Location of Efficient Single Outrigger Wall Connection and Wall Belt Supported System over Horizontal Plane

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Abstract— The demands of high rise structure with architectural impact are raise gradually in all over the world. The high rise structure development has extended speedily approximately the planet because now, people try to live in high rise structures. A Structure is said to acceptable if it satisfies the design criteria in it to oppose the lateral forces. Loads generally from vicious earthquakes. The shear wall was implemented to oppose tangential loads. To complete these characteristic the Outrigger & wall belt system should be used in the structure. In this project a G+20 Storey structure is analyzed using five different cases named as ST1 to ST5. 1 to 5 indicates single outrigger system at various location in transverse direction in equal direction at 20 storeys. In this analysis a high rise structure consist of structure made up of G+ 20 storey's building in Zone III. The plinth area is in use as 900 sq. m. The 5 bay & 6 bay with grid spacing is taken 5 m & 6 m in x and y direction respectively. For purpose of the study is Performance of structure under competent position of single outrigger and wall belt supported system over transverse direction in diverse location of building is major objective of project. The project concluded that efficient location for placing shear wall belt to increase lateral load.

***Keywords*- Transverse Direction, outrigger, wall belt, software analysis, multi-storey**

I. INTRODUCTION

With the increasing requirement for high-class and architecturally inspiring structures, as well as custom-built in this area, the diverse themes and the everyday enlarge in heights bring novel challenges and the necessity for new security systems. In sort of to survive earthquakes and tough winds due to structure development, such as improved building unsteadiness and tall heights, we necessitate to crack some protective measures. little example are spacers, cross-wall, outrigger systems, and more. Outrigger Structure Outrigger & Wall Belts always since the contest continues in the nation. The motive taken under this is that when a load is taken on a structure, with a system of vertical and horizontal supports, there is a massive quantity of mutual loads that are generated by the structure, and this load have to be supported by the structure itself.

Since an seismic activity causes vibrations from the earth, they are connected to the structure, and the mainly efficient way to utilize this to oppose the structure is by using this mutual system to use stabilizers, belts supported by the system, and stabilization and system supporting belt. Outriggers are elements that consist of beams or contact plates from the center to the outside of the uprights on both sides, which block the structure and operation of the connecting links. The core was made in the form of a detachable beam, which firmly held the entire structure in order to withstand loads and move the same loads from the supports.

This type of construction provides superior stiffness than a usual frame. The outrigger merge two elements to attach a robust body to resist urgent situation power. If a structure reinforced with outriggers is subject to deflection from wind or seismic loads, the outrigger connects the main wall to and from the uprights; the side load block replaces the complete structural system. The best technique used in multi-storey buildings is body support, be it a core strap or a rafter strap system. These are representatives of structural nodes and communication through them. They are called belt support systems because a belt usually consists of trusses or bolts that connect a line of a structure. The load is discharged from each element, distributed equally across the body.

External straps and straps are used to accommodate the force of the wave and to maintain the stability of the structure. The rules are for the outer uprights to be centered on the crossbar with spacers and straps in one or more positions. The truss straps are attached to the outer column of the house, and from the outside they are attached to the main or center vertical wall. The reason is that this approach is associated with a decrease in the value that occurs in the noise structure compared to the traditional method.

II. OBJECTIVES OF THE PROJECT

This research is based on the Efficiency Location of Single Wall Outrigger and Wall Belt Supported System in Transverse Direction. Under the study it is seems that the used of these type of concept in the structure increasing lateral load handling capacity. The following objectives are taken for this project areas follows:-

- To Study about Outrigger Wall Connection and Wall Belt Supported System.
- To Modeled a G+20 storey multistory Building using software approach.
- To find different results parameters such as Maximum displacement, Base shear, axial force, bending moment, Torsional moment & Stresses in required X Y and Z.
- To compare the ST1(regular model) with ST2 to ST5 model(Outrigger and wall belt models).
- To find the optimum Location of Efficient Single Outrigger Wall Connection and Wall Belt Supported System under above objectives.

