# ANALYSIS AND DESIGN OF RESIDENTIAL BUILDING WITH INVERTED V BRACING BY USING ETABS 2015

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**Abstract -** *From the ancient we know earthquake is a disaster causing occasion. Up to date days construction are fitting increasingly narrow and extra inclined to sway and consequently detrimental within the earthquake. Researchers and engineers had worked out within past to make the construction as earthquake resistant. After many functional reports it have been proven that use of lateral load resisting methods in the constructing configuration has drastically increased the performance of the structure. In the present analysis, a residential building is analyzed and designed with X bracing for a G+14 building. The building is analyzed in both static and dynamic analysis response spectrum method is carried out for the building. The building is analyzed in condition i.e., in Zone-4 and Zone-5 in Soil A,B and C.A commercial package of ETABS 2015 has been utilized for the analyzing residential building. The result has been compared using tables and graphs to find out the most optimized solution. Concluding remark has been made on the basis of that analyzing and comparison tables.*

***Key Words : ETABS 2015, Residential Building, Inverted V Bracing.***

## 1. INTRODUCTION

From a structural engineer's factor of view the tall constructing or high upward thrust constructing (HRB) may be outlined in concert that, with the inside the structural type. Tall constructions have involved grouping from the beginning of civilization. Such structures were made for safeguard and to indicate pleasure. The system of urbanization that began with the age of industrialization remains to be ongoing in setting up nations like India. Industrialization motives migration of contributors to urban centers wherever job opportunities are critical. The land accessible for structures to accommodate this migration is changing into scarce, main too fast expand inside the cost of land. The growth in latest multi storied constructing development, which began in late nineteenth century, is meant for essentially the most part for industrial and residential features. Tall buildings are the fundamental conflicting necessities and problematic constructing techniques to integrate. In these day's tall constructions are getting extra and evolved engineered structures considering there are a few additional slim ensuing in the hazard of further sway as compared with earlier high-rise structures.

For that reason the influence of wind and seismic forces performing on them turns into an awfully foremost facet of the seam. Rising the structural techniques of tall structures will management their dynamic response. A tall building can be outlined as a constructing whose design is dominated via the lateral forces prompted given that of wind and earthquake. On the way's aspect ten experiences, the lateral flow begins dominant the seam, the stiffness rather of force turns into the dominant problem. Fully distinctive structural forms of tall structures could also be accustomed strengthen the lateral stiffness and to decrease the waft index. Many Lateral resisting systems (comparable to introduction of body-wall, framed tube, belt truss with stabilizer, tube in tube and bundled tube programs) may be accustomed withstand the lateral plenty functioning on the constitution. This be taught seeks to understand the more than a few lateral techniques that have emerged and its associated structural behavior for soil kind three (i.e., smooth soil form) all advised 4 zones.

### 1.1 ETABS

From the beginning of style conception through the assembly of schematic drawings, ETABS integrates each side of the engineering style method. Creation of models has ne'er been easier - intuitive drawing commands provide the fast generation of floor and elevation framing. CAD drawings are often reborn directly into ETABS models or used as templates onto that ETABS objects could also be overlaid. The progressive SAP fireplace 64- bit problem solver permits extraordinarily giant and sophisticated models to be quickly analyzed, and supports nonlinear modeling techniques like construction sequencing and time effects (e.g., creep and shrinkage).

## 2. MATERIALS AND GEOMETRICAL PROPERITES

**Table -1:** Materials and Geometrical Properites

| S.No | DESCRIPTION OF PARAMETER | |
|---|---|---|
| 01 | Grade of Concrete | M30 |
| 02 | Grade of steel | Fe 500 |
| 03 | Column Sizes | 400mm x 450mm for Story 0 to 15 |
| 04 | Beam Sizes | 350mm x 400mm For Story 0 to 15 |
| 05 | Slab Thickness | 150mm |
| 06 | Seismic Zone | Zone – IV & V |
| 07 | Zone Factor | 0.24 & 0.36 |
| 08 | Importance Factor | 1.0 |
| 09 | Response Reduction Factor | 5.0 |
| 10 | Percentage of Damping | 5% |
| 11 | Type of Soil | A – Hard Soil |
| | | B – Medium Soil |
| | | C – Loose Soil |

