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Seismic Analysis of Symmetrical and Unsymmetrical High Rise Building with & Without Steel Bracings in Various Soils Using ETABS

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ABSTRACT: From the ancient time we know earthquake is a disaster causing occasion. Up to date days constructions are fitting increasingly narrow and extra inclined to sway and consequently detrimental within the earthquake. Researchers and engineers have worked out within the past to make the constructions as earthquake resistant. After many functional reports it has proven that use of lateral load resisting methods in the constructing configuration has drastically increased the performance of the structure in earthquake. In the present analysis, a residential building in different shapes i.e., L Shape, Octagon Shape is analysed with a height of 42m, width of the building is taken as 30m the building is analysed with Steel Bracings at optimum places and finding out the results of displacement in zone 2 & zone 5 in hard soil i.e. Soil-1, Loose soil i.e., S-3 a total of 8 models are made for finding the results in static analysis are drawn for each. A commercial package of ETABS 2013 has been utilized for analysing commercial building. The result has been compared using tables & graph to find out the most optimized solution. Concluding remark has been made on the basis of this analysis & comparison tables.

KEYWORDS: Residential Building, Storey displacement, Bracings, ETABS.

I. INTRODUCTION

Braced frames may be grouped into two categories, as either concentric braced frames (CBF) or eccentric braced frames (EBF), depending on their geometric characteristics. In CBFs, the axes of all members –i.e., columns, beams and braces –intersect at a common point such that the member forces are axial. EBFs utilize axis offsets to deliberately introduce flexure and shear into framing beams. The primary goal is to increase ductility. Depending on the magnitude of force, length, required stiffness, and clearances, the diagonal member can be made of double angles, channels, T-sections, tubes or wide flange shapes. Besides performance, the shape of the diagonal is often based on connection considerations. The least objectionable locations for braces are around service cores and elevators, where frame diagonals may be enclosed within permanent walls. The braces can be jointed together to form a closed or partially closed three-dimensional cell for effectively resisting torsional loads.

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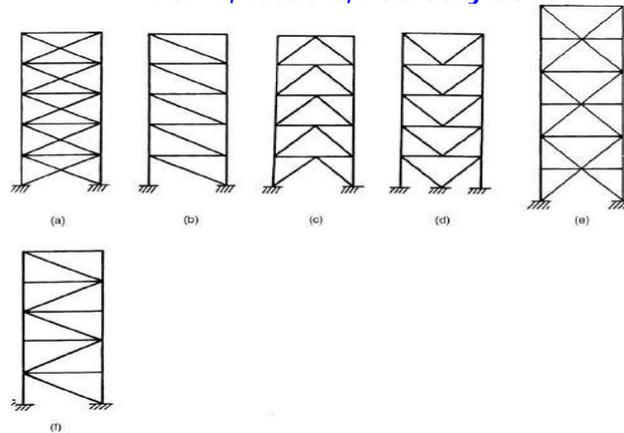


Figure 1 Typical concentric braced frame (CBF) configurations: (a) One-storey X-bracing; (b) Single-diagonal bracing; (c) and (d) Chevron bracings; (e) two-storey X-bracings; (f) Single-diagonal alternate-direction bracing.

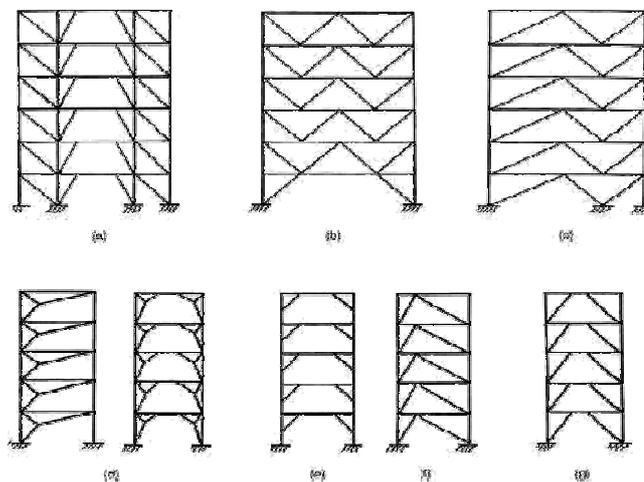


Figure 2 : Brace configuration that allows for door-size openings in interior space layouts.