III. MODELING AND ANALYSIS

The diverse case of Transverse direction with Outrigger and wall belt supported system are modeled by using fem based CSI- ETABS software. The Notations of cases are as follows:

Case ST 1 : Results for Regular structure with no outriggers support Case ST1
Case ST 2 : Results for Single Outrigger and wall belt supported system at 2G with dual core Case ST2
Case ST 3 : Results for Single Outrigger and wall belt supported system at 3G with dual core Case ST3
Case ST 4 : Results for Single Outrigger and wall belt supported system at 4G with dual core Case ST4
Case ST 5 : Results for Single Outrigger and wall belt supported system at 5G with dual core Case ST5

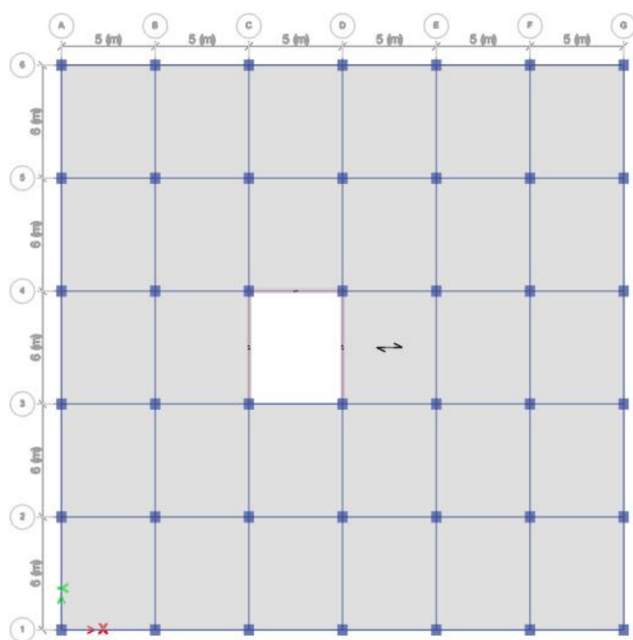


Figure 1: Plan of all the Structural Model Cases

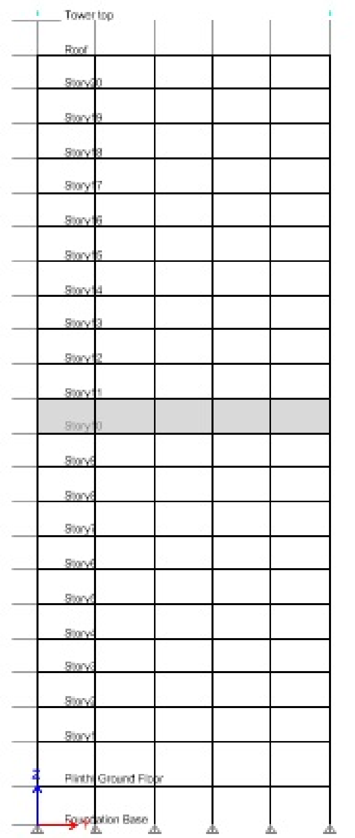


Figure 2: Front View of all the structural model cases

Structural Parameters used in G + 20 storey:

Table 1 & Table 2 shows the basic parameters used in the analysis of building.

Table 1. Structural Parameters

S. No.	Element Name	Description
1	Building Types	Commercial
2	No. of Storey	G+20
3	Plinth Area	900 m^2
4	Floor Height	4.5 GF & 3.5 each floor
5	Dimensions of Beam	0.55 m. x0.40 m.
6	Dimensions of Column	0.60 m. x 0.55 m.
7	Slab Thickness	0.150 m.
8	Shear wall	0.155 m.
10	Grade of Concrete	M25 & M30
11	Steel Used	Fe 500
12	Outrigger and wall belt supported at	1,2,3,4,5 Storey
13	Grid Spacing in X- Direction	5 m.
14	Grid Spacing in Y- Direction	6 m.
15	Time Period	1.3474 Second
16	Analysis Software used	CSI-Etabs

Earthquake Parameters used in G+20 Storey:

Table 2. Earthquake Parameters

S. No.	Parameters	Description
1	Earthquake Code	IS 1893(Part 1):2016
2	Earthquake Zone	III
3	Response Factor(RF)	4
4	Importance Factor(IF)	1.2
5	Soil Types	Medium
6	Damping	0.05
7	Structural Type	RCC Framed Building
8	Earthquake method	Response Spectrum Method

IV. RESULTS AND DISCUSSION

The Following results are to be obtained from the modeling and analysis of Multi storey building of G+20 Storey building in software analysis. The results are as follows:

Maximum Displacement: It is defined as the maximum displacement or distance moved by a point on a vibrating body or wave measured from its equilibrium position. Table 3 Shows that max. value of displacement in G+20 Storey Building for different cases from ST1 to ST5.

