

Behaviour of B+G+9 Tall RCC Irregular Stepped Type Structure with Floating Column Using the Bracing and Shear Wall System under Seismic Forces

Prof. Akshay Umare¹, Tejaswini Kittur², Divya Kurbet², Kasturi Biradar²

Assistant Professor, Department of Civil Engineering, S.G.Balekundri Institute of Technology, Belagavi, Karnataka, India¹

U.G. Student, Department of Civil Engineering, S.G.Balekundri Institute of Technology, Belagavi, Karnataka, India²

ABSTRACT: As per the current scenario in civil engineering industry tall structures need to be constructed because of less space availability. This paper aims to contribute some important factors need to be considered in irregular tall stepped type structure. When structure height increases, also the structure displacement increases and finally the member sizes will become very heavy which tends to provide less space for the premises. In this paper shear wall and bracing systems are used to control the displacement of structure and reduce the main member sizes so as to get more space. The structure is analyzed under seismic force in zone III, the dimension of the structure is 40m(L) X 16m (B) X 34m (H). X, Zigzag Diagonal, Diamond, V & Inverted V bracing system is used for structure.

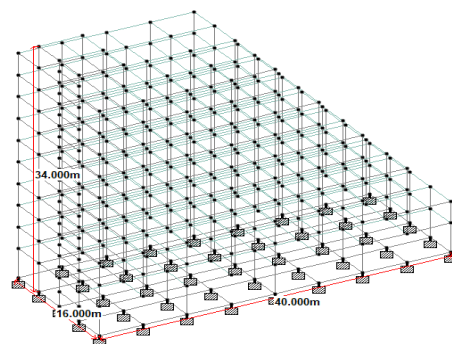
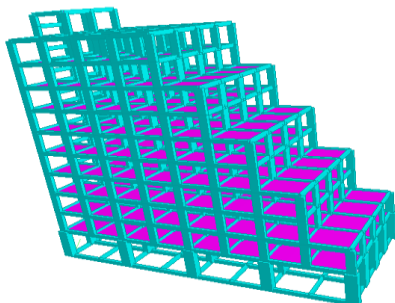
KEYWORDS: Irregular structure, Shear wall, Bracing System, Base shear, Displacement, Storey drift, new model after conclusion.

I. INTRODUCTION

Steel bracing and shear wall system is one of the effective measures for resisting the horizontal forces like seismic and wind forces in reinforced concrete multistory buildings. These bracing improves stability and resists lateral loads. Beams and columns are designed for vertical load in braced construction. Shear walls are a type of structural system that provides lateral resistance to a building or structure. They resist in-plane loads that are applied along its height. The applied load is generally transferred to the wall by a diaphragm or collector or drag member. They are built in wood, concrete, and (masonry).

II. MODELS FROM STAAD.PRO V8I SS6

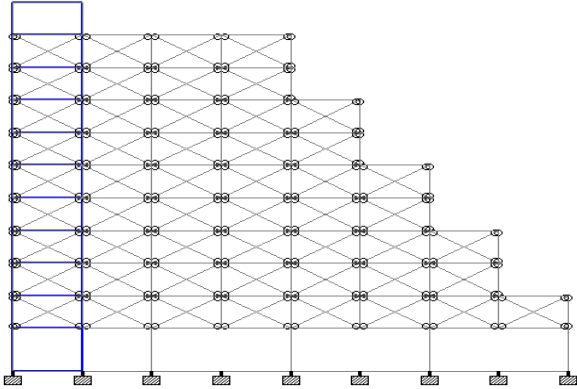
A. CONVENTIONAL BUILDING WITHOUT SHEAR WALL AND BRACE



