

Influence of Dual Core Type Shear Wall Used Around Lift Area with Opening in Different Percentages in Multistoried Structures

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Keywords— Seismic Effects, Shear
Wall, Opening Area, Response
spectrum, Wall Deduction Ratio.

Abstract— The Multistoried Building will consume lesser area of construction, on the other hand, it occupies more living space considering vertical approach. The reduction of the overall budget of the project leads to the cost effective one and there should be such criteria of reduction of the cost in different manner. Without losing the stiffness criteria, the work has been performed by using dual core type shear wall used around lift. The area of shear wall of the core has reduced to certain limit and the aim has decided and fixed to find a suitable reducible area upto the failure of the structure. Total 6 buildings that are modeled with different openings percentages in dual core type shear wall and then analysis procedures of the same has performed. Building with 50% opening area in dual core type shear wall performs well to reduce the overall cost of the project. Complete combined results drawn in the conclusion part.

I. INTRODUCTION

Firm and Stiff thin wall member in a structure used generally around the lift areas to resist the lateral effects is known as shear wall. Shear wall has constructed from foundation base to the top of the structure. These walls have the ability to resist the lateral forces along with the uplift forces due to the pull of wind. It has to resist the force that aim to push the walls over. The shear walls do not need extra finishing or plastering when construction is going on. The shear walls are connected with column components; thereby transfer the entire horizontal and vertical loads throughout it.

II. AIM OF THE CURRENT STUDY

The Aim of the current study has decided by selection of the optimum building case to counteract the seismic effects and analysis has done using analysis software. So for this, different loads applied and parametric values

obtained are considered and the point of comparison on different building models is as follows:

1. To take 6 different buildings, comparing them among each heads by using Response Spectrum Method of dynamic analysis.
2. To calculate Maximum Displacement and Base Shear in X and Z direction and then comparing all the 6 dual core cases.
3. To evaluate maximum Torsional Moments in beams along X and Z directions and then comparison have performed on all the 6 dual core cases.
4. To explore the possibilities of overall structural resistance by minimal use of shear wall area in with and without opening dual configuration multistoried structure.
5. To determine maximum Axial Forces in column and then comparison have performed on all the 6 dual core cases.

To obtain the best building with opening threshold criteria, all buildings are thoroughly observed and compared their parametric values.

III. 3D MODELING OF THE STRUCTURE AND PROCEDURE OF ANALYSIS:

As per criteria for earthquake resistance design of structures, a (G+19) commercial building with plinth area 750 sq. m. for dual core has taken for analysis. A total six different cases have been chosen for parametric analysis for dual core type shear wall, its description shown below. Considering medium soil in seismic zone III, M 30 grade of concrete used with Fe 500 grade of steel is used in the entire analysis approach.

Dead loads (as per IS 875 part 1), Live loads (as per IS 875 part 1) and Response spectrum loads (as per IS 1893: 2016), are applied on the structure with various load combinations considering building has to be rested over medium soil. The equation of Fundamental natural period of vibration (T_a) has taken as $0.09 \cdot h/(d)0.5$.

After then dual shear core building cases are selected with its own abbreviations. Figure 1 and figure 2 shows typical floor plan and the subsequent figure shows the entire sectional 3D views of the Dual Core building. After then, the comparative result of various parameters has shown with graphical representation of each core case.

Table 1: General Data used for analysis of research work

Constraint	Assumed data for all buildings
Structure Type	Commercial Building
Height of building	78.5 m
Building configuration	G + 19
Floor to floor height	3.5 m (for all floors)
Height of ground floor	4 m
Depth of foundation	4 m
Beam sizes	450 mm X 600 mm
Column sizes	550 mm X 650 mm
Slab thickness	160 mm (0.16 m)
Shear wall thickness	280 mm (0.28 m)

Table 2: Seismic Data used for analysis of research work (as per IS 1893:2016)