## 3. RESULTS

### 3.1 STATIC ANALYSIS

**Table -2:** Static Analysis Without and With Inverted V Bracing in Zone – 4

| ZONE – 4 | | | | | | |
|---|---|---|---|---|---|---|
| Description | WITHOUT BRACING | | | WITH BRACING | | |
| | Soil A | Soil B | Soil C | Soil A | Soil B | Soil C |
| Displacement | 20.1 | 26.9 | 0.9 | 10 | 11.7 | 0.5 |
| Bending Moment | 9.686 | 9.686 | 11.13 | 1.981 | 1.981 | 2.69 |
| Shear Force | 6.764 | 9.131 | 0 | 1.285 | 1.883 | 2.37 |

**Table -3:** Static Analysis Without and With Inverted V Bracing in Zone – 5

| ZONE – 5 | | | | | | |
|---|---|---|---|---|---|---|
| Description | WITHOUT BRACING | | | WITH BRACING | | |
| | Soil A | Soil B | Soil C | Soil A | Soil B | Soil C |
| Displacement | 29.3 | 201.2 | 49.9 | 14.6 | 81.4 | 24.6 |
| Bending Moment | 9.186 | 1.486 | 13.51 | 1.964 | 0.478 | 3.855 |
| Shear Force | 9.171 | 12.42 | 11.26 | 1.878 | 0.110 | 0.879 |

### 3.2 DYNAMIC ANALYSIS

**Table -4:** Dynamic Analysis Without and With Inverted V Bracing in Zone – 4

| ZONE – 4 | | | | | | |
|---|---|---|---|---|---|---|
| Description | WITHOUT BRACING | | | WITH BRACING | | |
| | Soil A | Soil B | Soil C | Soil A | Soil B | Soil C |
| Displacement | 99.9 | 136.5 | 117.2 | 46.1 | 52.6 | 0.001 |
| Bending Moment | 9.229 | 1.128 | 1.18 | 1.947 | 0.279 | 0.14 |
| Shear Force | 9.912 | 7.350 | 5.84 | 1.887 | 0.029 | 0 |

**Table -5:** Dynamic Analysis Without and With Inverted V Bracing in Zone - 5

| ZONE – 5 | | | | | | |
|---|---|---|---|---|---|---|
| Description | WITHOUT BRACING | | | WITH BRACING | | |
| | Soil A | Soil B | Soil C | Soil A | Soil B | Soil C |
| Displacement | 149.8 | 201.2 | 251.4 | 69.2 | 81.4 | 92.1 |
| Bending Moment | 9.186 | 1.486 | 4.268 | 1.964 | 0.478 | 3.112 |
| Shear Force | 8.364 | 12.42 | 3.332 | 0.086 | 0.110 | 0.112 |

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### 3.3 STATIC & DYNAMIC ANALYSIS COMPARISON