The most efficient (but also the most obstructive) types of bracing are those that form a fully triangulated vertical truss. Figure 2 shows other types of braced bents that pose fewer problems in the architectural organization of internal space as well as in locating door openings, but may cause bending in columns and girders. Historically, Bracings have been used to provide lateral buildings, from the earliest examples at the end of the 19th century to the present. An outstanding example is the 1250-ft-high Empire State Building completed in 1931.

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LITERATURE REVIEW:

Dhanaraj and Keshav (1), studied performance of different bracing systems in high rise steel buildings. The parameters considered in seismic analysis are storey displacement, inter storey drift, base shear when compared with Moment Resisting Frames. They concluded that use of Chevron Bracing, V bracing, Cross bracing (X), intensify Structural performance of steel building.

Nauman and Islam(2), concluded from their study the maximum storey displacement of the structure decreases after application of X braced system compared to other types of steel systems. Also by the application of bracings the Bending Moment(BM) and Shear Force(SF) reduces in columns.

A.R. Khaloo and M. Mahdi Mohseni (5), had worked on Non Linear seismic Behaviour of RC Frames with RC braces. This study concentrated on evaluation of strength, stiffness, ductility and energy absorption of RC Braced Frames and compare with Moment Resisting Frames and Frames with shear wall.

II. RELATED WORK

STRUCTURE PARAMETERS

No of Storey	G+14
Type of Building	Residential Building
Storey height	3m
Grade of concrete	M30
Grade of steel	Fe500
Density of RCC	25KN/m ²
Thickness of slab	110mm
Column size used from storey 1 to 8	650x300 (in mm)
Column size used from storey 9 to 14	500x300 (in mm)
Beam size	450x250 (in mm)
Steel Bracing size(ISMB)	230mm x 230mm
Seismic zones	II, V
Soil Type Considered	Hard & Loose Soils
Importance factor	1
Response reduction factor	3,5
Live Load (IS 875 Part-1)	3 KN/m ²
Floor Finish	1 KN/m ²

