

# International Journal of Innovative Research in Science, Engineering and Technology

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## Analysis and Design of Commercial Building Using ETABS

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**ABSTRACT:** An earthquake is the shaking of the surface of the Earth, resulting from the sudden release of energy in the Earth's lithosphere that creates seismic waves. Effects are often classified as primary and secondary impacts. Primary effects occur as a direct result of the ground shaking, eg buildings collapsing. Secondary effects occur as a result of the primary effects, eg tsunamis or fires due to ruptured gas mains. In structural engineering, a bracing is a lateral load system composed to counter the effects of lateral load acting on a structure. Bracings are structural members used to augment the strength of RCC structures. These bracings will be built in each elevation of the structure, to form an effective structure. In the present work “Analysis and Design of Commercial building with bracings using ETABS” is an attempt to analyse and design a commercial building using ETABS. A G+9 storey building is considered for this study. Analysis is carried out by static method and design is done as per IS 456:2000 guidelines. For the analysis of the building for seismic loading with two different Zones (Zone-III & Zone-V) is considered with all three soil types. The results from the analysis are obtained in static method and are presented in tabular form and the results are compared using graphical form.

**KEYWORDS:** ETABS, Commercial Building, Bracings.

### I. INTRODUCTION

All over the world bracing system has been considered as the most efficient measure against the lateral loads induced in the building due to the seismic forces. This paper aims at providing an efficient bracing system against such forces. In order to increase the stiffness of the columns and to reduce their net longitudinal reinforcement decreasing their effective length can be a good solution but the challenge is to how can we do so without changing the general building specifications ( specially architectural) and not disturbing the basic building frame structure as a whole.

#### 1.1 Use of bracing system in decreasing the effective length of the column

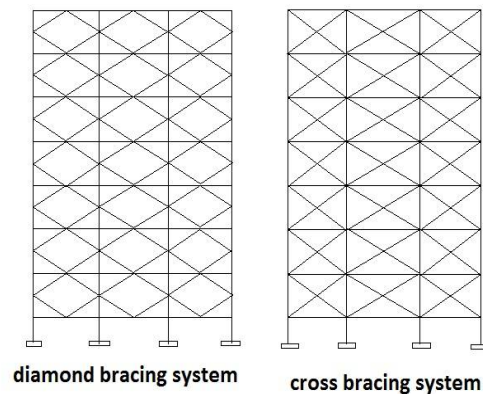
A new bracing system shaped like a diamond is incorporated in the main building frame and its applicability is evaluated by detailed calculations. It is also compared with the other known bracing system known as the cross bracing system. Both the bracing system has been shown below.

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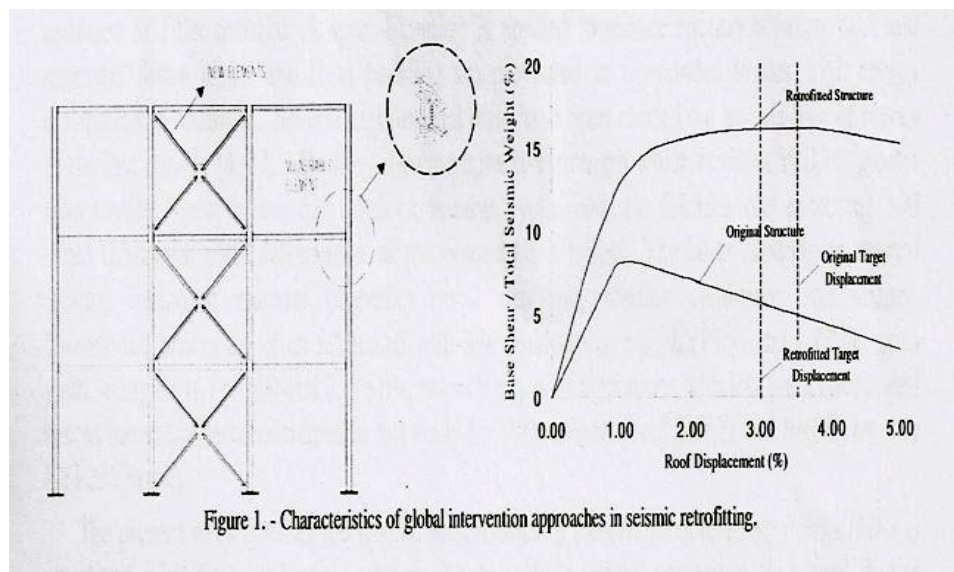
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*Fig-1.1 Showing different types of bracings*