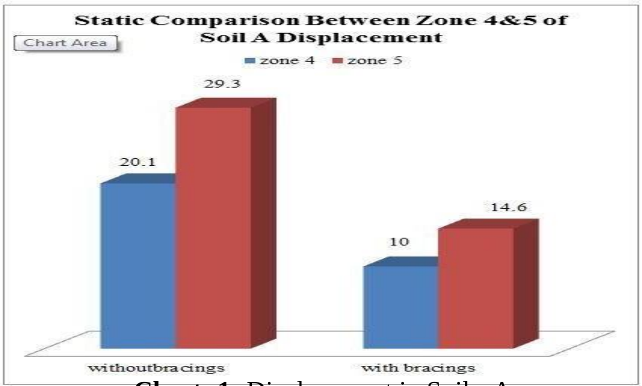


**Chart -1:** Displacement in Soil - A

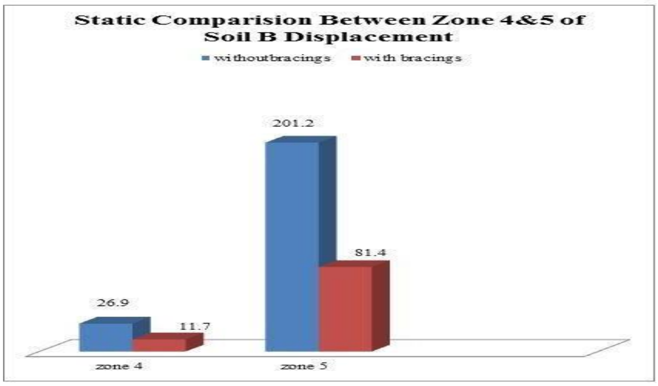


**Chart -2:** Displacement in Soil - B

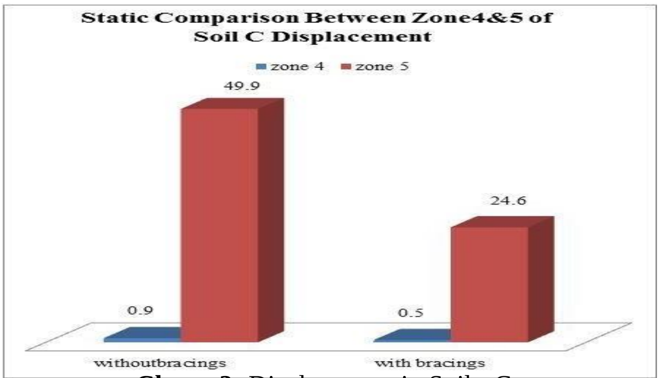


**Chart -3:** Displacement in Soil - C

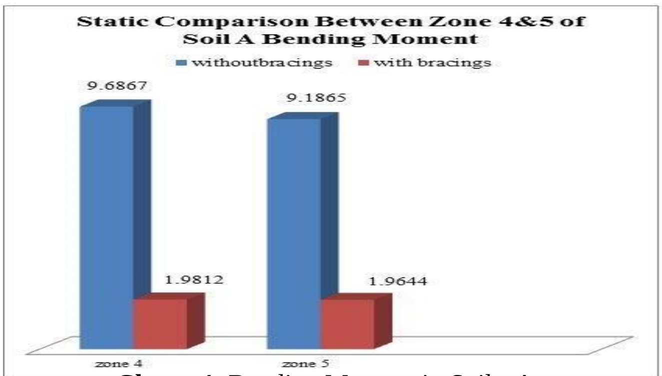


**Chart -4:** Bending Moment in Soil - A

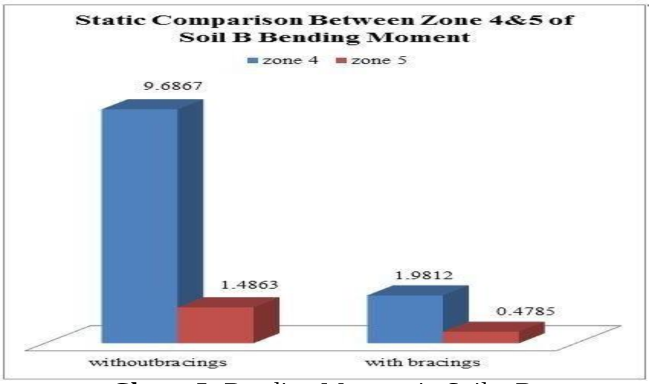


**Chart -5:** Bending Moment in Soil – B

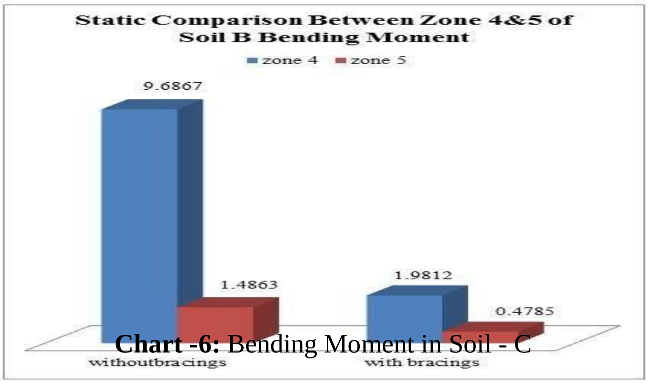


**Chart -6:** Bending Moment in Soil - C

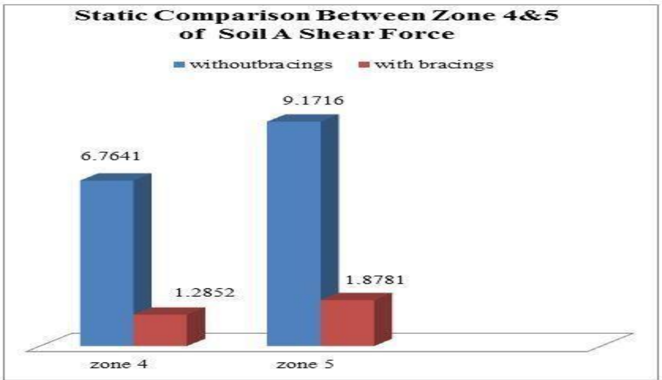


**Chart -7:** Shear Force in Soil - A

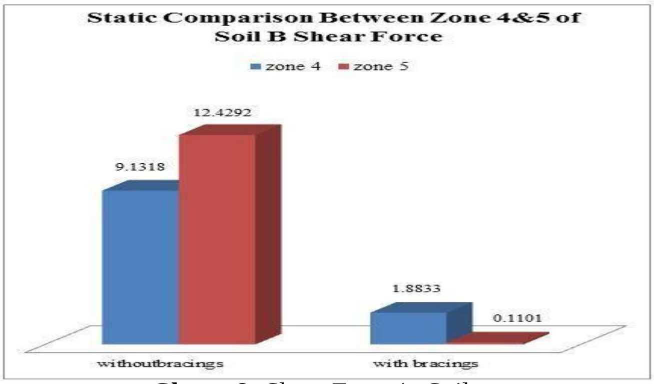


**Chart -8:** Shear Force in Soil

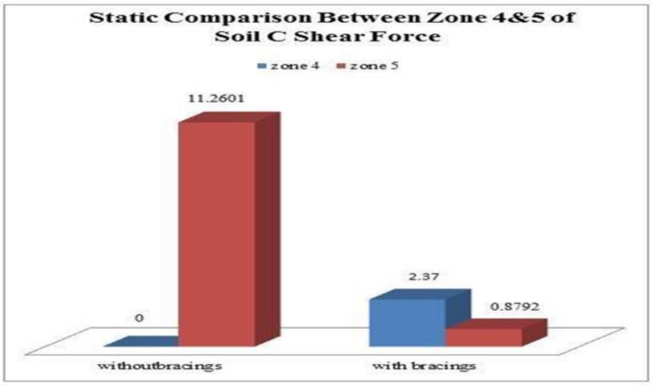


**Chart -9:** Shear Force in Soil – C

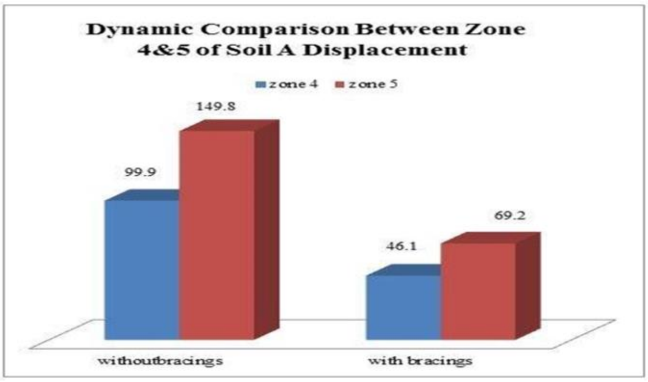