Table 3. Maximum Displacement Results

Cases	Maximum Displacement (mm)	
	For X Direction	For Z Direction
Case ST1	284.688	269.734
Case ST2	242.85	210.557
Case ST3	238.456	221.151
Case ST4	229.148	213.831
Case ST5	241.429	219.783

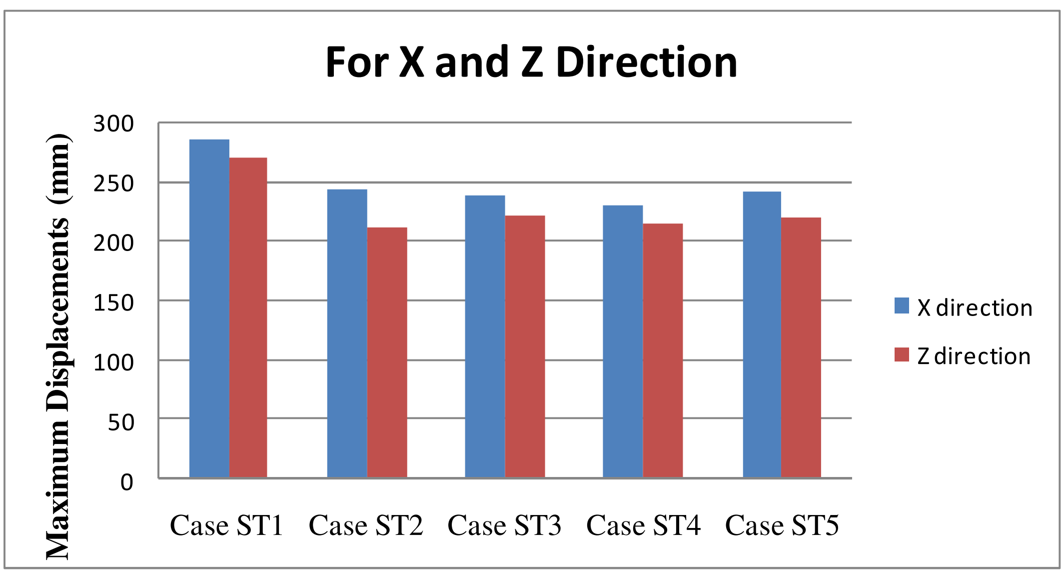


Figure 3: Bar chart of Max. Displacement under ST1 to ST5

Baser Shear*:* Base shear is an estimate of the maximum expected lateral force on the base of the structure due to seismic activity. Table 4 Shows that max. Value of Base shear in G+20 Storey Building for different cases from HP1 to HP6 in X& Z direction.

Table 4. Base Shear Results

Cases	Base Shear (KN)	
	X direction	Z direction
Case ST1	5321.9388	5321.9352
Case ST2	5387.1604	5387.1598
Case ST3	5387.1601	5387.1614
Case ST4	5384.9188	5384.924
Case ST5	5387.1606	5387.1599

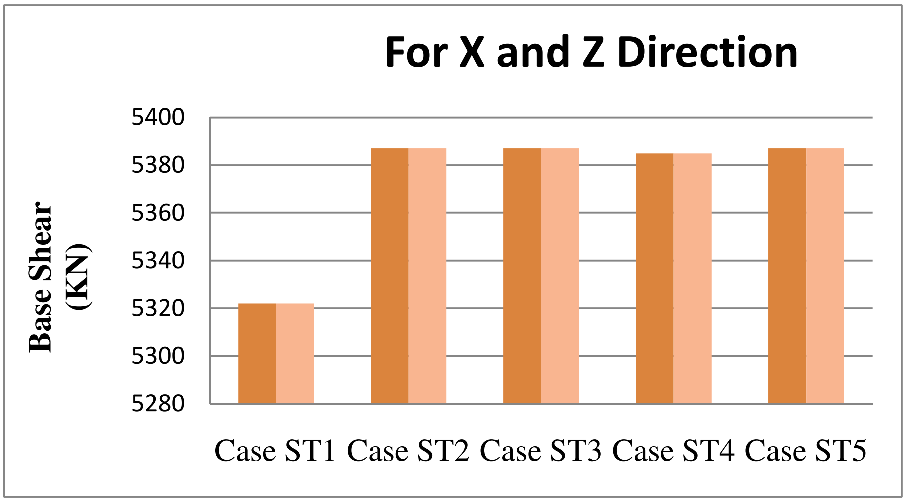


Figure 4: Bar chart of Max. Base Shear under ST1 to ST5

Maximum Axial Forces: If the load on a column is applied through the center of gravity of its cross section, it is called an axial load. Axial force is the compression or tension force acting in a member. Table 5 Shows that max. value of Axial forces in G+20 Storey Building for different cases from HP1 to HP6.