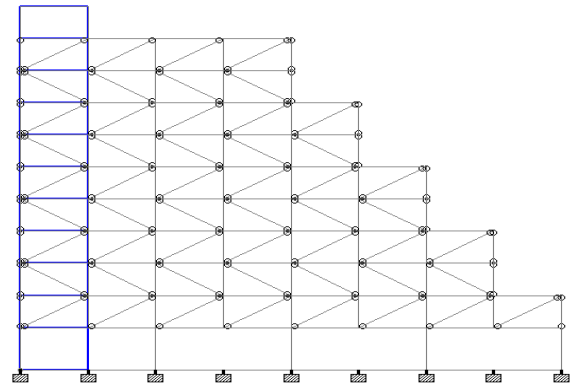
1.1 Structural element Detail:

1. **Beam Size :** 300 X 500 mm
2. **Column Size :** 400 X 1000 mm (Other than Basement)
3. **Column Size :** 800 X 1400 mm (Basement)
4. **Slab Thickness:** 150 mm
5. **Steel Bracing :** 50 mm Circular Brace

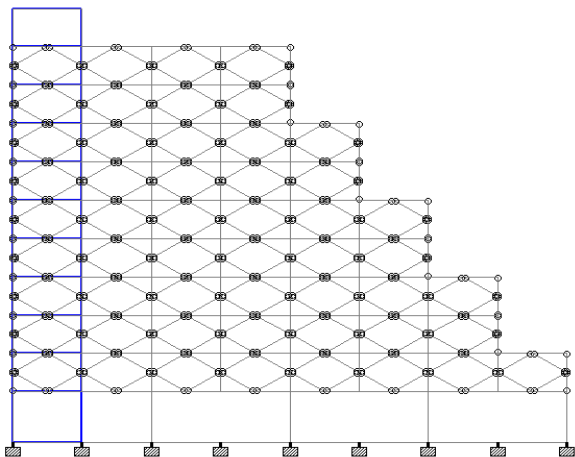
- 6. Shear wall: 250 mm Thk.
- 7. Wall Thickness: 230mm (Main Wall)
150mm (Partition Wall)



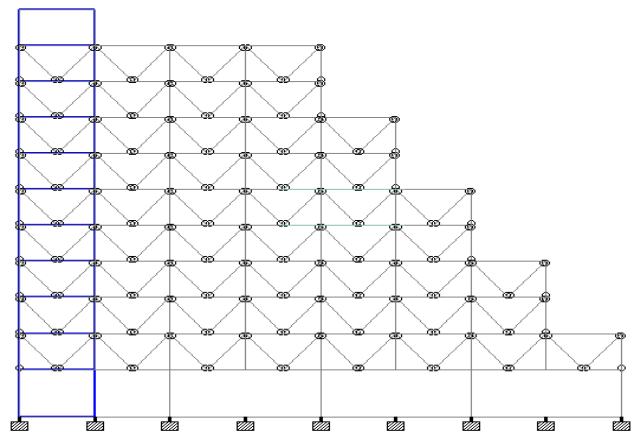
1. X-Bracing with Shear Wall



2. Zigzag Diagonal Bracing with shear wall

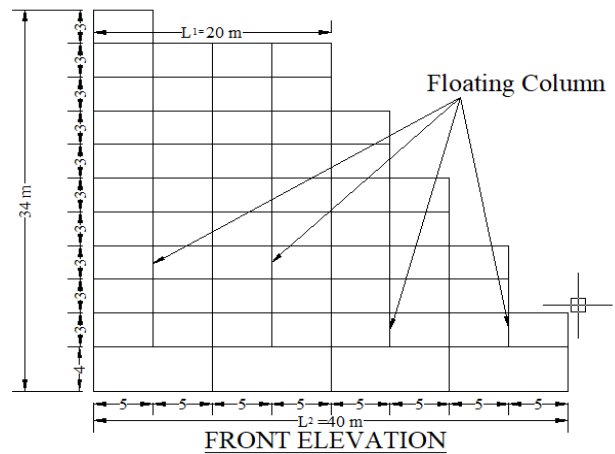
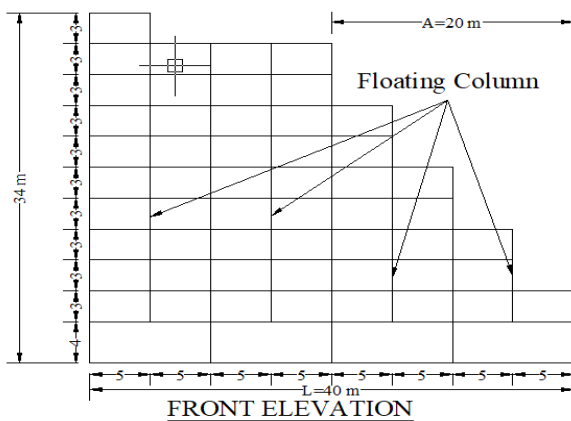