Seismic Constraint	Assumed data for all buildings
Shear wall type	Ordinary Shear wall with Special moment resisting frames
Response Reduction factor	4
Damping Ratio	5 %
Importance Factor	1.2

Different building model cases selected for analysis using Staad Pro software

When Dual Core is used:-

- **Dual Core Case A:** Building with 100 % shear wall area used
- **Dual Core Case B:** Building with 90 % shear wall area used
- **Dual Core Case C:** Building with 87.5 % shear wall area used
- **Dual Core Case D:** Building with 83.33% shear wall area used
- **Dual Core Case E:** Building with 75 % shear wall area used
- **Dual Core Case F:** Building with 50 % shear wall area used

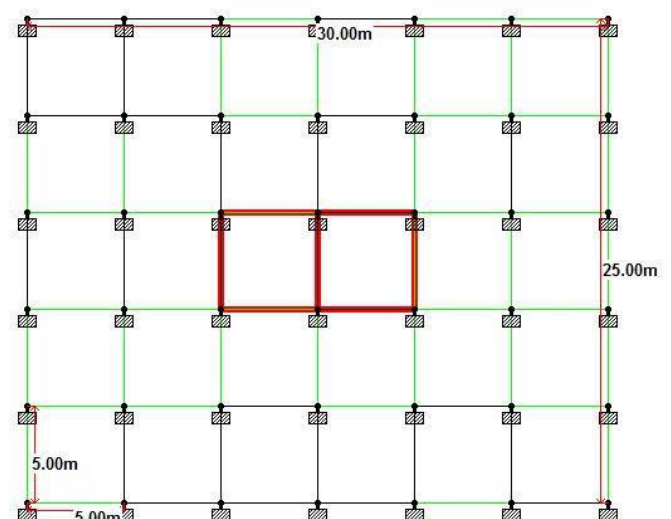


Fig 1: Typical floor plan of Dual Core

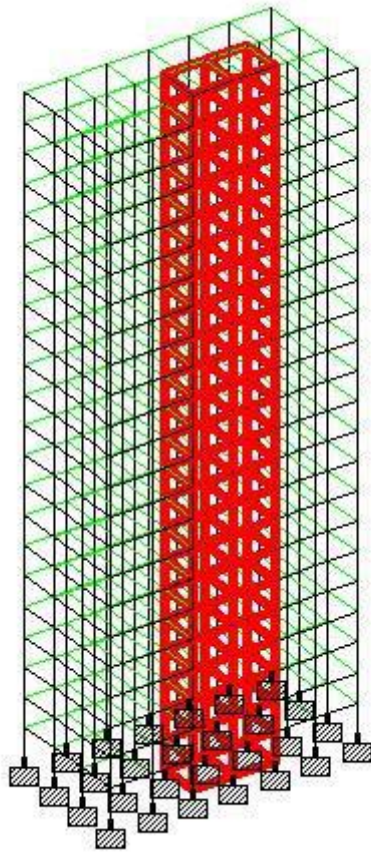


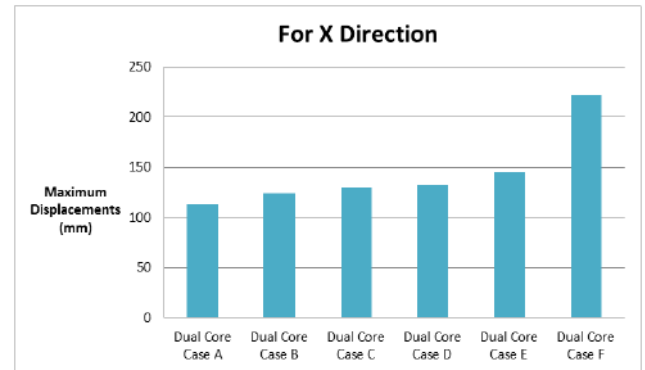
Fig 2: Sectional 3D view of Dual Core

IV. RESULT ANALYSIS

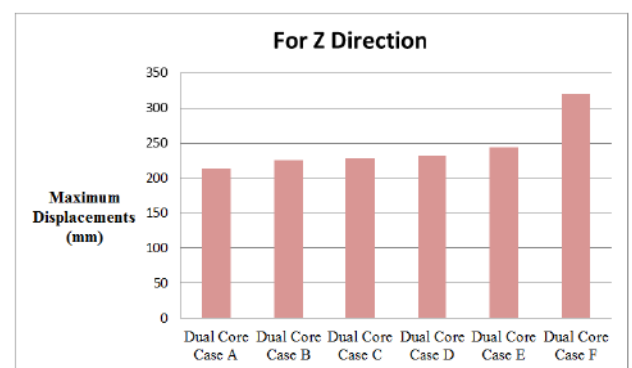