Table 5. Maximum Axial Forces Results

Cases	Column Axial Force (KN)
Case ST1	7913.5328
Case ST2	7280.0567
Case ST3	7182.7683
Case ST4	7521.5103
Case ST5	7285.7476

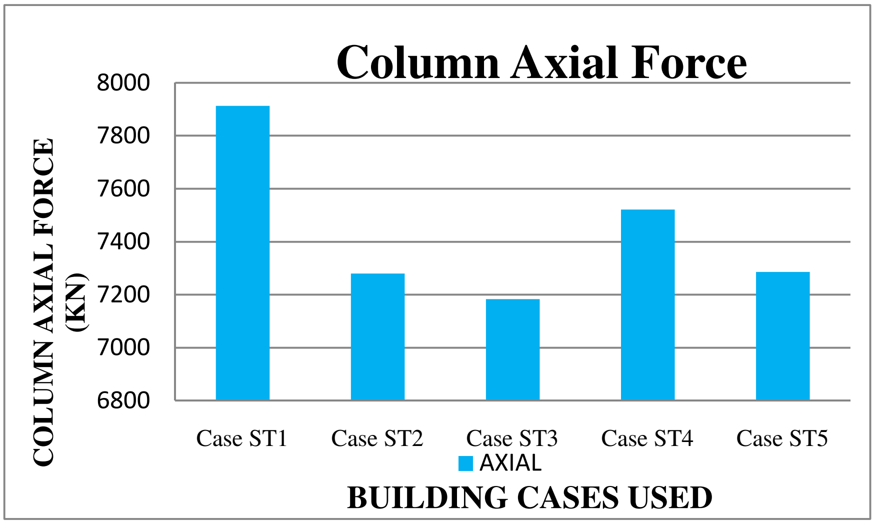


Figure 5: Bar chart of Max. Axial Forces under ST1 to ST5

Maximum Shear Force in Column*:* Shearing forces are unaligned forces pushing one part of a body in one specific direction, and another part of the body in the opposite direction. When the forces are aligned into each other, they are called compression forces. Table 6 Shows that max. value of shear Forces Results in G+20 Storey Building for different cases from HP1 to HP6.

Table 6. Maximum shear Forces in column Results

Cases	Column Shear Force (KN)	
	Shear along Y	Shear along Z
Case ST1	137.4636	136.0902
Case ST2	160.5571	210.8961
Case ST3	188.9118	210.3544
Case ST4	178.2738	199.9827
Case ST5	164.7256	207.8335

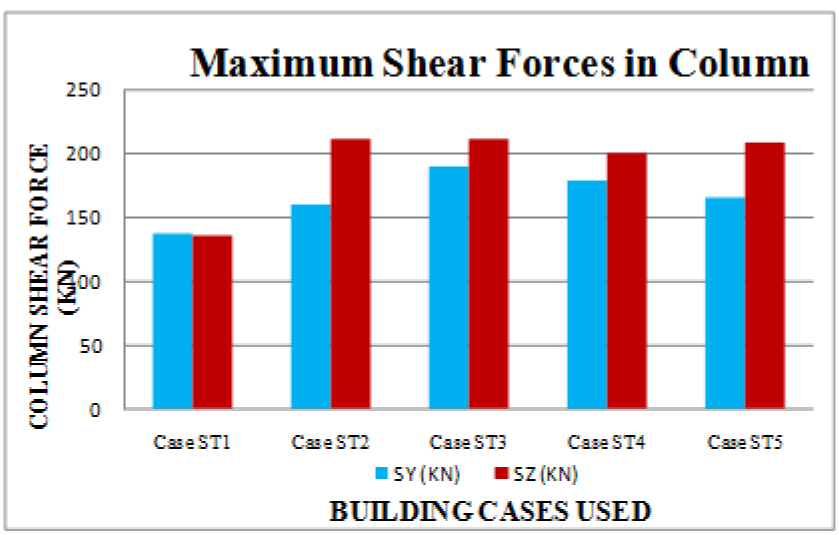


Figure 6: Bar chart of Max. shear Forces under ST1 to ST5

Maximum Bending Moment in Column: A bending moment is the reaction induced in a structural element when an external force or moment is applied to the element causing the element to bend. The most common or simplest structural element subjected to bending moments is the beam. Table 7 Shows that max. value of bending moment Results in G+20 Storey Building for different cases from HP1 to HP6

Table 7. Maximum Bending Moment Results

Cases	Column Bending Moment (KN.m)	
	Moment along Y	Moment along Z
Case ST1	208.4792	239.556
Case ST2	496.9613	367.1999
Case ST3	492.2901	420.8447
Case ST4	466.3364	395.7814
Case ST5	487.8005	371.9137