Bracing is a very effective global upgrading strategy to enhance the global stiffness and strength of steel and composite frames. It can increase the energy absorption of structures and/or decrease the demand imposed by earthquake loads. Structures with augmented energy dissipation may safely resist forces and deformations caused by strong ground motions. Generally, global modifications to the structural system are conceived such that the design demands, often denoted by target displacement, on the existing structural and non-structural components, are less than their capacities (Figure 1). Lower demands may reduce the risk of brittle failures in the structure and/or avoid the interruption of its functionality. The attainment of global structural ductility is achieved within the design capacity by forcing inelasticity to occur within dissipative zones and ensuring that all other members and connections behave linearly.



*Figure 1. - Characteristics of global intervention approaches in seismic retrofitting.*

Bracing may be inefficient if the braces are not adequately capacity-designed. Braces can be aesthetically unpleasant where they change the original architectural features of the building. In addition, braces transmit very high actions to connections and foundations and these frequently need to be strengthened. Several configurations of braced frames may be used for seismic rehabilitation. The most common are concentric braced frames (CBFs),

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eccentric braced frames (EBFs) and the novel knee-brace frames (KBFs), recently proposed for earthquake loads. However due to buckling of the compression members and material softening due to the Bauschinger effect, the hysteretic behavior of CBFs is unreliable. It follows that the key to improving seismic behaviour depends on the scrupulous design of bracing members. Common configurations for CBFs include V and inverted-V bracings, K, X and diagonal bracings. Macro-bracings can be utilized for strengthening and stiffening of steel and composite steel-concrete buildings. They are often employed to form mega braced frames (MBFs), which exhibit high stiffness and enhanced ductility. Brace configurations with MBFs have been utilized in the present analytical work to retrofit a medium-rise steel moment resisting frames (MRFs) with inadequate lateral stiffness. Alternative systems, such as traditional SCBFs and frames with unbounded braces, have also been assessed