III. MODELLING IN ETABS

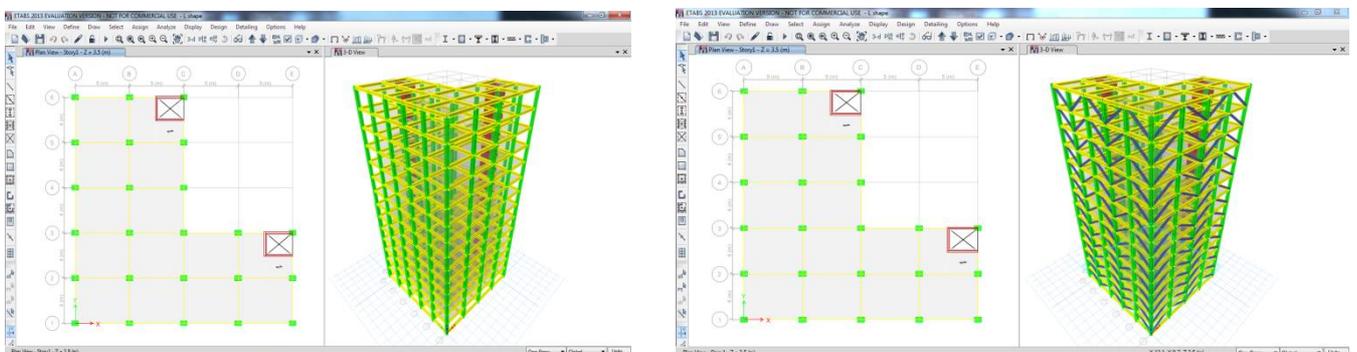


Figure:1 Model showing of L-Shape with and without steel bracings

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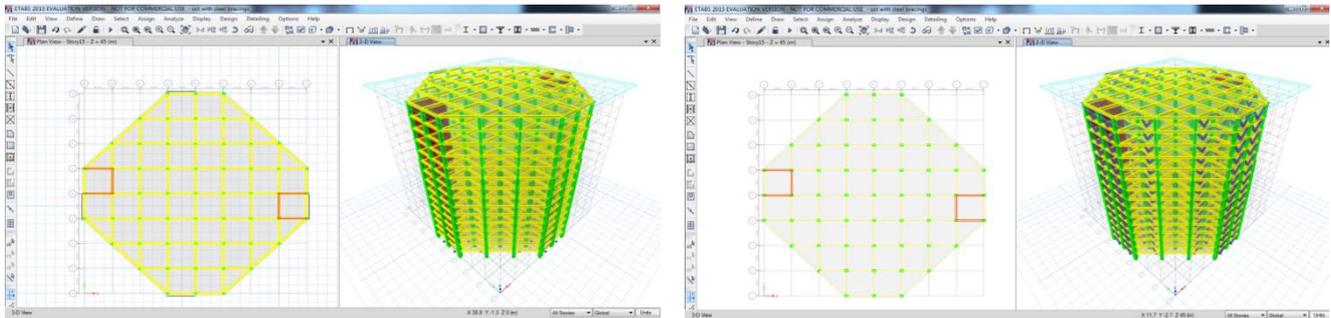


Figure:2 Model showing of Octagon-Shape with and without steel bracings

Case 1: Comparison of displacement in L-Shape building in Zone-2 & Zone-5 in hard soil (S-1) & Loose soil (S-3) In Static Analysis

Table : 1 Displacement comparison values along storey wise of L-Shape Building along zone-2 soil-1 in static analysis of without bracings model and with bracing model.

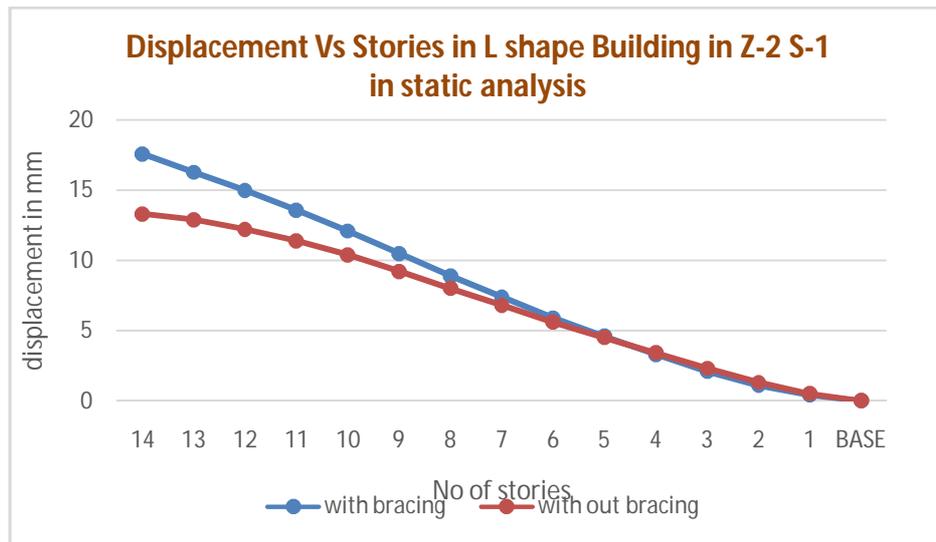
Stories	With Out Bracing	With Bracing
14	17.6	13.3
13	16.3	12.9
12	15	12.2
11	13.6	11.4
10	12.1	10.4
9	10.5	9.2
8	8.9	8
7	7.4	6.8
6	5.9	5.6
5	4.6	4.5
4	3.3	3.4
3	2.1	2.3
2	1.1	1.3
1	0.4	0.5
BASE	0	0

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Graph : 1 Displacement variation along zone 2 soil-1 in static analysis

Table : 2 Displacement comparison values along storey wise of L-Shape Building along zone-5 soil-1 in static analysis of without bracings model and with bracing model.

