	195.77	122.52	19.00	29.51	20.08	31.57
Story 14	42	190.41	118.90	18.30	28.09	19.34	30.06
Story 13	39	181.01	113.19	17.43	26.45	18.40	28.28
Story 12	36	168.00	105.48	16.39	24.56	17.29	26.24
Story 11	33	153.97	97.64	15.21	22.54	16.03	24.08
Story 10	30	137.68	88.76	13.91	20.37	14.66	21.76
Story 9	27	119.56	78.95	12.52	18.09	13.19	19.33
Story 8	24	106.15	68.97	11.11	15.78	11.72	16.88
Story 7	21	92.02	58.50	9.65	13.44	10.18	14.40
Story 6	18	77.30	47.70	8.16	11.10	8.63	11.92
Story 5	15	62.78	37.35	6.69	8.84	7.09	9.53
Story 4	12	48.02	27.16	5.22	6.65	5.57	7.19
Story 3	9	33.22	17.55	3.79	4.56	4.07	4.96
Story 2	6	19.20	9.26	2.42	2.64	2.63	2.90
Story 1	3	6.72	2.83	1.08	0.94	1.22	1.06
Base	0	0.00	0.00	0.00	0.00	0.00	0.00



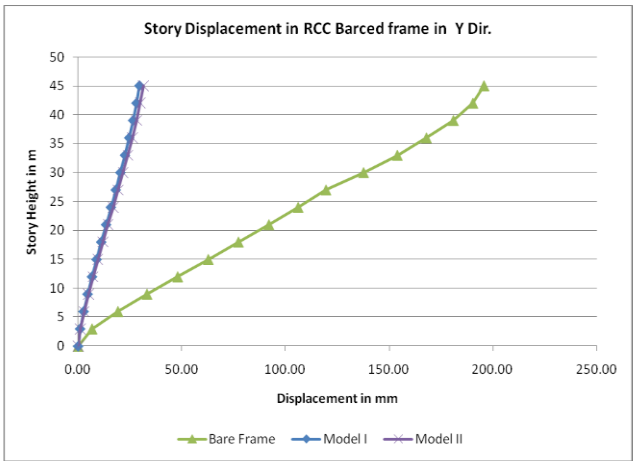
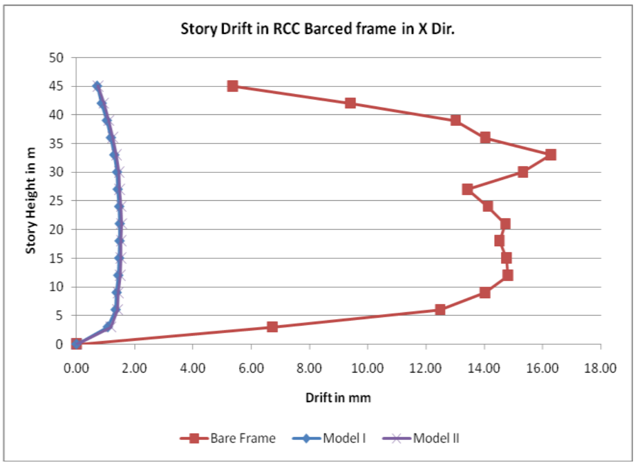


Fig. 4 Story Displacement

Table 4 Story Drift

Story Drift in RCC Braced model (mm)							
Story	Height (m)	Bare Frame		Model I		Model II	
		X Dir.	Y Dir.	X Dir.	Y Dir.	X Dir.	Y Dir.
Story 15	45	5.36	3.63	0.71	1.42	0.74	1.51
Story 14	42	9.40	5.71	0.87	1.64	0.94	1.78
Story 13	39	13.01	7.71	1.04	1.89	1.12	2.03
Story 12	36	14.03	7.84	1.18	2.02	1.25	2.17
Story 11	33	16.29	8.88	1.30	2.17	1.37	2.32
Story 10	30	15.33	9.81	1.39	2.28	1.47	2.43
Story 9	27	13.42	9.98	1.41	2.31	1.48	2.45
Story 8	24	14.12	10.47	1.46	2.34	1.53	2.48
Story 7	21	14.72	10.81	1.48	2.34	1.55	2.48
Story 6	18	14.52	10.34	1.48	2.26	1.54	2.39
Story 5	15	14.76	10.19	1.46	2.19	1.53	2.33
Story 4	12	14.81	9.61	1.43	2.09	1.50	2.23
Story 3	9	14.02	8.28	1.38	1.92	1.44	2.06
Story 2	6	12.48	6.44	1.34	1.69	1.42	1.84
Story 1	3	6.72	2.83	1.08	0.94	1.18	1.04
Base	0	0.00	0.00	0.00	0.00	0.00	0.00



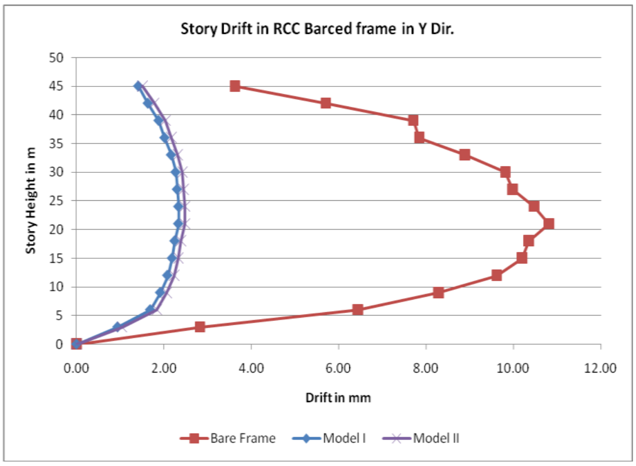


Fig. 5 Story Drift

Table 5 Quantity comparision

Quantity			
Model	**Concrete (cum)**	**Steel (kn)**	**Total steel (Kn)**
Bare Frame	806.9	1117.77	1117.77
Model I	931.4	886.364	886.364
Model II	931.2	929.928	929.928

IV. CONCLUSION

Analysis and study of results, it can be conclude that to reduce the forces from the column and to resist the lateral forces bracing is effective system. Increase in base shear is observed in RSA and also in braced frame while storey drifts, and displacement is reduced by using bracing.

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By using periphery fully braced the reduction in Story Displacement is much higher and the reduction of displacement of braced frame model I to bare frame is around 70%-80%, for braced frame model II to bare frame model 70%-80%. The fully periphery braced model I(i.e inverted V) RCC braced model is giving best economic steel less, story displacement and drift compare to other models.

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