## II. ANATOMY OF MULTI-STORIED BUILDINGS

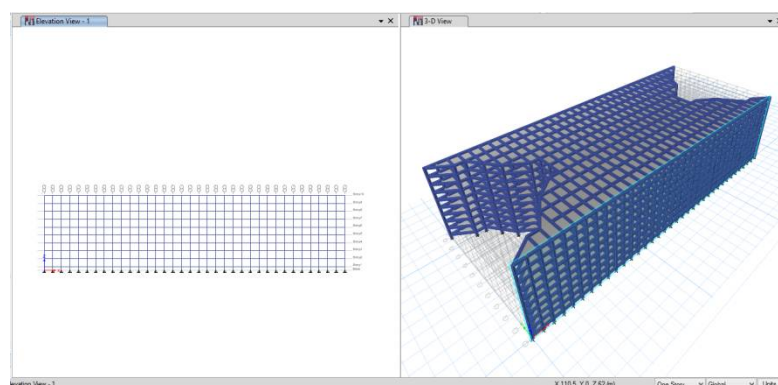


Figure. 1: show the plan without bracings

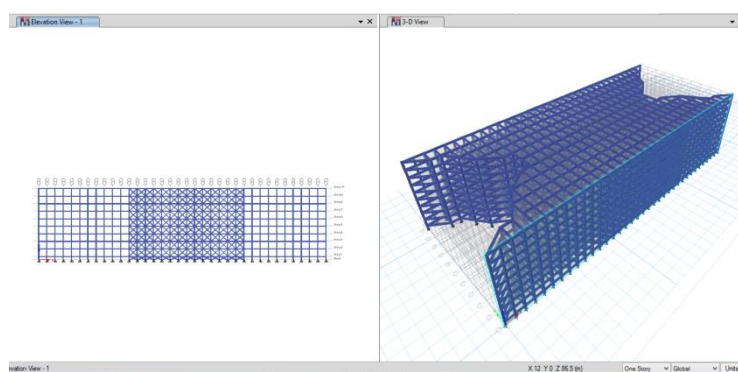


Figure.2 : show the plan with bracings

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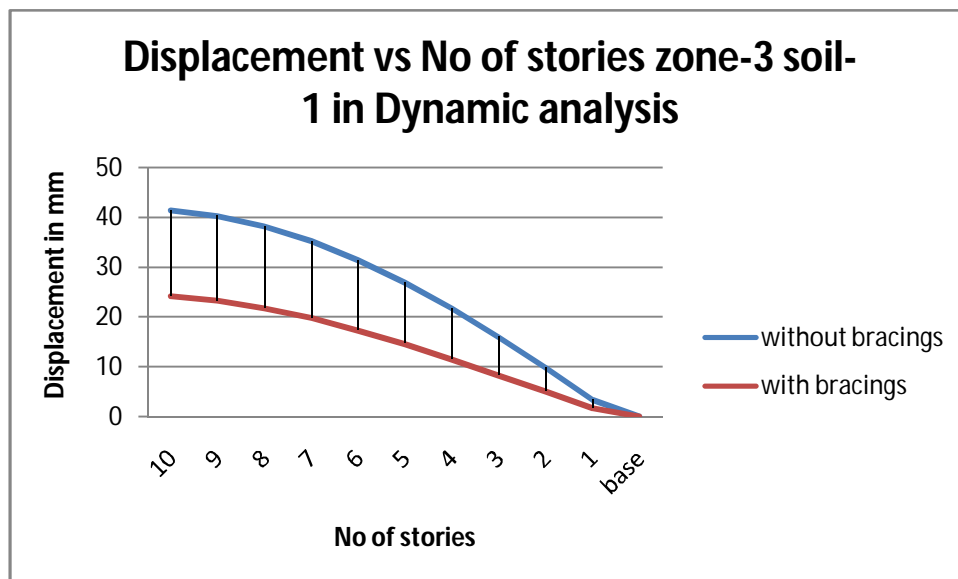
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## III. RESULTS

Table 5.1 Comparative values of displacement in Dynamic analysis along zone-3, soil-1 with bracings & without bracings.

No of stories	without bracings	with bracings
10	41.4	24.2
9	40.3	23.3
8	38.2	21.8
7	35.2	19.8
6	31.4	17.3
5	26.9	14.6
4	21.7	11.5
3	16	8.3
2	9.8	5
1	3.3	1.7
base	0	0



Graph 5.1 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 3 soil-1.

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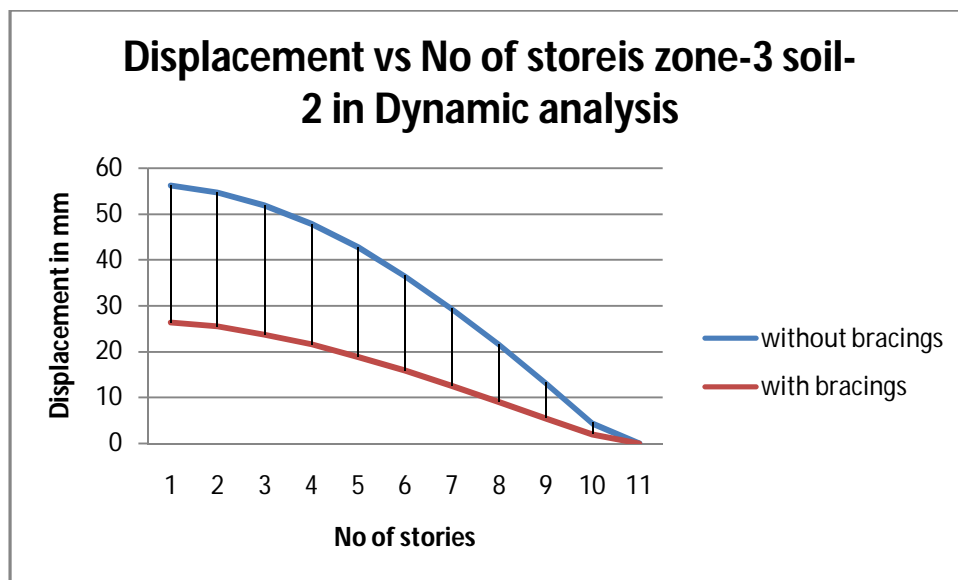
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Table 5.2 Comparative values of displacement in Dynamic analysis along zone-3, soil-2 with bracings & without bracings.