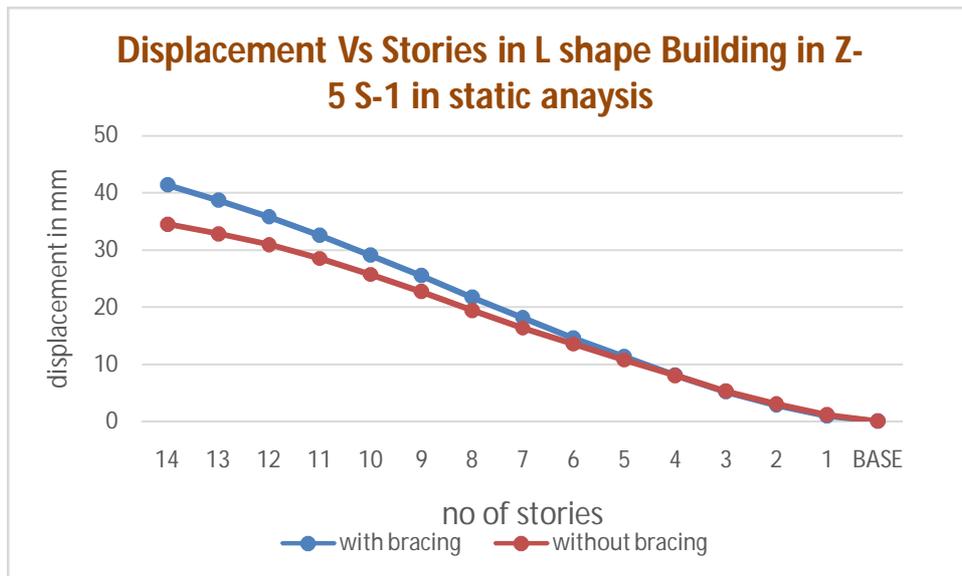
Stories	With out Bracing	With Bracing
14	41.4	34.5
13	38.7	32.8
12	35.8	30.9
11	32.6	28.5
10	29.1	25.7
9	25.5	22.7
8	21.7	19.4
7	18.1	16.3
6	14.6	13.5
5	11.3	10.7
4	8.1	8
3	5.2	5.3
2	2.8	3
1	0.9	1.1
BASE	0	0

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Graph : 2 Displacement variation along zone 5 soil-1 in static analysis

Table : 3 Displacement comparison values along storey wise of L-Shape Building along zone-2 soil-3 in static analysis of without bracings model and with bracing model.

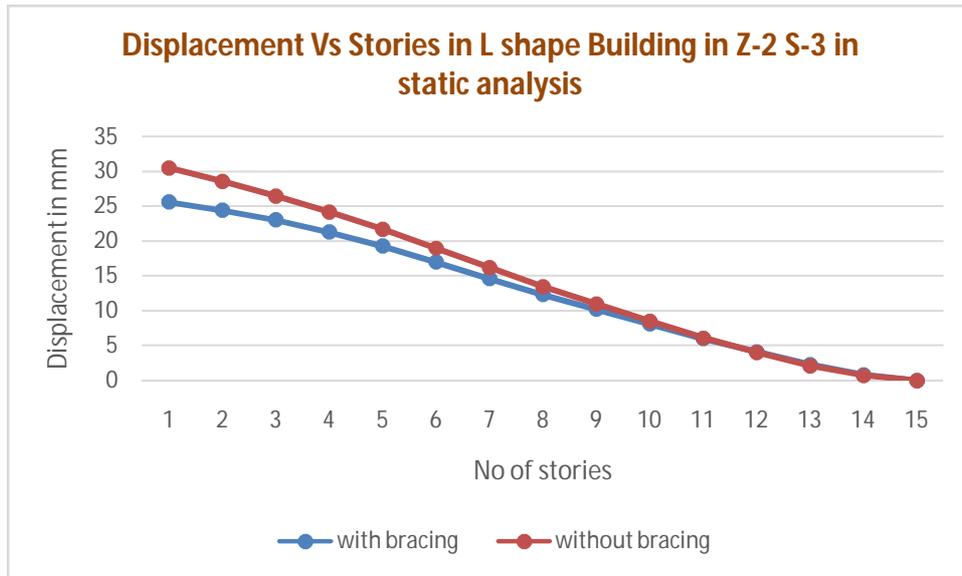
Stories	Without Bracing	With Bracing
14	30.5	25.6
13	28.6	24.4
12	26.5	23
11	24.2	21.3
10	21.7	19.3
9	19	17
8	16.2	14.6
7	13.5	12.3
6	11	10.2
5	8.5	8.1
4	6.1	6
3	4	4.1
2	2.1	2.3
1	0.7	0.8
BASE	0	0

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Graph : 3 Displacement variation along zone 2 soil-3 in static analysis

Table : 4 Displacement comparison values along storey wise of L-Shape Building along zone-5 soil-3 in static analysis of without bracings model and with bracing model.