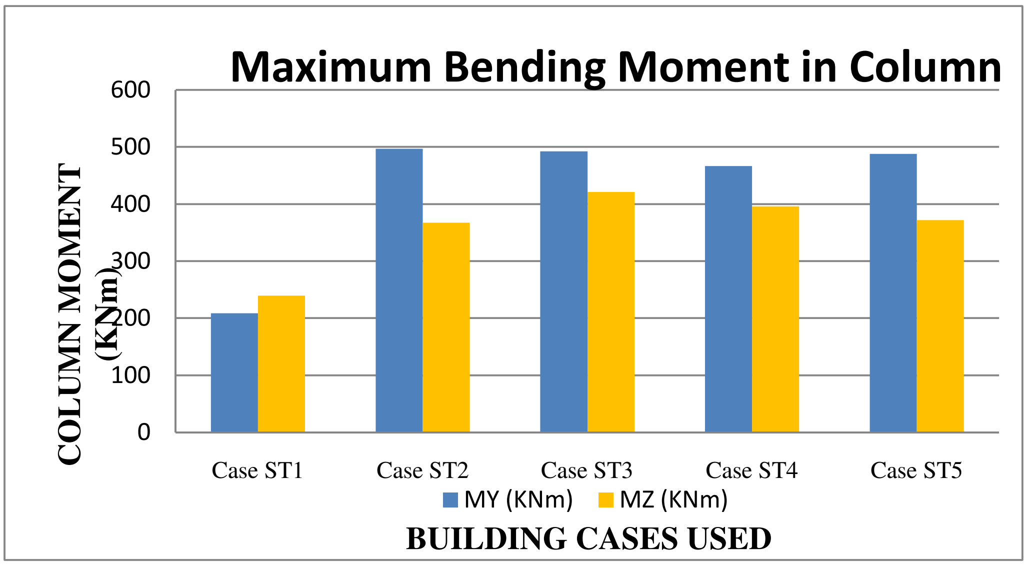


Figure 7: Bar chart of Max. Bending Moment in column under ST1 to ST5

Maximum Shear Force in Beam*:* Table 8 Shows that max. value of bending moment Results in G+20 Storey Building for different cases from ST1 to ST5.

Table 8. Maximum Shear Force in Beam

Cases	Beam Shear Force (KN)	
	Shear along Y	Shear along Z
Case ST1	169.8228	1.7354
Case ST2	151.8172	1.7259
Case ST3	138.7818	1.7258
Case ST4	138.4243	1.7075
Case ST5	150.1443	1.7175

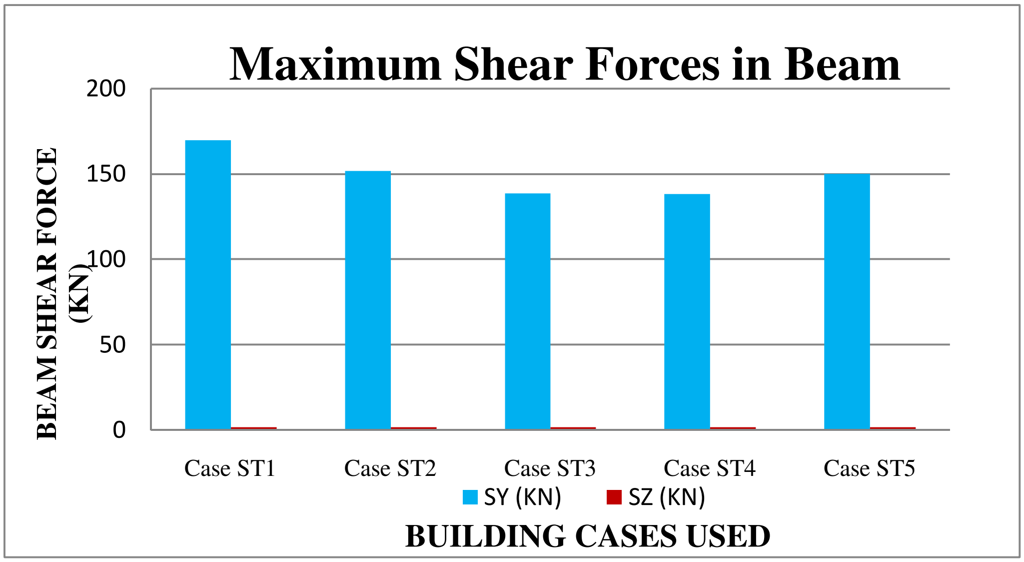


Figure 8: Bar chart of Max. shear force in beam under ST1 to ST5

Maximum Bending Moment in Beam:

Table 9. Maximum Bending Moment in beam

Cases	Beam Bending Moment (KNm)	
	Moment along Y	Moment along Z
Case ST1	3.9107	312.7863
Case ST2	4.3658	271.319
Case ST3	4.6332	258.2509
Case ST4	4.1938	253.5418
Case ST5	4.1042	267.5027

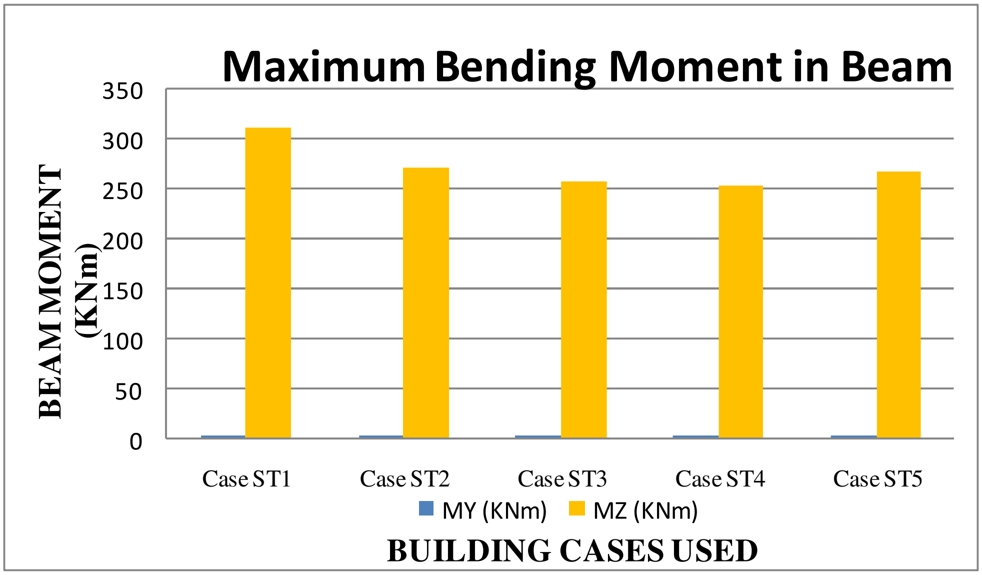
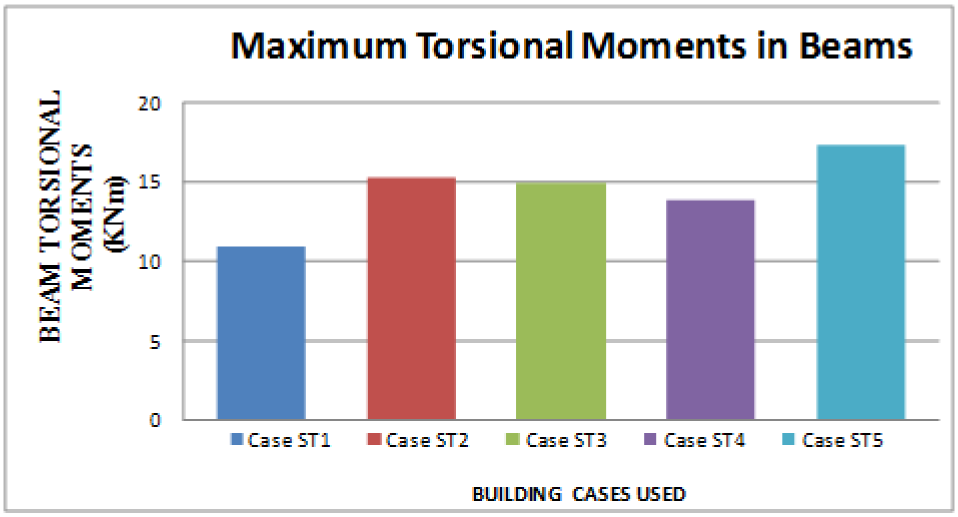


Figure 9: Bar chart of Max. Bending Moment in beam under ST1 to ST5

Maximum Torsional Moments in Beam & Column: Torsion, also known as torque, describes a moment that is acting upon an object around the same axis in which the object lies.