No of stories	without bracings	with bracings
10	56.3	26.3
9	54.7	25.4
8	51.9	23.7
7	47.9	21.5
6	42.7	18.8
5	36.5	15.8
4	29.4	12.5
3	21.6	9
2	13.2	5.4
1	4.4	1.9
base	0	0



Graph 5.2 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 3 soil-2.

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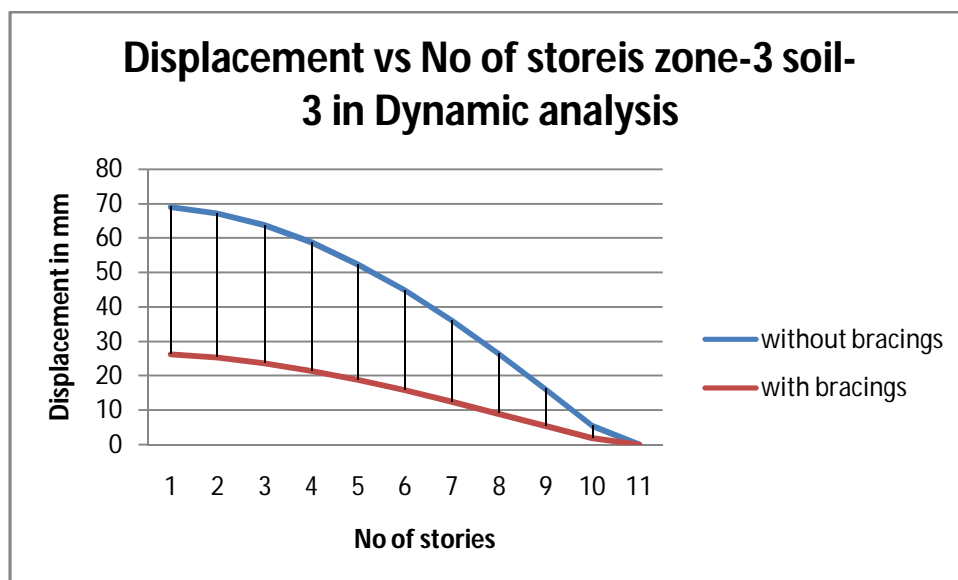
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Table 5.3 Comparative values of displacement in Dynamic analysis along zone-3, soil-3 with bracings & without bracings.

No of stories	without bracings	with bracings
10	69.1	26.3
9	67.2	25.4
8	63.8	23.7
7	58.8	21.5
6	52.4	18.8
5	44.8	15.8
4	36.1	12.5
3	26.4	9
2	16.1	5.4
1	5.4	1.9
base	0	0



Graph 5.3 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 3 soil-3.