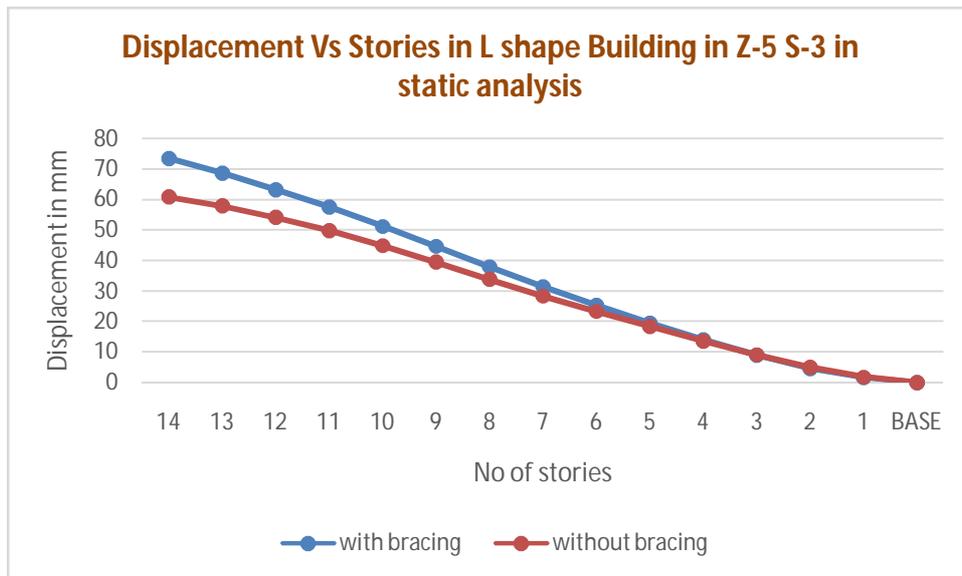
Stories	With out Bracing	With Bracing
14	73.5	60.8
13	68.6	57.8
12	63.2	54.1
11	57.5	49.8
10	51.2	44.8
9	44.7	39.4
8	38	33.8
7	31.5	28.3
6	25.4	23.3
5	19.5	18.4
4	14	13.6
3	9	9.1
2	4.7	5.1
1	1.6	1.8
BASE	0	0

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Graph : 4 Displacement variation along zone 5 soil-3 in static analysis

Case2: Comparison of displacement in OCTAGON-Shape building in Zone-2 & Zone-5 in hard soil (S-1) & Loose soil (S-3) In Static Analysis

Table : 5 Displacement comparison values along storey wise of octagon-Shape Building along zone-2 soil-1 in static analysis of without bracings model and with bracing model.

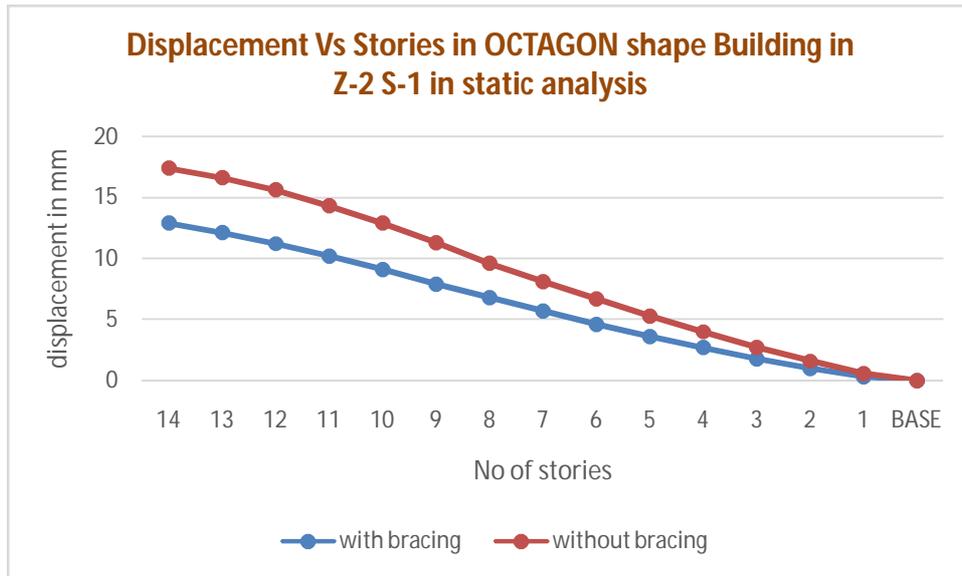
Stories	Without Bracing	With Bracing
14	17.4	12.9
13	16.6	12.1
12	15.6	11.2
11	14.3	10.2
10	12.9	9.1
9	11.3	7.9
8	9.6	6.8
7	8.1	5.7
6	6.7	4.6
5	5.3	3.6
4	4	2.7
3	2.7	1.8
2	1.6	1
1	0.6	0.3
BASE	0	0

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Graph : 5 Displacement variation along zone 2 soil-1 in static analysis

Table : 6 Displacement comparison values along storey wise of OCTAGON-Shape Building along zone-5 soil-1 in static analysis of without bracings model and with bracing model.