**Chart -10:** Displacement in Soil - A

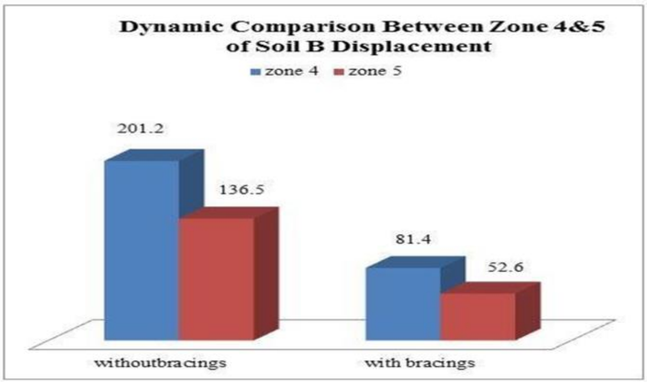


**Chart -11:** Displacement in Soil – B

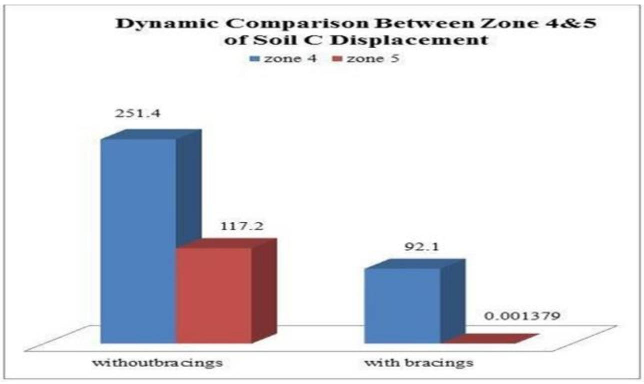


**Chart -12:** Displacement in Soil – C

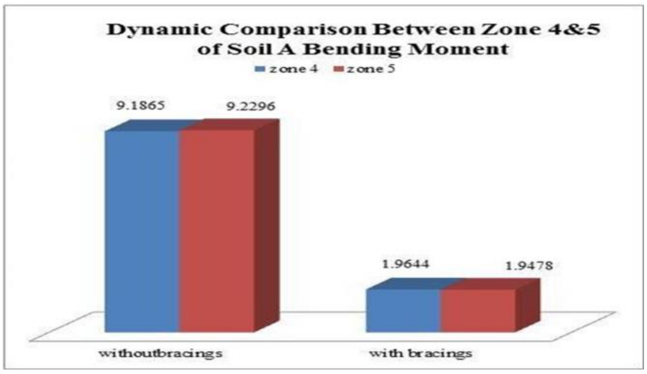


**Chart -13:** Bending Moment in Soil – A

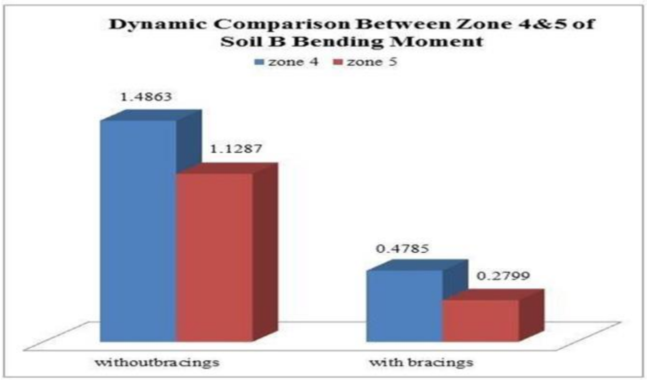


**Chart -14:** Bending Moment in Soil - B

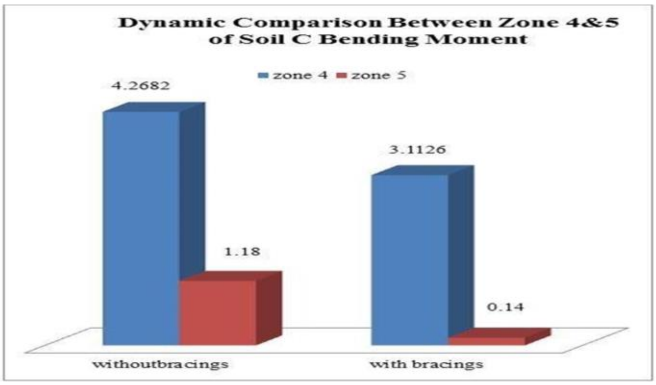


**Chart -15** Bending Moment in Soil - C

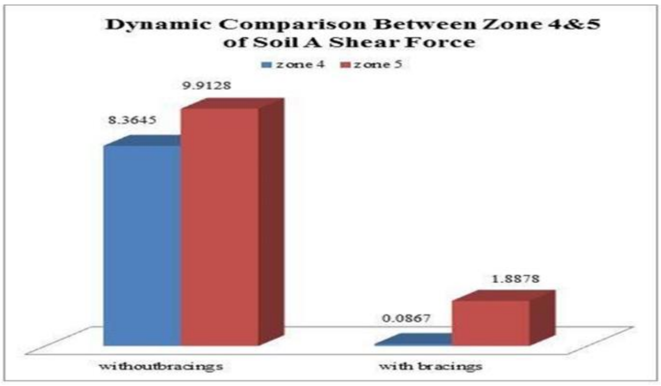


**Chart -16:** Shear Force in Soil – A

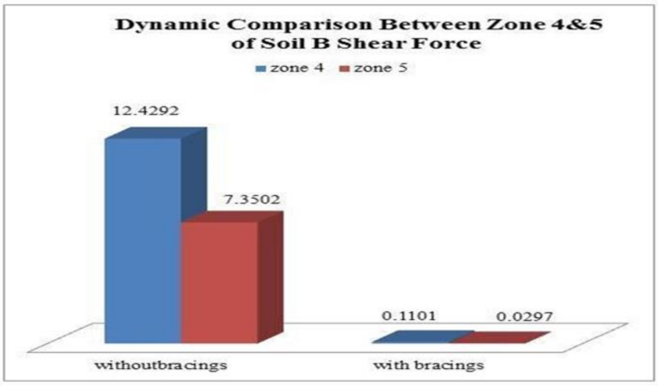


**Chart -17:** Shear Force in Soil – B

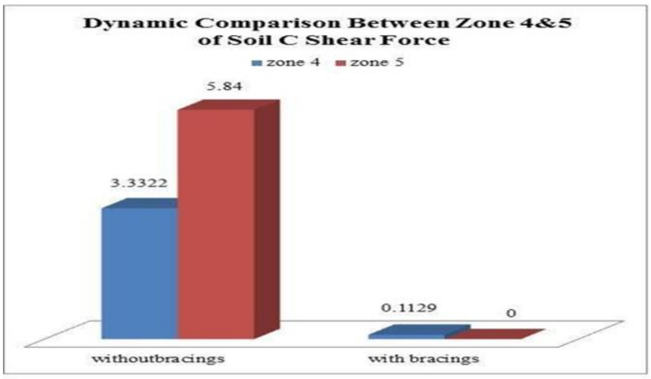


**Chart -18:** Shear Force in Soil – C

## 4. CONCLUSION

**Table 4.1** Static Analysis Conclusion in Zone – 4

| Type of Soil | Description | Zone - 4 |