3. Diamond Bracing with Shear Wall



4. V-Bracing with shear wall

Irregular structure as per IS 1893-2002/2005

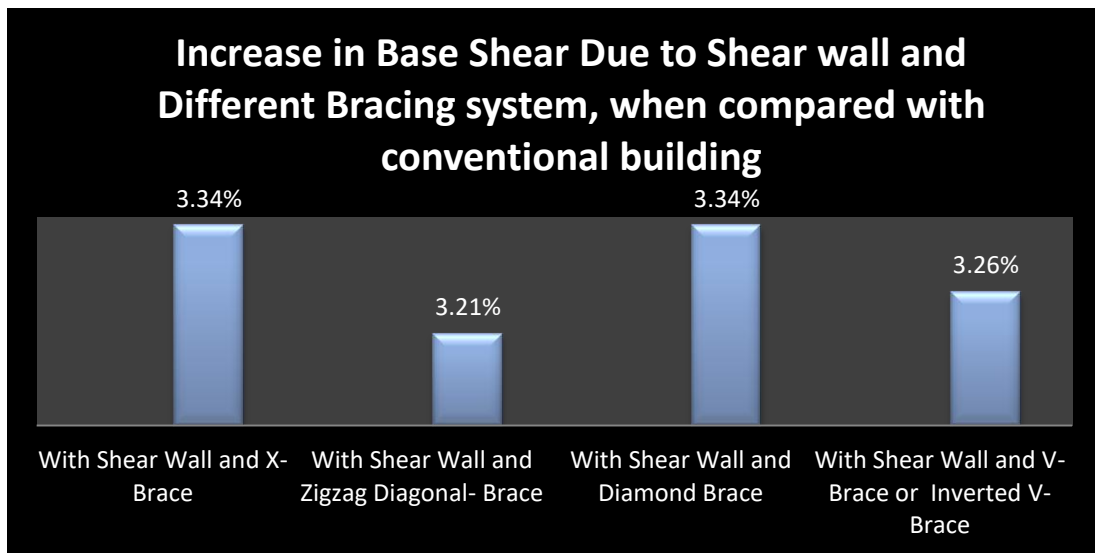


$A/L=20/40=0.5 > 0.25$ & $L_2=40m$ & $1.5L_1 = 1.5 \times 20 = 30m \infty L_2 > 1.5L_1$ [Hence, it is vertical geometrical irregularity]

III. EXPERIMENTAL RESULTS

III.1 Comparison of Base shears of all models with Conventional Building:

Increase in Base Shear Due to Shear wall and Different Bracing system, when compared with conventional building.			Lowest to Highest % Increase
Sl.No	Type of Building	% Increase	
1	With Shear Wall and X- Brace	3.34%	3
2	With Shear Wall and Zigzag Diagonal- Brace	3.21%	1
3	With Shear Wall and Diamond Brace	3.34%	3
4	With Shear Wall and V- Brace or Inverted V- Brace	3.26%	2