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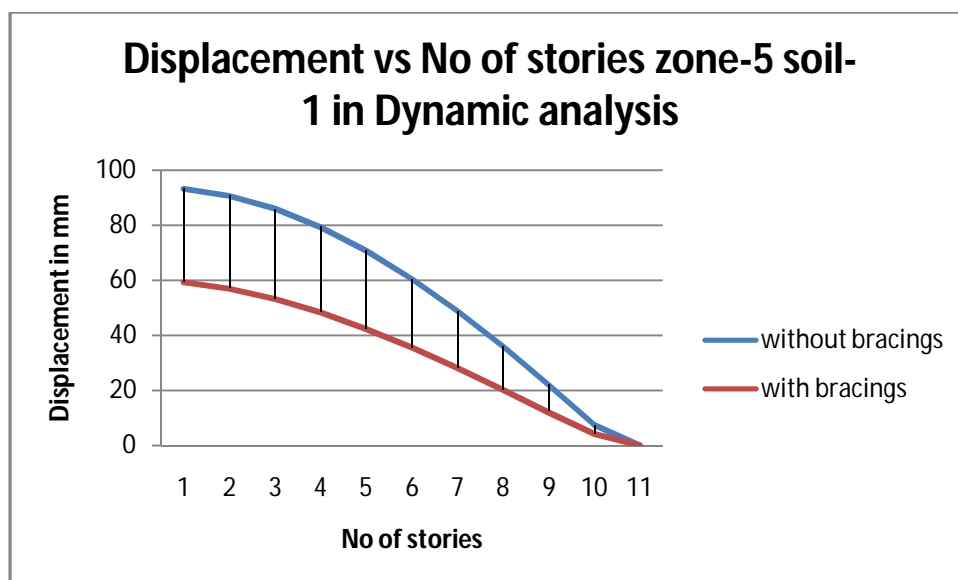
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Table 5.4 Comparative values of displacement in Dynamic analysis along zone-5, soil-1 with bracings & without bracings.

No of stories	without bracings	with bracings
10	93.2	59.3
9	90.6	57
8	85.9	53.3
7	79.2	48.3
6	70.7	42.4
5	60.5	35.6
4	48.9	28.2
3	36	20.3
2	22.1	12.2
1	7.5	4.2
base	0	0



Graph 5.4 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 5 soil-1.

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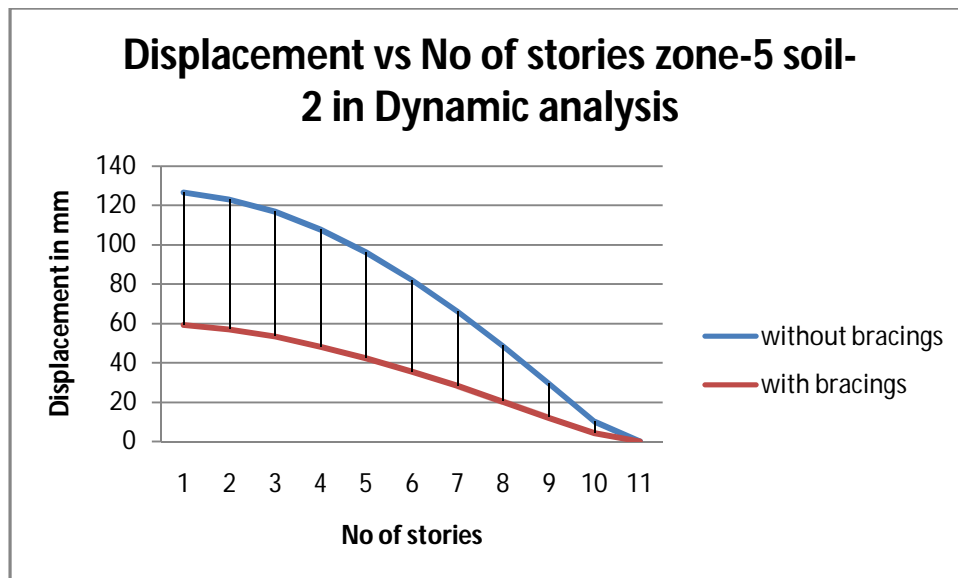
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Table 5.5 Comparative values of displacement in Dynamic analysis along zone-5, soil-2 with bracings & without bracings.

No of stories	without bracings	with bracings
10	126.6	59.3
9	123.1	57
8	116.8	53.3
7	107.7	48.3
6	96.1	42.4
5	82.1	35.6
4	66.2	28.2
3	48.6	20.3
2	29.7	12.2
1	10	4.2
base	0	0



Graph 5.5 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 5 soil-2.