|---|---|---|
| Soil – A | Displacement | 50% |
| | Bending Moment | 79.54% |
| | Shear Force | 81.00% |
| Soil – B | Displacement | 56.50% |
| | Bending Moment | 79.54% |
| | Shear Force | 79.37% |
| Soil – C | Displacement | 44.44% |
| | Bending Moment | 75.83% |
| | Shear Force | 100% |

**Table 4.2** Static Analysis Conclusion in Zone – 5

| Type of Soil | Description | Zone - 5 |
|---|---|---|
| Soil – A | Displacement | 50.17% |
| | Bending Moment | 78.61% |
| | Shear Force | 79.52% |
| Soil – B | Displacement | 59.54% |
| | Bending Moment | 67.80% |
| | Shear Force | 99.11% |
| Soil – C | Displacement | 50.70% |
| | Bending Moment | 71.48% |
| | Shear Force | 92.19% |

**Table 4.3** Dynamic Analysis Conclusion in Zone – 4

| Type of Soil | Description | Zone - 4 |
|---|---|---|
| Soil – A | Displacement | 53.85% |
| | Bending Moment | 78.72% |
| | Shear Force | 98.96% |
| Soil – B | Displacement | 59.54% |
| | Bending Moment | 67.80% |
| | Shear Force | 99.11% |
| Soil – C | Displacement | 63.36% |
| | Bending Moment | 27.04% |
| | Shear Force | 96.61% |

**Table 4.4** Dynamic Analysis Conclusion in Zone – 5

| Type of Soil | Description | Zone - 5 |
|---|---|---|
| Soil – A | Displacement | 53.80% |
| | Bending Moment | 78.89% |
| | Shear Force | 80.95% |
| Soil – B | Displacement | 61.46% |
| | Bending Moment | 75.21% |
| | Shear Force | 99.76% |
| Soil – C | Displacement | 99.99% |
| | Bending Moment | 88.13% |
| | Shear Force | 100% |

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