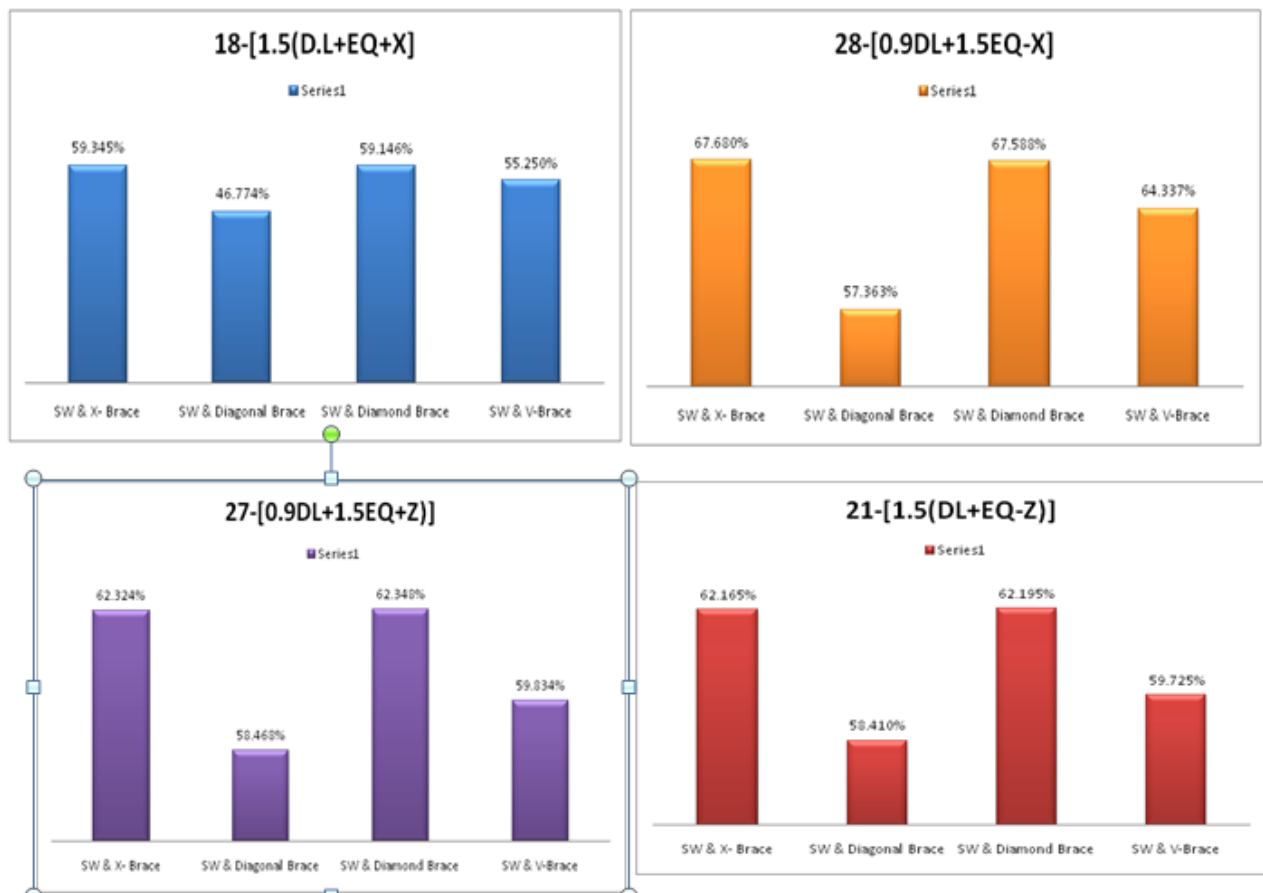


III.2 Below table shows displacement at top level of building ie; @ 34 m and compared with conventional building to check, which model is Suitable for this type of irregular structure in all direction with maximum value in different load combination.