To reduce the overall cost and to reduce the weight of the structure, Dual Core type Shear Wall used around lift area with opening in different percentages is used. For the stability criteria, percentage change in the shear wall opening is used. at different locations. Parameters such as the nodal displacement in X and Z direction, base shear in X and Z direction, column axial forces, column shear and moment values, beam shear and moment values and last but not the least beam torsion values in X and Z direction.

The above parameters obtained by the application of loads and their combinations on various cases of the multistory building as per Indian Standard 1893: 2016 code of practice.

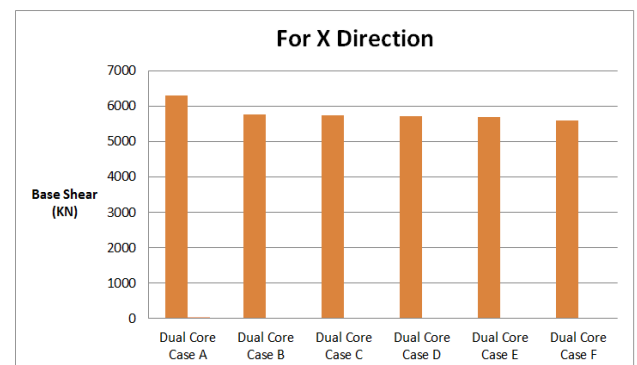
Result of each parameter for all Dual Core cases has discussed by graphical form below:-



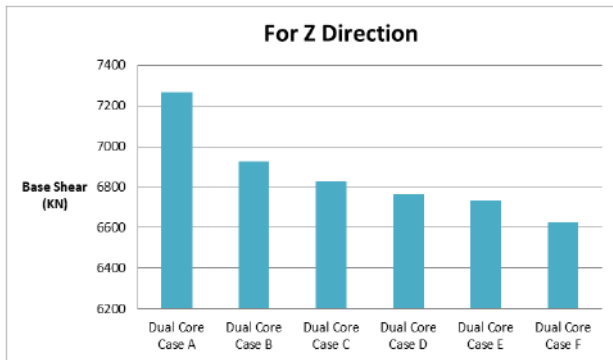
Graph 1: Maximum Displacement in X direction for Dual Core Case A to F



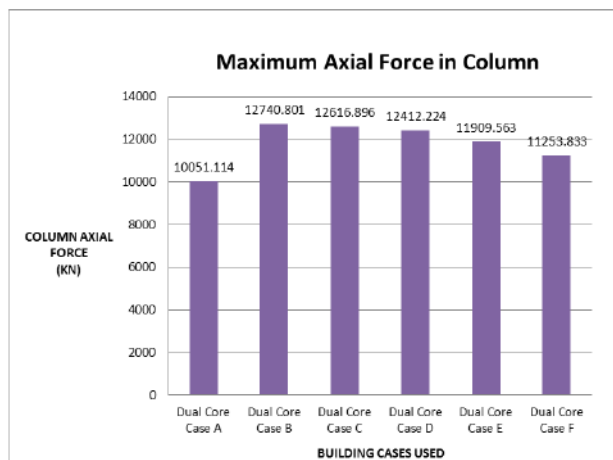
Graph 2: Maximum Displacement in Z direction for Dual Core Case A to F