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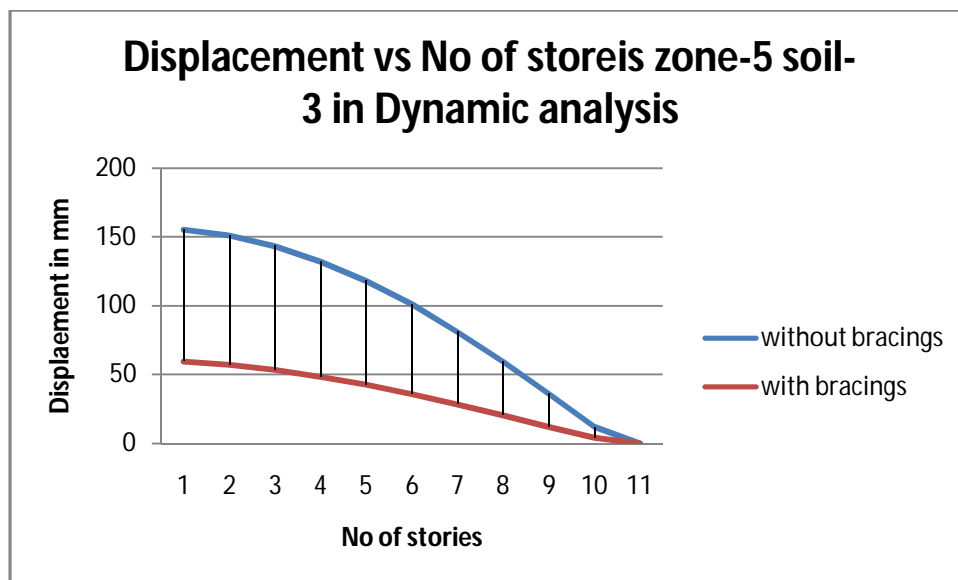
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Table 5.6 Comparative values of displacement in Dynamic analysis along zone-5, soil-3 with bracings & without bracings.

No of stories	without bracings	with bracings
10	155.4	59.3
9	151.1	57
8	143.5	53.3
7	132.3	48.3
6	118	42.4
5	100.8	35.6
4	81.1	28.2
3	59.5	20.3
2	36.3	12.2
1	12.2	4.2
base	0	0



Graph 5.6 Variation of displacement with bracings & without bracings in Dynamic analysis along Zone 5 soil-3.

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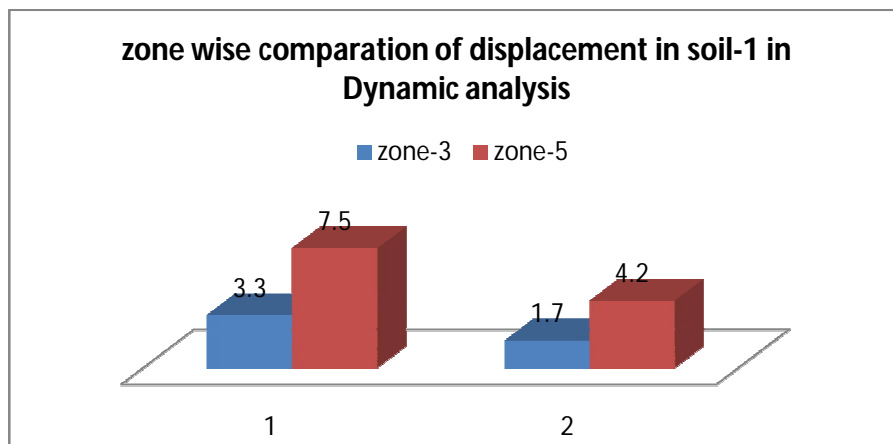
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Table 5.7 Comparative values of displacement in Dynamic analysis along zone-3 zone-5, soil-1 with bracings & without bracings.

zones	soil-1	soil-1
zone-3	3.3	1.7
zone-5	7.5	4.2



Graph 5.7 Variation of displacement with bracings & without bracings in Dynamic analysis along zone-3 Zone 5 soil-1

Table 5.8 Comparative values of displacement in Dynamic analysis along zone-3 zone-5, soil-2 with bracings & without bracings.