18-[1.5(D.L+EQ+X)]	28-[0.9DL+1.5EQ-X]	27-[0.9DL+1.5EQ+Z]	21-[1.5(DL+EQ-Z)]
Conventional Building Displacement at top level (@ 34 m Height)			
127.991	113.563	153.067	152.312
With Shear wall and X-Brace Displacement at top level (@ 34 m Height)			
52.035	36.703	57.67	57.628
With Shear wall and Zigzag Diagonal-Brace Displacement at top level (@ 34 m Height)			
68.124	48.42	63.572	63.346
With Shear wall and Diamond-Brace Displacement at top level (@ 34 m Height)			
52.29	36.808	57.633	57.581
With Shear wall and V-Brace Displacement at top level (@ 34 m Height)			
57.276	40.5	61.481	61.344

Below table shows the % Decreased Displacement at top level of building compared to Conventional Building

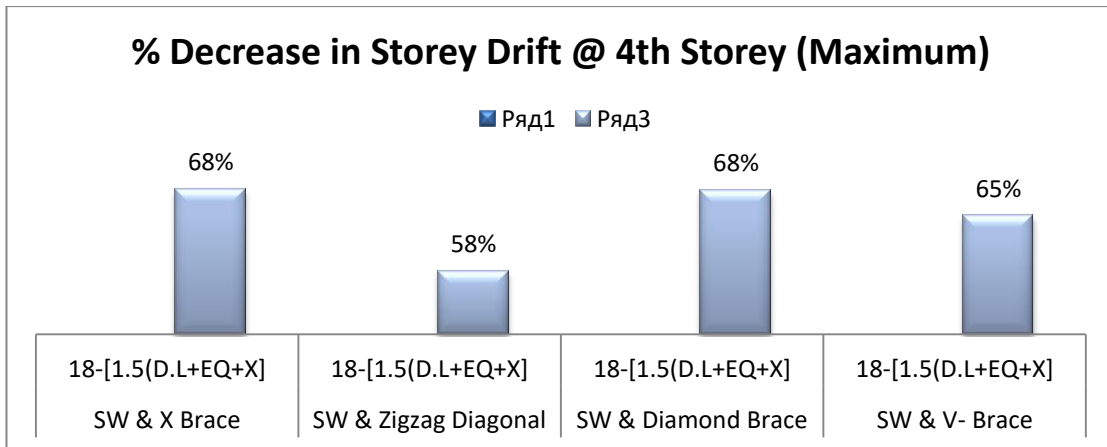
18-[1.5(D.L+EQ+X)]	28-[0.9DL+1.5EQ-X]	27-[0.9DL+1.5EQ+Z]]	21-[1.5(DL+EQ-Z)]
With Shear wall and X-Brace Displacement at top level (@ 34 m Height)			
59.345%	67.680%	62.324%	62.165%
With Shear wall and ZigZag Diagonal-Brace Displacement at top level (@ 34 m Height)			
46.774%	57.363%	58.468%	58.410%
With Shear wall and Diamond-Brace Displacement at top level (@ 34 m Height)			
59.146%	67.588%	62.348%	62.195%
With Shear wall and V-Brace Displacement at top level (@ 34 m Height)			
55.250%	64.337%	59.834%	59.725%



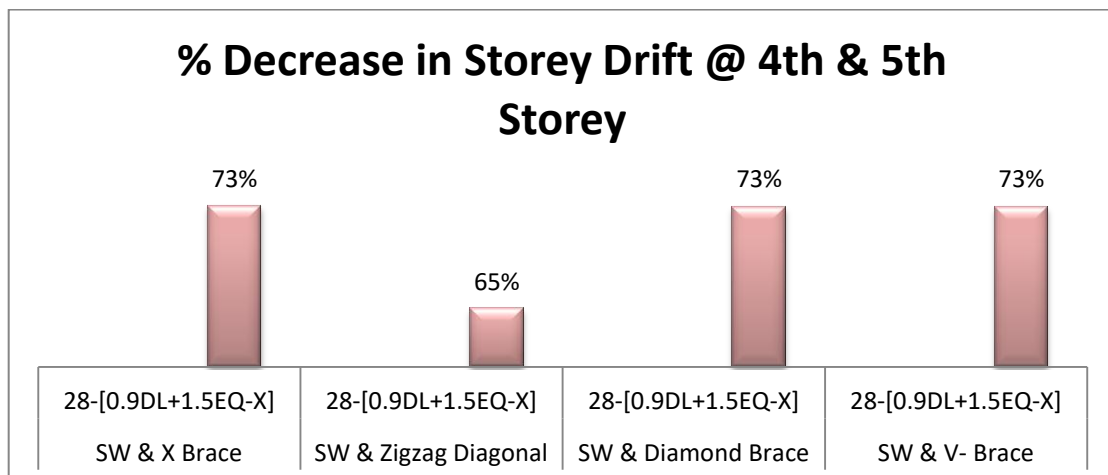
III.3 shows the % Decreased Storey drift at Different level of building Compared to Conventional Building.