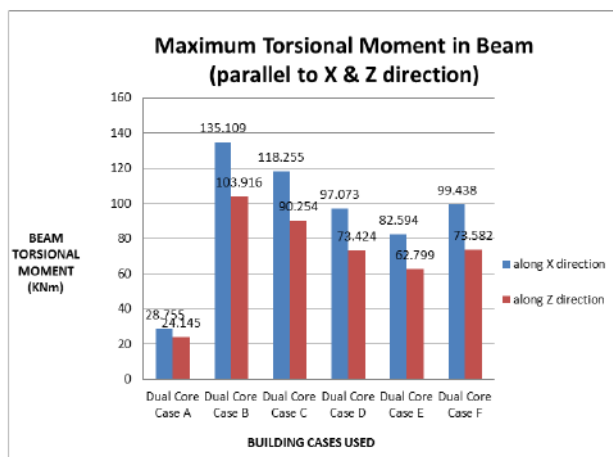
Graph 3: Base Shear in X direction for Dual Core Case A to F



Graph 4: Base Shear in Z direction for Dual Core Case A to F



Graph 5: Maximum Axial Forces in Column for Dual Core Case A to F



Graph 6: Maximum Torsional Moment in beams along X and Z direction for Dual Core Case A to F

V. CONCLUSION

By analyzing different model cases and comparing their results, it is estimated that certain parameters will definitely be used for the conclusive part of this research and for that only that result values were taken are as follows:-The systems minimize hindered space compared to the traditional method. The floor space does not contain any columns and remains among the core and the external columns; as a consequence, increment in the functional efficiency of the building occurs.

1. Maximum displacement in X direction and Z direction increases due to reduction in Shear Wall and when the opening crosses 10%, there is an increase in displacements for dual core cases.
2. Base shear values decreases as the weight of the structure decreases since there is an increase in opening area percentage. For this, in both X and Z directions, Building Core Case F shows the best parametric values at 50 % shear wall opening.
3. Values of Maximum Axial forces in column first increases from 0% to 10 % opening area and then the values constantly decreases and hence building core case F is economical among all with 50% opening area.
4. Torsion in beam shows limiting parametric values under Dual Core Case B when there will be deduction in shear wall area.

Due to Seismic effects, for Dual Core structures, Building Core Case F shows best parametric values among all.

REFERENCES

- [1] Gagan Yadav, et. al, (2020), "Opening Effect of Core Type Shear Wall Used in Multistoried Structures: A Technical Approach in Structural Engineering", *International Journal of Advanced Engineering Research and Science*, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 3, pp. 344-351. <https://dx.doi.org/10.22161/ijaers.73.50>
- [2] Surendra Chaurasiya, et. al, (2018), "Determination of Efficient Twin Tower High Rise Building Subjected to Seismic Loading", *International Journal of Current Engineering and Technology*, INPRESSCO, E-ISSN 2277 – 4106, P-ISSN 2347 – 5161, Vol. 8, No. 5, pp. 1200 – 1203, DOI: <https://doi.org/10.14741/ijcet/v.8.5.1>
- [3] Sagar Jamle, et. al, (2017), "Flat Slab Shear Wall Interaction for Multistoried Building Analysis When Structure Length is greater than width under seismic Forces", *International Journal of Software & Hardware Research in Engineering (IJSHRE)*, ISSN: 2347-4890 Vol.-05, Issue-3, pp. 32-53.
- [4] Sachin Sironiya, Sagar Jamle, M. P. Verma, (2017), "Experimental Investigation On Fly Ash & Glass Powder