Table 10. Torsional Moment in Beam & Column

Case	Beam Torsional Moments (KN.m)	Column Torsional Moments (KN.m)
Case ST1	10.9019	16.9018
Case ST2	15.3184	17.5331
Case ST3	14.8864	18.5171
Case ST4	13.902	19.2547
Case ST5	17.3935	18.06



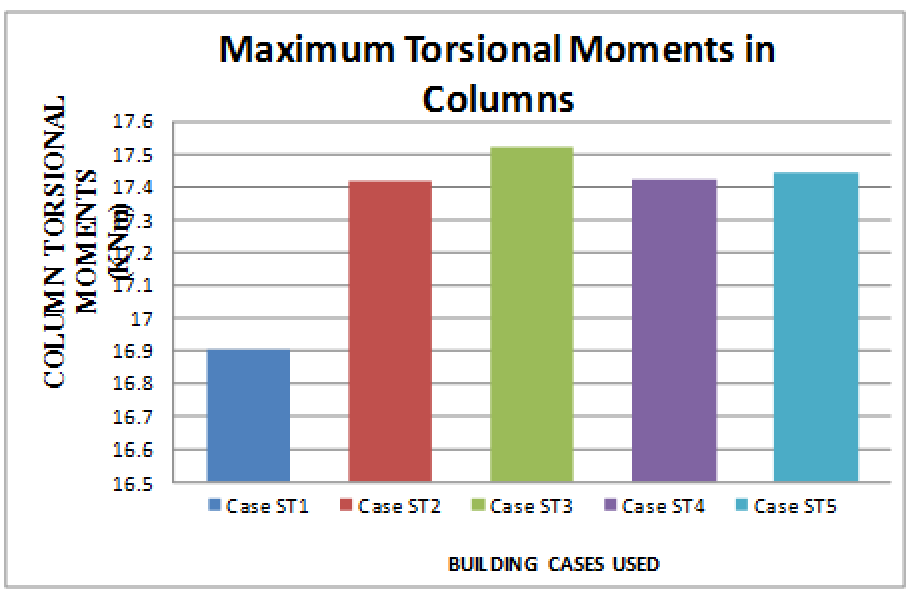
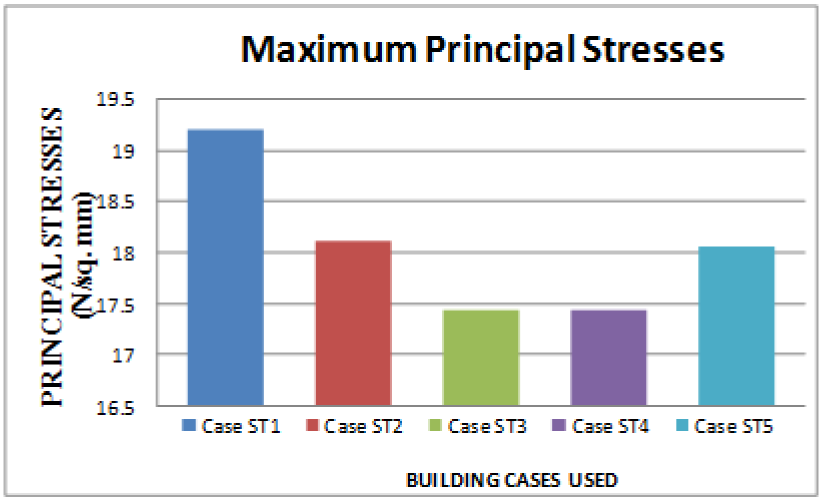


Figure 10: Bar chart of Torsional Moment in Beams & Columns under ST1 to ST5

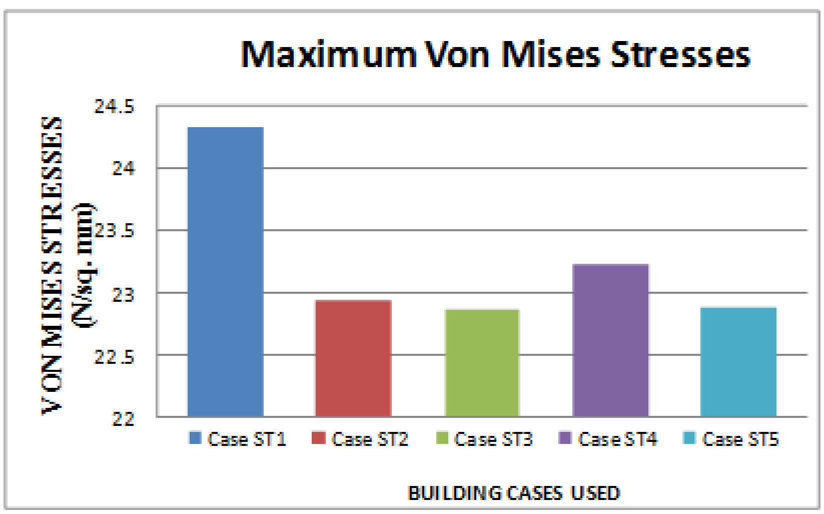
Maximum Stresses developed: Stress is a physical quantity that expresses the internal forces that neighboring particles of a continuous material exert on each other. In this project three types stresses are to be analyzed i.e principal stresses, Von Mises Stresses,Shearing Stresses with their maximum magnitude