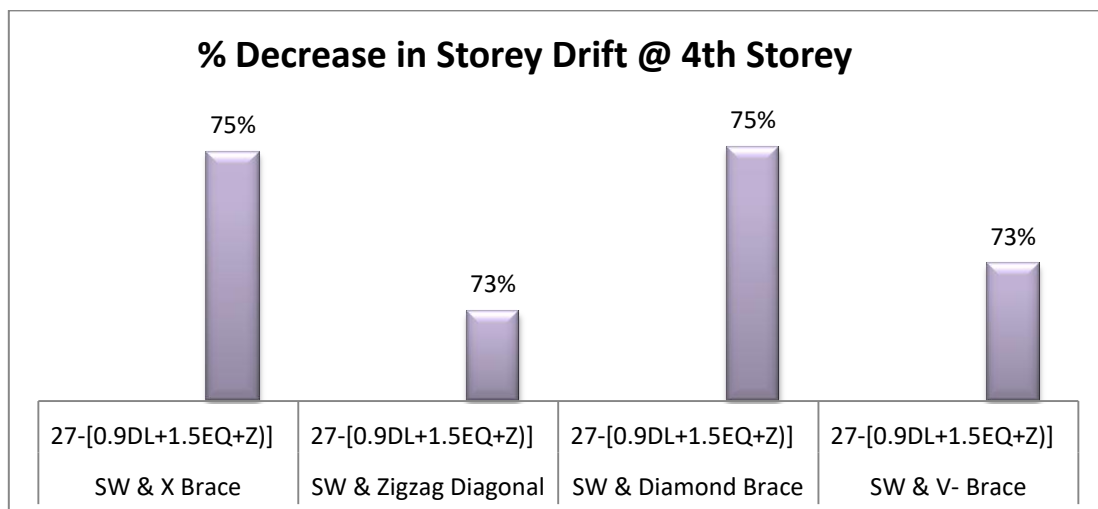
1. Graph below Shows % Decrease Storey drift of all models for load combination 18 (+X)



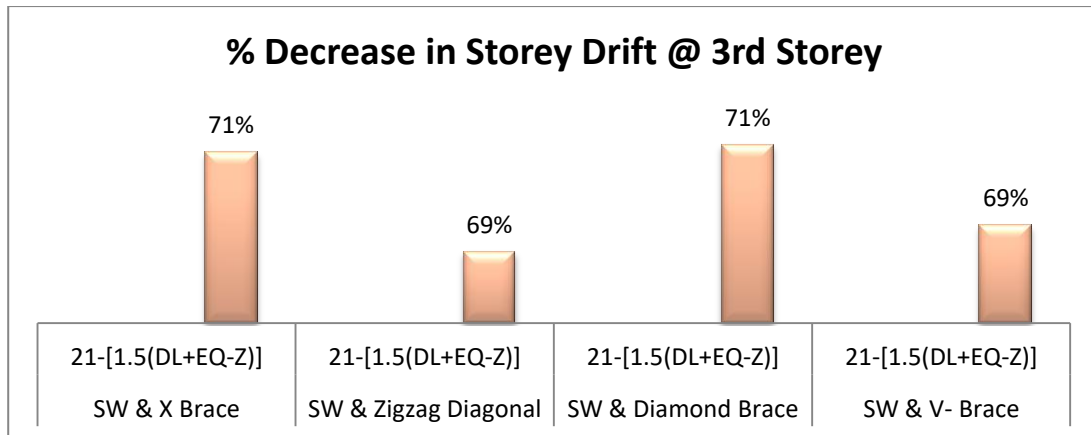
2. Graph below Shows % Decrease Storey drift of all models for load combination 28 (-X)



