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Comparative Study On Seismic Behaviour Of High Rise Building Using Shear Wall And Bracing As Lateral Load Resisting Method

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ABSTRACT: Earthquake is the natural calamity; it produces strong ground motions which affect the structure. Small or weak motions that can or cannot be felt by the humans. Provision of shear walls and bracings are installed to enhance the lateral stiffness, ductility, minimum lateral displacements and safety of the structure. Storey drift and lateral displacements are the critical issues in seismic design of buildings.

In this project a, G+16 storey building, along with shear wall and two different types of bracing is considered for analysis. The performance of building will be evaluated on the basis of following parameters –Storey displacement, Storey drift, Base shear. In this work, the shear walls and bracings are provided at corner with the overall analysis to be carried out using ETABS software.

Keywords: ETABS, Seismic analysis, Bracing, Shear wall.

I. INTRODUCTION

In addition to the gravity loads, the structure should withstand lateral forces caused by earthquake or wind depending upon the terrain category. The lateral loads produce sway moments and induce high stresses, thus reduces the stability of the structure. In order to resist lateral forces stiffness of structure is more important parameter than strength. The lateral load resisting systems that are widely used are rigid frame, shear wall, diagrid structural system, wall frame, braced tube system, outrigger system and tubular system. The RCC bracing results in higher stiffness and stability as a potential advantage over other bracing systems, whereas Steel bracing results in increase in stiffness without much increase in seismic weight. In conclusion, lateral bracing system provides stiffness and stability to the structure, and is economical.

The BIS code IS 1893:2002 is taken as criteria for earthquake resistant design of structures. This standard provides basis for calculation of base shear, torsion, storey drift, and design lateral force in structure due to lateral seismic action. These parameters are affected by nature of foundation soil, material, size, shape, type of structure, duration of seismic activity and ground motion characteristics.

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ground motion characteristics. It also provides the limitations of storey drift

Few of the lateral load resisting system
1. Frame Action of Column and Slab Systems
2.Braced Frame
3.Shear Wall
4. Framed shear Wall
5. Framed Tube System
6. Tube in Tube System

II. OBJECTIVE

The main objective of this project is to check and compare the seismic response of multi-storied building by using shear wall, X bracing and inverted V bracing.
1) Behaviour study of G+16 storey tall building with four different models one is bare frame, one with shear wall and other with X and inverted V bracing at corner of building for seismic loads.
2) The variation of displacement, storey drift, storey shear of the models to be studied.
3)The model is analysed in zone V.
4) Response spectrum analysis is to be carried out.

III. METHODOLOGY

1.Modelling of G+16 storey building using ETABS software
2.Shear wall and Bracing system (X bracing and inverted V bracing) are applied at corner periphery of the building.
3.Parameters considered in this project are storey displacement, storey shear and storey drift.
4.Seismic zone considered in this project is zone V
5.Evaluate the analysis result and verify the requirement of geometrical limitations.

3.1 PROBLEM STATEMENT
The study is focused on seismic behaviour of Regular Multi-Storey RCC (G+16) building located in Zone V with using ETABS-2018 Software. The Lateral load resisting system used in the building are Bracings and Shear wall.
Model-1 Bare frame building.
Model-2 Frame with Shear wall at the corner of building.
Model-3Frame with X Bracing at the corner of building.
Model-4 Frame with inverted V bracing at the corner of building.

3.2 GEOMETRICAL PROPERTOES

Description of Building
The size of the building in plan – (35 m x 35 m) (COMMERCIAL)
Bay width of plane frame (In both X and Z): 3.5 m
Number of stories: 17 (G+16)
Ground storey height: 3.5 m
Intermediate floor height: 3 m
Type of soil: medium soil
Zones: V
Materials
Grade of concrete: M25
Grade of steel: Fe-550
Density of concrete: 25 KN/m3
Density of masonry infill: 20 KN/m3
Member Dimensions
Column size: (900 mm * 600 mm)
Beam size: (500mm * 300mm)
Slab thickness: 125 mm
Thickness of external Wall: 230 mm
Thickness of internal Wall: 115 mm
Thickness of Shear Wall: 200mm
Clear cover of Column: 40 mm
Clear cover of beam: 25 mm
Clear cover of slab: 20 mm
Clear cover of shear wall: 25
Loads Considered:
Dead Load: Self weight
Floor Live Load: 4KN/m²
Roof live load: 1.5KN/m²
Wall Load: 13 KN/m² (9" Thick)
Other Loads: Seismic Load
Seismic Load:
Seismic design shall be done in accordance with IS: 1893:2016. The parameters to be used for analysis and design are given below (As per IS: 1893:2016 (Part I)).
Zone: V
Zone factor: 0.36 (IS 1893 (Part 1)
Importance factor: 1.2
Response Reduction: 5.0
Soil type: Type 2