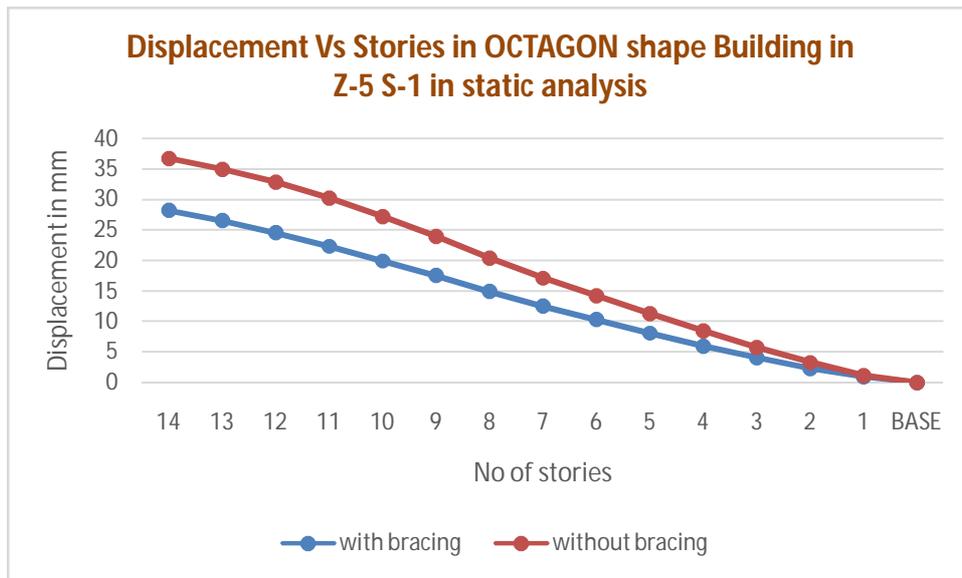
Stories	Without Bracing	With Bracing
14	36.7	28.2
13	34.9	26.5
12	32.8	24.5
11	30.2	22.3
10	27.2	19.9
9	23.9	17.5
8	20.4	14.9
7	17.1	12.5
6	14.2	10.3
5	11.3	8.1
4	8.5	6
3	5.8	4.1
2	3.3	2.3
1	1.2	0.9
BASE	0	0

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Graph : 6 Displacement variation along zone 5 soil-1 in static analysis.

Table : 7 Displacement comparison values along storey wise of OCTAGON-Shape Building along zone-2 soil-3 in static analysis of without bracings model and with bracing model.

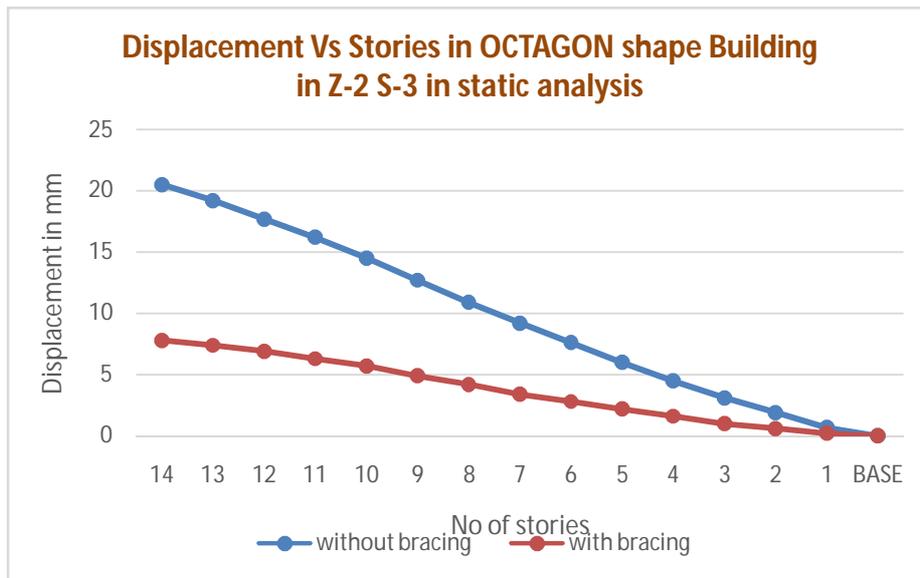
Stories	Without Bracing	With Bracing
14	20.5	7.8
13	19.2	7.4
12	17.7	6.9
11	16.2	6.3
10	14.5	5.7
9	12.7	4.9
8	10.9	4.2
7	9.2	3.4
6	7.6	2.8
5	6	2.2
4	4.5	1.6
3	3.1	1
2	1.9	0.6
1	0.7	0.2
BASE	0	0