3. Graph below shows % Decrease Storey drift all models for load combination 27 (+Z)



4. Graph below shows Displacement of all models for load combination 20 (+Z)



IV. CONCLUSION

IV.1 After observing the results from all the models following can be concluded which are as follows:

1. Shear wall with X and Diamond Brace are giving highest result in +X & -X direction ie; 59.345%, 59.146% (+X) & 67.680%, 67.588% (-X) for displacement.
2. Shear wall with X and Diamond Brace are giving highest result in +Z & -Z direction ie; 62.324%, 62.348% (+Z) & 62.324%, 62.195% (-Z) for displacement.
3. As per the above two conclusion 1 & 2, X and Diamond bracing are best suited for this type of structure when displacement is considered.
4. Highest increased base shear are in X and Diamond bracing ie; 3.34% but it will get reduced when the remodeling of structure done with suitable SW & bracing system and for this model best suited system are X & Diamond bracing as mentioned in point 3.
5. Maximum % Decrease storey drift compare to conventional structure in SW with X & Diamond Brace (68%) in **18-[1.5(D.L+EQ+X)] @ 4th Storey**; with X, V & Diamond (73%) in **28-[0.9DL+1.5EQ-X] @ 4th & 5th Storey**; with X & Diamond Brace (73%) in **27-[0.9DL+1.5EQ+Z] @ 4th Storey**; with X & Diamond Brace (71%) **21-[1.5(DL+EQ-Z)] @ 3rd Storey**.
6. **Note: Structure with good light and air is the best structure as per the society demand, so as per our project result diamond bracing is recommended so as to provide clear opening in walls which is giving highest results compared to other models.**

IV.2 After conclusion the model is revised by taking shear wall and Diamond bracing System the % decrease in concrete and steel are as follows:

Conventional structure with shear wall and diamond bracing system after conclusion. The sizes of member are as follows:

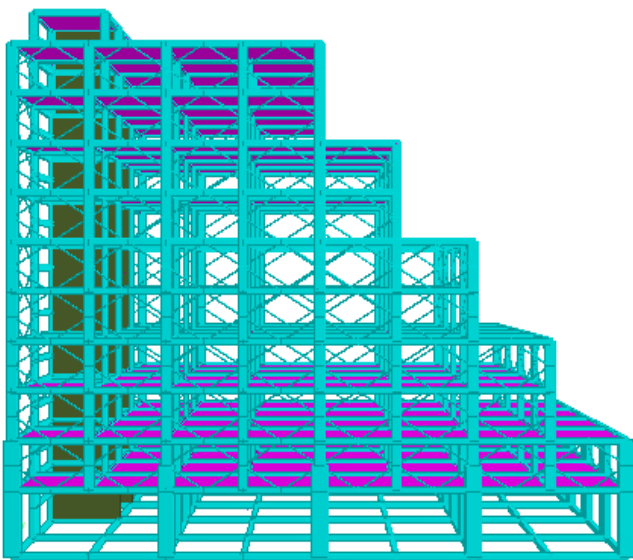
- **Beam Size :** 300 X 350 mm
- **Column Size :** 300 X 600 mm (From 1st floor)
- **Column Size :** 400 X 1000 mm (B+GF)
- **Slab Thickness:** 150 mm

- **Steel Bracing** : 50 mm Circular Brace
- **Shear wall**: 250 mm Thk.
- **Wall Thickness**: 230mm (Main Wall)
150mm (Partition Wall)