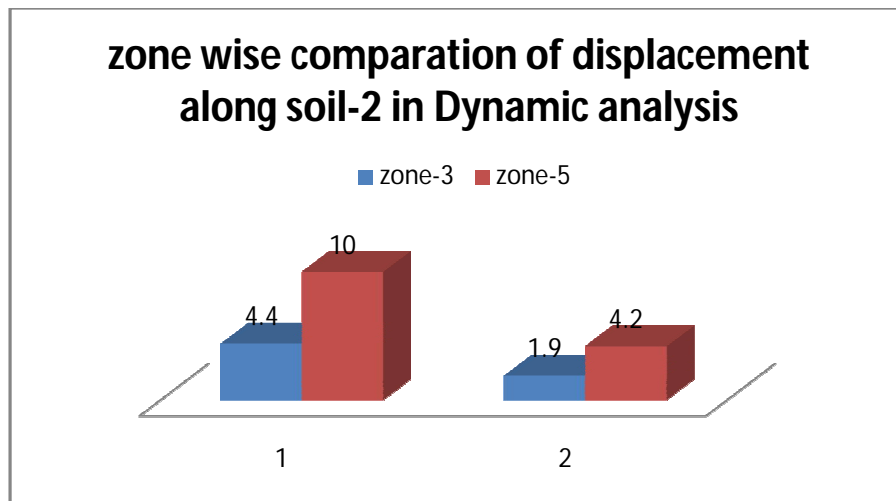
zones	soil-2	soil-2
zone-3	4.4	1.9
zone-5	10	4.2

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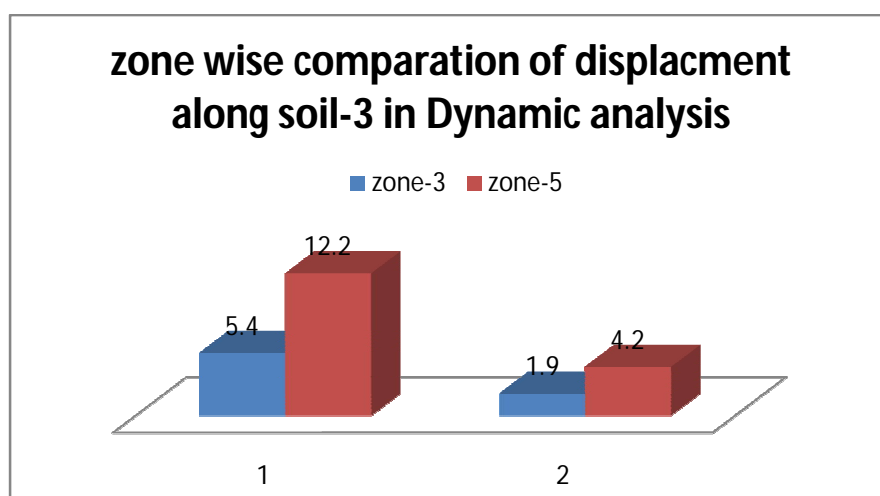
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Graph 5.8 Variation of displacement with bracings & without bracings in Dynamic analysis along zone-3 Zone 5 soil-2.

Table 5.9 Comparative values of displacement in Dynamic analysis along zone-3 zone-5, soil-3 with bracings & without bracings.

zones	soil-3	soil-3
zone-3	5.4	1.9
zone-5	12.2	4.2



Graph 5.9 Variation of displacement with bracings & without bracings in Dynamic analysis along zone-3 Zone 5 soil-3.

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## VICONCLUSION

Based on the analysis

1. The structural performance is analysed in two different models I.e. without bracings and with bracings of X shape, the displacement of 50% is reduced when lateral system are provided.
2. Zone wise comparison in made for each soil and it is observed that average of 50% is reduced in displacement, shear, moment.

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