IV. MODELLING OF STRUCTURE

The modeling of the members like Beam, Column and Slab will be done as per the standard procedure by adopting following properties –
1.Beams, Column will be designed by M30 grade of concrete and Fe415 and Fe250 grade of steel.
2.The slab will be defined as thin shell in ETABS.
3.The building to be modeled is having G+16 storeys.
4.Shear wall and Bracing system are applied in the building to resist Lateral Loads.

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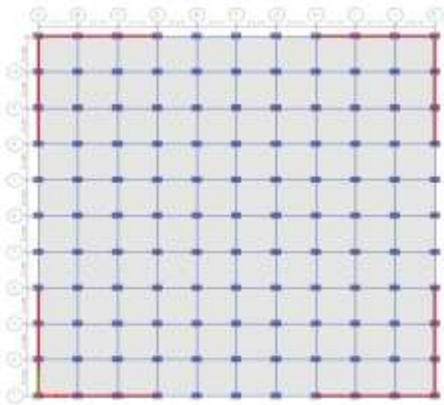

Figure.1: Plan view of building

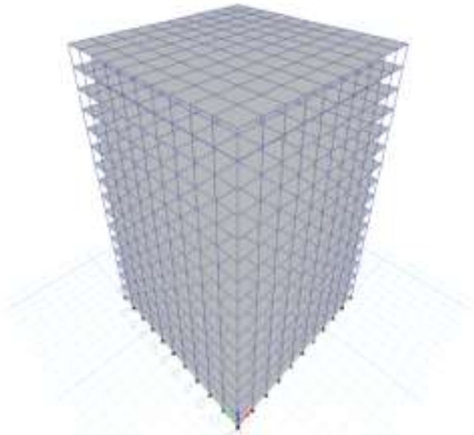

Figure 2: Bare Frame Building

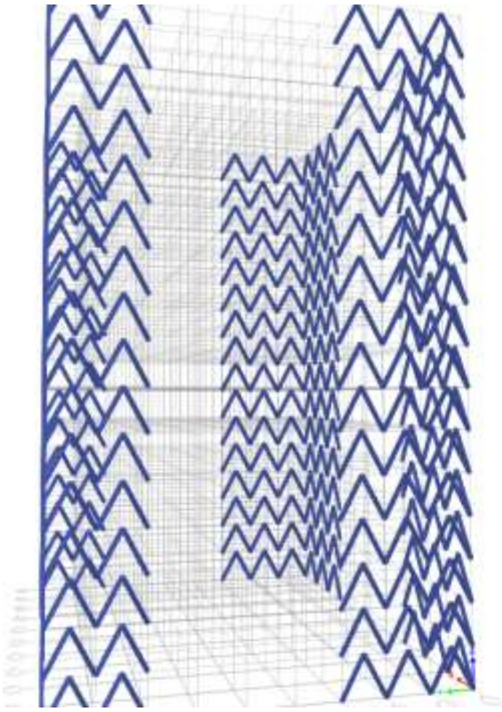

Figure 3: Building with X Bracing

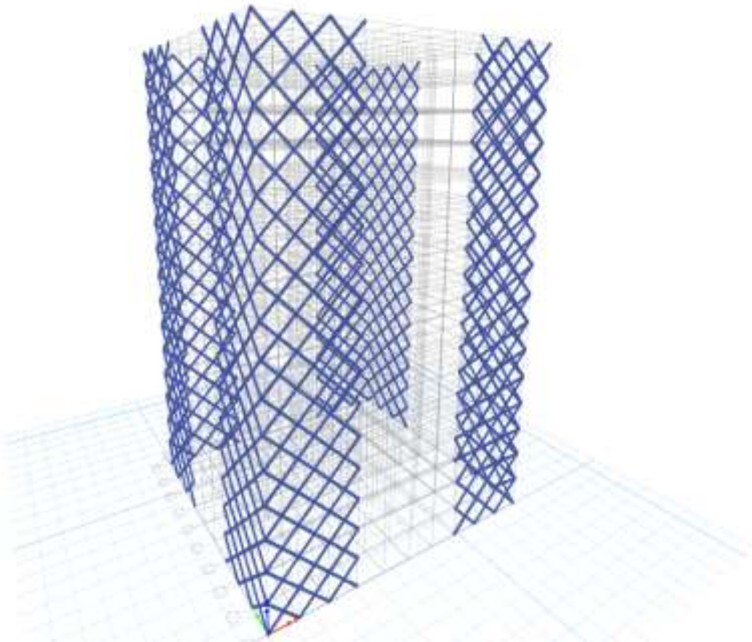

Figure 4: Building with Inverted V Bracing

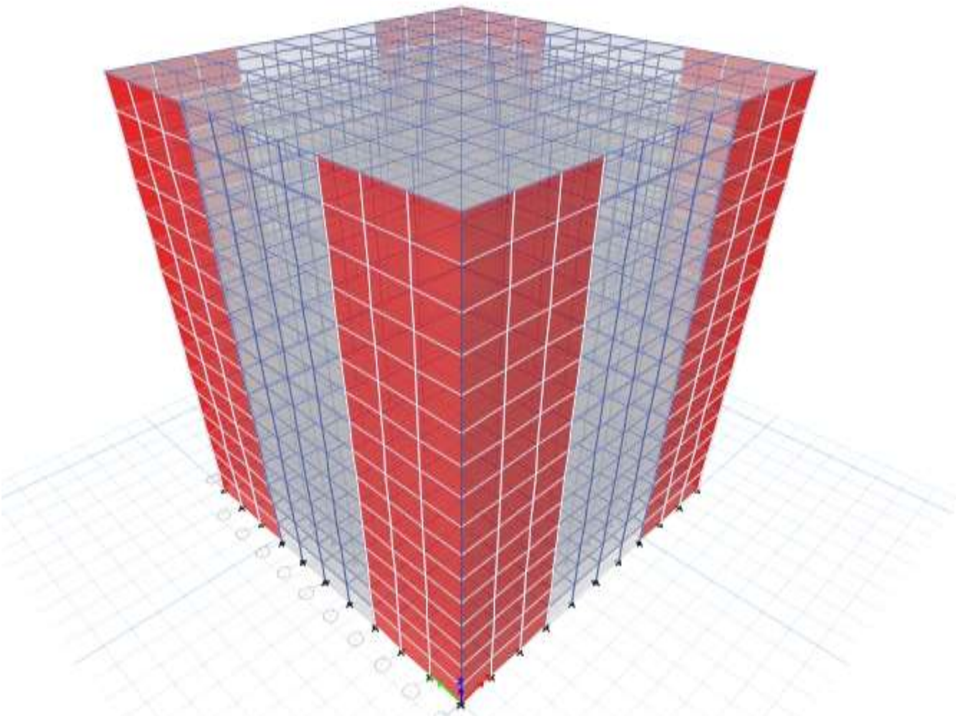

Figure 5: Building with Shear Wall

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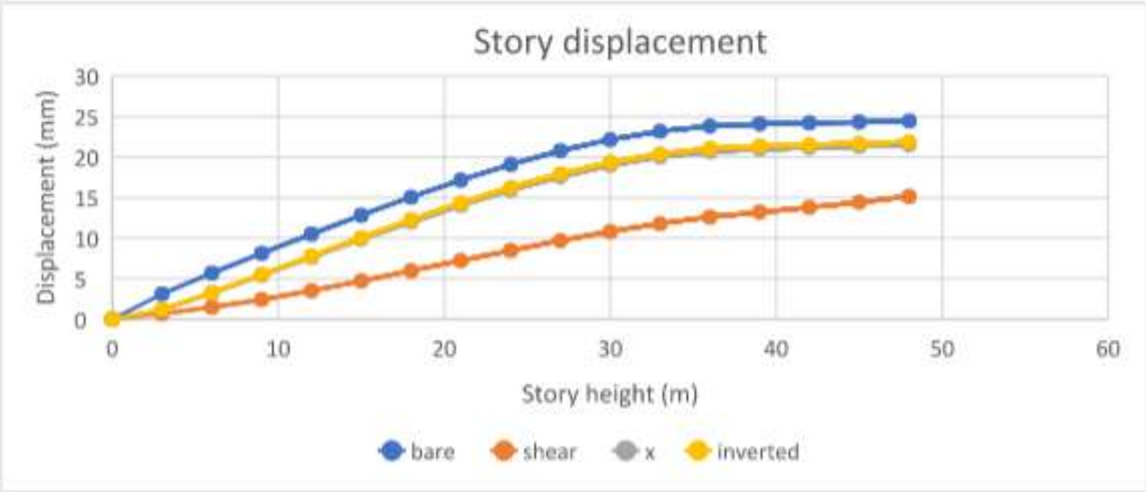
V. RESULTS AND DISCUSSIONS