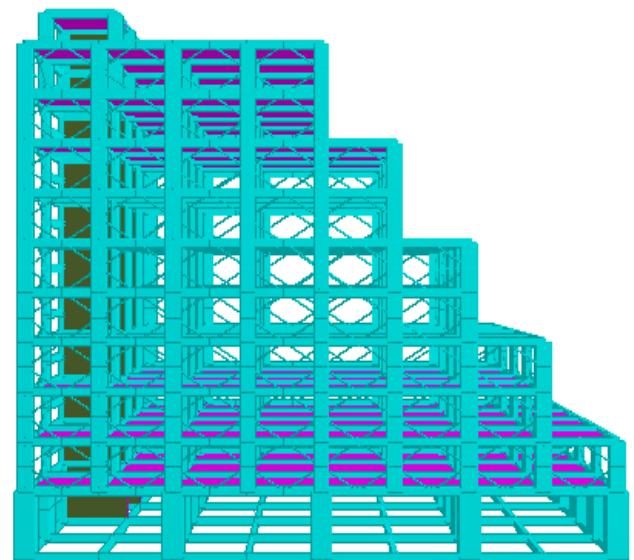
IV.3 Conclusion after revised model:

1. % Decreased in Concrete = 44.72 %
2. % Decreased in Steel = 15.86%
3. In beam 30% (from 500mm to 350mm) depth is reduced.
4. In Column 25 % (from 400mm to 300mm) width reduced and 40% (from 1000mm to 600mm) depth is reduced.
5. Basement column 28.57% (from 1400mm to 1000mm) depth is reduced & 50% (800mm to 400mm) width reduced.
6. Base shear is decreased by $((7075.168-6571.01)/ 7075.168)$ 7.13 % compared with conventional without shear wall and bracing system.
7. Base shear is decreased by $((7319.69-6571.01)/ 7319.69)$ 10.23 % compared with conventional with shear wall and Diamond bracing system.

After Conclusion



Before Conclusion



Observe the member sizes in above image for difference



REFERENCES

- [1] M. Bertalmio, G. Sapiro, V. Caselles, and C. Ballester, "Image inpainting", in Proc. SIGGRAPH, pp. 417–424, 2000.
- [2] Analysis of G+25 RCC Structure with shear wall under the effect of seismic loads using STAAD Pro V8i, Submitted by Akshay Umare et.al, from S.G.B.I.T Belagavi
- [3] Seismic Analysis of RCC Building with and Without Shear Wall, Submitted by P. P. Chandurkar et.al, from Ram Meghe Institute of Technology and Research Badnera, Sant Gadge Baba Amravati University, Amravati, Maharashtra
- [4] Experimental studies of high seismic performance shear walls, submitted by Wen-I Liao et.al, from Assistant Professor, Assistant Professor, Dept. of Civil and Environmental Engineering, National University of Kaohsiung, Kaohsiung, Taiwan
- [5] Comparative study of different bracing systems in RCC buildings using staad.ProV8i, submitted by Pratik Patel et.al, from Department of Civil Engineering, VIEAT-Kim, Gujarat
- [6] Assessment of seismic performance for G+5 multi-storey building with bracings at different stories, submitted by T.S.D. Phanindranath et.al, from research scholar, department of civil engineering, GITAM university college of engineering vizianagaram, Andhra Pradesh
- [7] Behaviour of multi-storey RCC structure with different type of bracing system, submitted by Nauman Mohammed et.al, from Structure Engineer, Department of Civil Engineering, Faculty of Engineering and Technology, Jamia Millia Islamia, New Delhi
- [8] Comparative study of different types of bracing and regular RCC Structure, submitted by Dr. Ramakrishna Hegde et.al, from Head of the Department of Civil Engineering, Srinivas School of Engineering, Mangalore
- [9] A Study On Bracing Systems On High Rise Steel Structures, submitted by Tejas D. Doshi et.al, from Assistant Professor, Department of Civil Engineering, KLE Dr. MSSCET, Belgaum
- [10] Viswanath K.G et.al. (2010), Seismic Analysis of Steel Braced Reinforced Concrete Frames, International Journal of Civil and Structural Engineering, pp 114-116.