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Graph : 7 Displacement variation along zone 2 soil-3 in static analysis

Table : 8 Displacement comparison values along storey wise of OCTAGON-Shape Building along zone-5 soil-3 in static analysis of without bracings model and with bracing model.

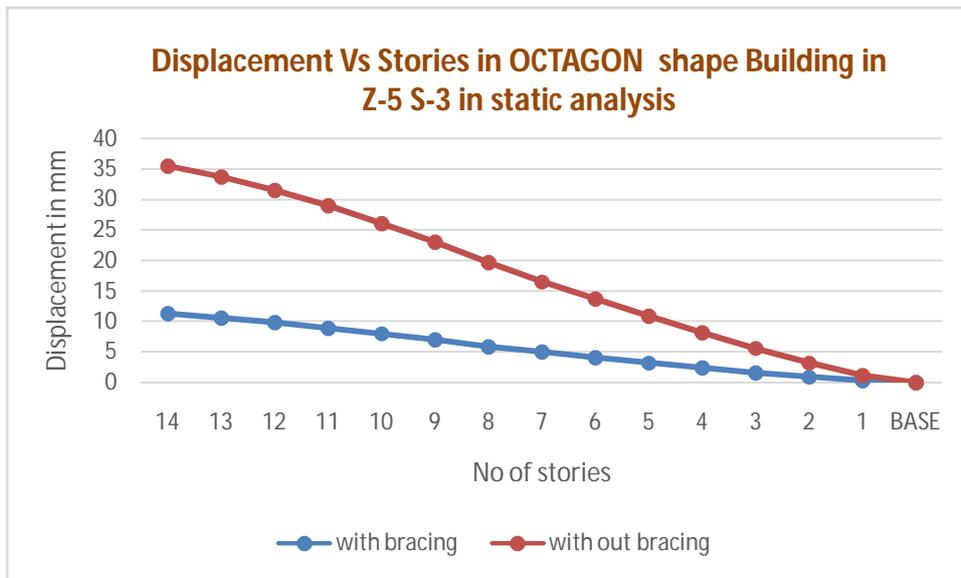
Stories	With Out Bracing	With Bracing
14	35.5	11.3
13	33.7	10.6
12	31.5	9.8
11	29	8.9
10	26.1	8
9	23	7
8	19.7	5.9
7	16.5	5
6	13.7	4.1
5	10.9	3.2
4	8.2	2.4
3	5.6	1.6
2	3.2	0.9
1	1.2	0.3
BASE	0	0

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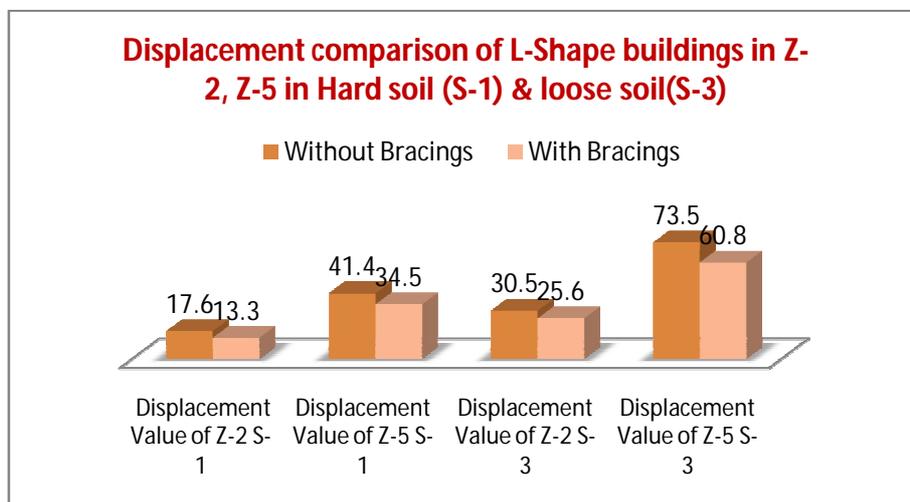