Table 11. Maximum Stresses developed

Maximum Stresses developed (N/sq. mm)			
Beam Stability Case	**Maximum Principal Stresses (N/sq. mm)**	**Maximum Von Mises Stresses (N/sq. mm)**	**Maximum Shearing Stresses (N/sq. mm)**
Case ST1	19.21	24.33	7.16
Case ST2	18.11	22.95	7.74
Case ST3	17.45	22.87	9.76
Case ST4	17.45	23.24	11.85
Case ST5	18.06	22.89	8.76



(a)



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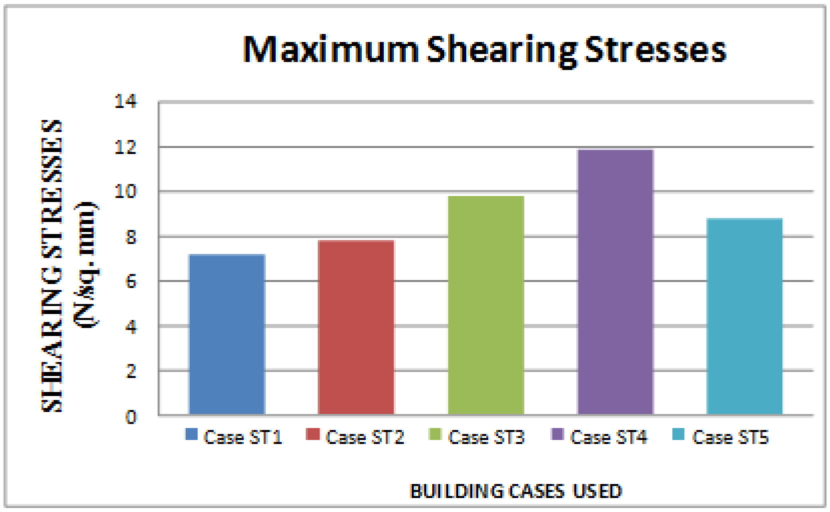

(c)

Figure 11: Bar chart of Max. Stresses developed- Principal Stresses (a),Von Mises Stresses (b) & Shearing Stresses (c) under ST1 to ST5.

V. CONCLUSIONS

The following conclusions are obtained based the different results obtained of model ST1 to model ST5.
The Response spectrum approach is adopted in the entire conclusion are valid only and only for this project. The conclusions are as follows:

1. On comparing it has been concluded that the maximum displacement in X direction obtained for case ST4 with a minimum value respectively again maximum displacement in Z direction obtained for case ST2 with a minimum value.
2. As per comparative results, Case ST4 and ST4 for base shear forces in X direction and Z direction values are respectively efficient among all cases.
3. As per comparative results in axial force, Case ST3 is very effective than other cases.
4. As per comparative results, Case ST2 and ST4 for Column shear forces in X direction and Z direction values are respectively efficient among all cases.
5. As per comparative results, Case ST4 and ST2 for Column beam bending in X direction and Z direction values are respectively efficient among all cases.
6. As per comparative results, Case ST4 and ST4 for Beam shear forces in X direction and Z direction values are respectively efficient among all cases.
7. As per comparative results, Case ST5 and ST4 for Beam Bending Moment in X direction and Z direction values are respectively efficient among all cases.
8. On analyzing the Torsional Moment in beams Case ST4 is very efficient and Torsional Moment in column case ST2 is very efficient
9. As per comparative results in Smax stress , SVM stress and S12 stress values are Case ST4, Case ST3 and Case ST2 respectively observed efficient.
10. Comparing all the cases Case ST4 and case ST2 are the efficient case among all cases.

As we study in this research and also which is shown in the above result that Case ST4 and Case ST2 are the best suited case in Efficient Location of Single Wall Outrigger and Wall Belt Supported System in Transverse Direction. The major outcome is that Efficient Location of Single Wall Outrigger and Wall Belt Supported System in Transverse Direction at dual core at two floor most efficient at 4th floor and second is 2nd floor.

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