- As Partial Replacement Of Cement For M-25 Grade Concrete", IJSART - Volume 3 Issue 5, ISSN- 2395-1052, pp. 322-324.
- [5] Yash Joshi, et. al, (2019), "Dynamic Analysis of Dual Structural System", *International Journal of Research and Analytical Reviews*, (ISSN: 2348-1269 (O), 2349-5138 (P)), vol. 6, no. 2, pp. 518-523
- [6] Sachin Sironiya, Sagar Jamle, M.P. Verma, (2017), "Assessment Of Concrete Properties By Partial Replacement Of Fly Ash With Cement & Recycled Aggregate With Natural Coarse Aggregate", IJSART - Volume 3 Issue 5, ISSN- 2395-1052, pp. 466-470.
- [7] Neeraj Patel, et. al, (2019), "Use of Shear Wall Belt at Optimum Height to Increase Lateral Load Handling Capacity in Multistory Building: A Review", *International Journal of Advanced Engineering Research and Science*(ISSN : 2349-6495(P) | 2456-1908(O)),vol. 6, no. 4, pp. 310-314, AI Publications, <https://dx.doi.org/10.22161/ijaers.6.4.36>
- [8] Taha A. Ansari, et. al, (2019), "Performance Based Analysis of RC Buildings with Underground Storey Considering Soil Structure Interaction", *International Journal of Advanced Engineering Research and Science* (ISSN: 2349-6495(P) | 2456-1908(O)),vol. 6, no. 6, pp. 767-771, AI Publications, <https://dx.doi.org/10.22161/ijaers.6.6.89>
- [9] Sagar Jamle, et. al, (2017), "Flat Slab Shear Wall Interaction for Multistoried Building under Seismic Forces", *International Journal of Software & Hardware Research in Engineering (IJSHRE)*, ISSN: 2347-4890 Vol.-05, Issue-3, pp. 14-31.
- [10] Rajesh Chouhan, Sagar Jamle, Kundan Meshram, (2019), "Dynamic Analysis of Tuned Mass Damper Steel Structure: A Review", *International Journal of Management, Technology And Engineering*, (ISSN: 2249-7455(O)), vol. 9, no. 7, pp. 212-216.
- [11] Prafoolla Thakre, et. al, (2019), "A Review on Opening Area with Respect to Wall Area in Shear Wall for Multistoried Building", *International Journal of Research and Analytical Reviews*, (ISSN: 2348-1269 (O), 2349-5138 (P)), vol. 9, no. 3, pp. 156-161.
- [12] Rajesh Chouhan, Sagar Jamle, Kundan Meshram, (2019), "Dynamic Analysis of Tuned Mass Damper on Steel Structure: A Technical Approach", *International Journal of Research and Analytical Reviews*, (ISSN: 2348-1269 (O), 2349-5138 (P)), vol. 6, no. 2, pp. 956-960.
- [13] Shirish Kumar Kanungo, et. al, (2019), "Determination of Stable USR system", *International Journal of Management, Technology And Engineering*, (ISSN: 2249-7455(O)), vol. 9, no. 11, pp. 143-151.
- [14] Sapan Chawla, et. al, (2020), "A Review on Economical Design of Intz Water Tank as per IS-875-III, for Wind Speed in India", *International Journal of Advanced Engineering Research and Science*, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 1, pp. 147-151. <https://dx.doi.org/10.22161/ijaers.71.19>
- [15] Romesh Malviya, et. al, (2020), "Examination on Increasing Stability of Multistoried Building: A Theoretical Review", *International Journal of Advanced Engineering Research and Science*, (ISSN: 2456-1908 (O), 2349-6495(P)), vol. 7, no. 1, pp. 162-164. <https://dx.doi.org/10.22161/ijaers.71.22>
- [16] Rajesh Chouhan, Sachin Sironiya, Chetan Gurjar, (2021), "Comprehensive Stability Enhancement Techniques of Multistoried Buildings through Altering Beam Structural components at Different Levels", *Journal of Xi'an University of Architecture & Technology*, ISSN: 1006-7930, vol. 13, no. 4, pp. 596-606.