Graph : 8 Displacement variation along zone 5 soil-3 in static analysis.

Case 3: Zone wise comparison of displacement of L-Shape building in Zone-2 & Zone-5 in hard soil (S-1) & Loose soil (S-3) In Static Analysis.

Table : 1 Displacement comparison values of L-Shape Building along zone-2 & zone-5 in soil-1 & soil-3 in static analysis of without bracings model and with bracing model.

Zone & Soil	Without Bracings	With Bracings
Displacement Value of Z-2 S-1	17.6	13.3
Displacement Value of Z-5 S-1	41.4	34.5
Displacement Value of Z-2 S-3	30.5	25.6
Displacement Value of Z-5 S-3	73.5	60.8



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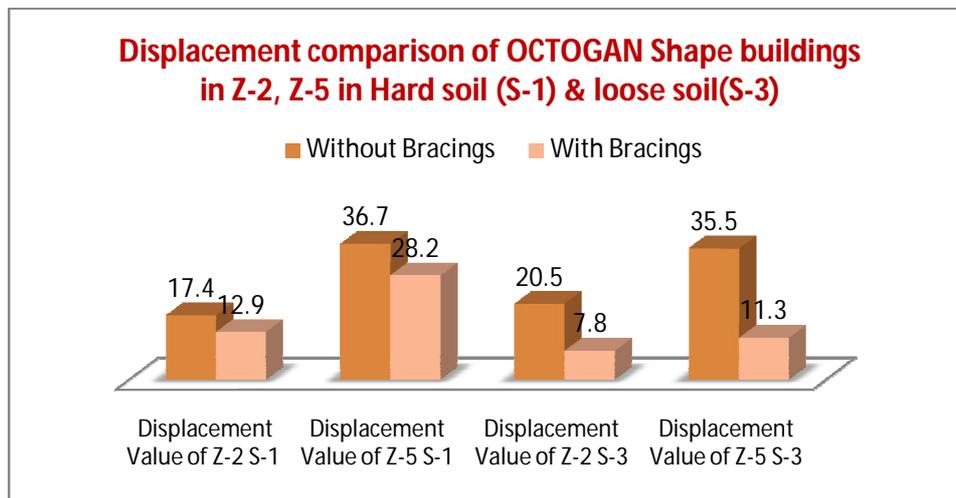
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Zone wise comparison of displacement of OCTOGON--Shape building in Zone-2 & Zone-5 in hard soil (S-1) & Loose soil (S-3) In Static Analysis.

Zone & Soil	Without Bracings	With Bracings
Displacement Value of Z-2 S-1	17.4	12.9
Displacement Value of Z-5 S-1	36.7	28.2
Displacement Value of Z-2 S-3	20.5	7.8
Displacement Value of Z-5 S-3	35.5	11.3



IV. CONCLUSIONS

In this paper different shapes of buildings with and without bracings are studied and the seismic parameters in terms of storey displacement are compared. The following conclusions are summarized based on analysis :

1. Moment Resisting Frames shows more storey displacement when compared to Braced Frame. This shows that Moment Resistant Frame is prone to excessive damage in earthquake.
2. Displacement for L-Shape without bracings Building & with bracings building in two zones i.e. in Zone 2 & zone 5 in three different soils are noted and it is observed that displacement of 50% is reduced when steel bracings are provided.
3. Displacement for Octagon-Shape without bracings Building & with bracings building in two zones i.e. in Zone 2 & zone 5 in three different soils are noted and it is observed that displacement of 55% is reduced when steel bracings are provided.
4. On comparing the three building shapes with respect to displacement it can be concluded that providing steel bracings on each elevation can reduce the displacement.
5. Lateral displacement in Unsymmetrical Structure is more when compared to Symmetrical structure.

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