Comparative Graph Showing Displacement in Y Direction

Elevation m	bare frame	shear wall	x bracing	inverted v bracing
48	24.462	15.145	21.545	21.889
45	24.337	14.447	21.344	21.703
42	24.232	13.811	21.172	21.547
39	24.098	13.208	20.982	21.371
36	23.836	12.612	20.682	21.08
33	23.21	11.804	20.025	20.424
30	22.176	10.812	18.977	19.367
27	20.784	9.697	17.591	17.963
24	19.095	8.5	15.931	16.275
21	17.171	7.251	14.057	14.366
18	15.069	5.983	12.022	12.29
15	12.838	4.732	9.876	10.099
12	10.517	3.532	7.661	7.836
9	8.137	2.436	5.425	5.543
6	5.704	1.476	3.225	3.28
3	3.133	0.679	1.208	1.216
0	0	0	0	0

Total displacement of any story with respect to ground is defined as story displacement. Maximum permissible story displacement is limited to H/500, where H is the total height of building. The maximum displacement in bare frame, shear wall, X bracing and inverted V bracing are 24.46mm, 15.45mm, 21.5mm, and 21.88 mm respectively.

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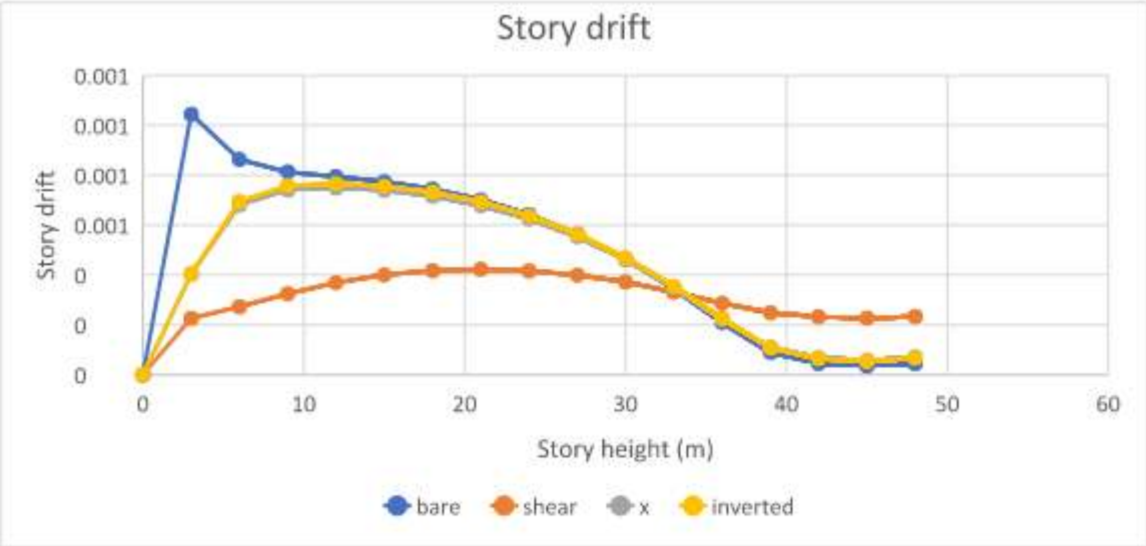
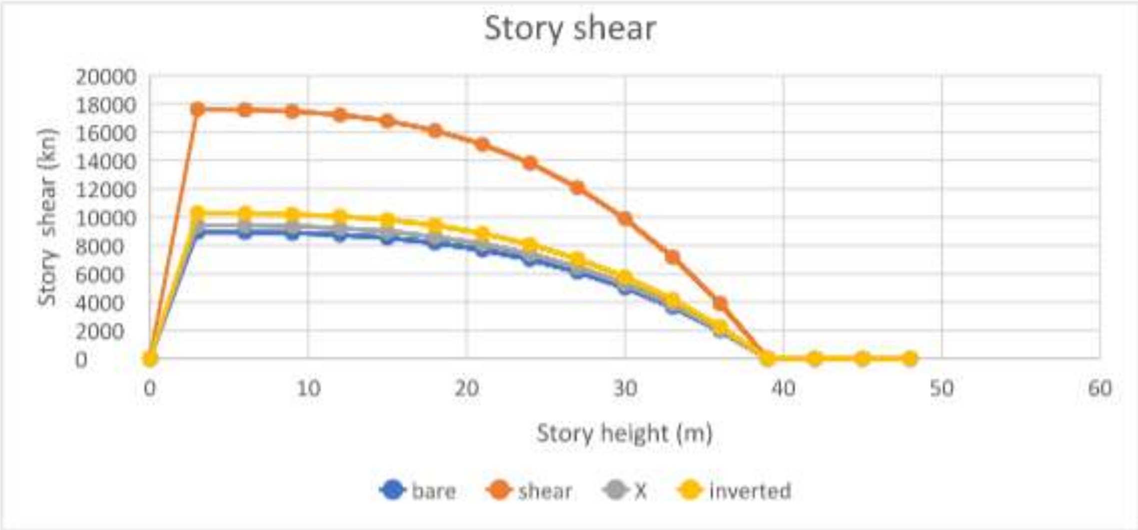


Comparative Graph Showing Drift in Y Direction

Elevation m	Bare Frame	Shear Wall	x bracing	inverted V bracing
48	4.5E-05	0.000233	0.00007	0.000066
45	3.5E-05	0.000227	0.000058	0.000053
42	4.5E-05	0.000232	0.000068	0.000064
39	8.9E-05	0.000248	0.000109	0.000107
36	0.00021	0.000286	0.000222	0.000225
33	0.00035	0.000331	0.000349	0.000355
30	0.00046	0.000372	0.000462	0.000469
27	0.00056	0.000399	0.000553	0.000563
24	0.00064	0.000416	0.000625	0.000637
21	0.0007	0.000423	0.000678	0.000693
18	0.00074	0.000417	0.000715	0.000732
15	0.00077	0.0004	0.000739	0.000756
12	0.00079	0.000369	0.000749	0.000766
9	0.00081	0.000324	0.000741	0.000758
6	0.00086	0.000272	0.000681	0.000695
3	0.00104	0.000226	0.000403	0.000405
0	0	0	0	0

The word "Drift" can be defined as the lateral displacement of the structure, Storey drift is the slower and small movement of one level of a multilevel building relative to the level below. Inner storey drift is the difference between the floor and roof displacements of any given story as the building sways during the earthquake, marked by the story height, more is the storey drift will cause more damages to the structures, its value should not be beyond the limit 0.004h, where (h) is height of the building. The value of story drift increases up to the mid height of building and then decreases to the top of building.



Comparative Graph Showing Shear in Y Direction

Elevation m	bare frame	shear wall	X bracing	inverted V bracing
48	0	0	0	0
45	0	0	0	0
42	0	0	0	0
39	0	0	0	0
36	1982	3900	2068.7	2278.2
33	3648	7178	3840.1	4192.5
30	5024	9886	5289.2	5774.6
27	6139	12080	6463	7056.1
24	7020	13814	7390.4	8068.6
21	7694	15141	8100.5	8843.8
18	8190	16116	8622.2	9413.4
15	8534	16793	8984.4	9809.9
12	8754	17226	9216.3	10062
9	8878	17470	9364.7	10204
6	8933	17579	9404.7	10268
3	8947	17606	9419.2	10284
0	0	0	0	0

The amount of maximum lateral force because of seismic ground motion at the soffit or base of the structure is base shear, its horizontal movement of base of the structures, it depends on following factors: Condition of soil on the site, Closeness to potential sources of seismic activity like geological faults, Probability of significant seismic ground motion due to earthquakes, Total weight of Building, Period of the vibration. Base shear is inversely proportional to story displacement. Maximum shear occurs on bottom of the building.

VI. CONCLUSION

1.From the above results introducing shear walls reduces the sway or displacement
2.Base Shear of the above-Mentioned Structures Heavily Increases And makes the Structure stable against seismic loading.

3.The Natural Time period of the above designed Structures are highly reduced after placing of bracings and Shear walls with comparison to Normal structure.
4.The lateral forces are resisting capacity is highly increased after the placement of Shear wall.
5.When comparing the above Structures Lateral displacements are minimal when Shear wall are applied.
6.From the above Comparison of structures and through discussion it is concluded that Shear wall could improve the lateral Stability of the structures.
7.On comparison of various parameters like story drift, story displacement and story shear, building with shear wall has better performance than both bracing.
8.Model with least story displacement and maximum base shear value resist maximum lateral force therefore building with shear wall resist maximum lateral loads.

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