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Determination of Usage of Opening Area Effect of Single and Dual Core Type Effect of Shear Wall in Multistoried Building under Seismic Loading

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Abstract: As per the objectives of Determination of usage of opening area effect of single and dual core type effect of single and dual core type wall in multistoried building under seismic loading, the Response Spectrum Analysis has performed on different building models consist of 5 single core buildings with 100 % shear wall area used abbreviated as SC 1, with 90 % shear wall area used abbreviated as SC 2, with 87.5 % shear wall area used abbreviated as SC 3, with 83.33 % shear wall area used abbreviated as SC 4, with 75 % shear wall area used abbreviated as SC 5.

The Response Spectrum Analysis has also performed on different building models consist of 6 single core buildings with 100 % shear wall area used abbreviated as DC 1, with 90 % shear wall area used abbreviated as DC 2, with 87.5 % shear wall area used abbreviated as DC 3, with 83.33 % shear wall area used abbreviated as DC 4, with 75 % shear wall area used abbreviated as DC 5 and with 50 % shear wall area used abbreviated as DC 6. Since for the analysis of seismic effects, all the cases of the structures have been analyzed for seismic shake for longitudinal along with transverse direction, as conditions should be satisfied in clause 6.3.3, IS 1893-2016.

Various loads along with load combinations applied on all the buildings and reflective result parameters have been analyzed with each other to determine the efficient case. Results are shown both in tabular form as well as graphical form. The analysis results obtained using Staad pro software is shown in tabular form along with various graphs with various parameters in this study shows.

Due to Seismic effects, for single core structures, building SC 5 shows best parametric values among all and for dual core structures, building DC 6 shows best parametric values among all.

Keywords: Seismic activities, ETABS, Stability, High Rise Building

I. INTRODUCTION

One of the foremost glitches in this age of construction ecosphere is the problem of empty and steady land. This absence in urban parts has displayed to the vertical construction exaggeration of low-rise, medium-rise, high rise buildings and even sky-scraper (over 50 meters tall). These buildings usually used Framed Buildings imperilled to the perpendicular as well as lateral loads. In these gatherings, the lateral loads from solid winds and tremors are the key concerns to keep in mind while designing rather than the vertical loads caused by the construction itself.

These both aspects may be contrary wise proportional to each other as the structure which is designed for supporting vertical loads may not have the bulk to withstand or resist the above stated lateral loads. The lateral loads are the major one as they are dissimilar against one additional as the vertical loads are hypothetical to growth linearly with tallness; on the other hand lateral loads are fairly changeable and increase rapidly with height.

When lateral loads of a uniform wind or an earthquake load arrives the overturning moment at base of the structure is humongous and varies proportionally to square of the building height. This causes the building to act as cantilever as these lateral loads are especially higher in the topmost storied comparatively different than the bottom storied.

These lateral forces from the sideways tend to sway the frame. The seismic prone areas where the chances of earthquakes are comparatively higher the buildings collapsed which have not been designed in concern to these seismic loads. All these above stated reactions make it major to study the source and effects of lateral loads and lead us how to erect this. The shear wall is a structural component used to counterattack the earthquake forces or the forces equivalent to the plane of wall. Generally, it is provided in tall buildings to dodge total failure of the structure under seismic loads.

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II. OBJECTIVES

This study of multistorey building for determination of usage of opening area effect of single and dual core type effect of single and dual core type wall in multistoried building under seismic loading modelled the help of Staad Pro model. There are total 11 cases of structure multistoried building at medium soil condition under seismic forces for earthquake zone III exist. Result examine for stresses displacements base shear etc. in longitudinal and transverse direction. After this, the most efficient floor level will be optimizing.

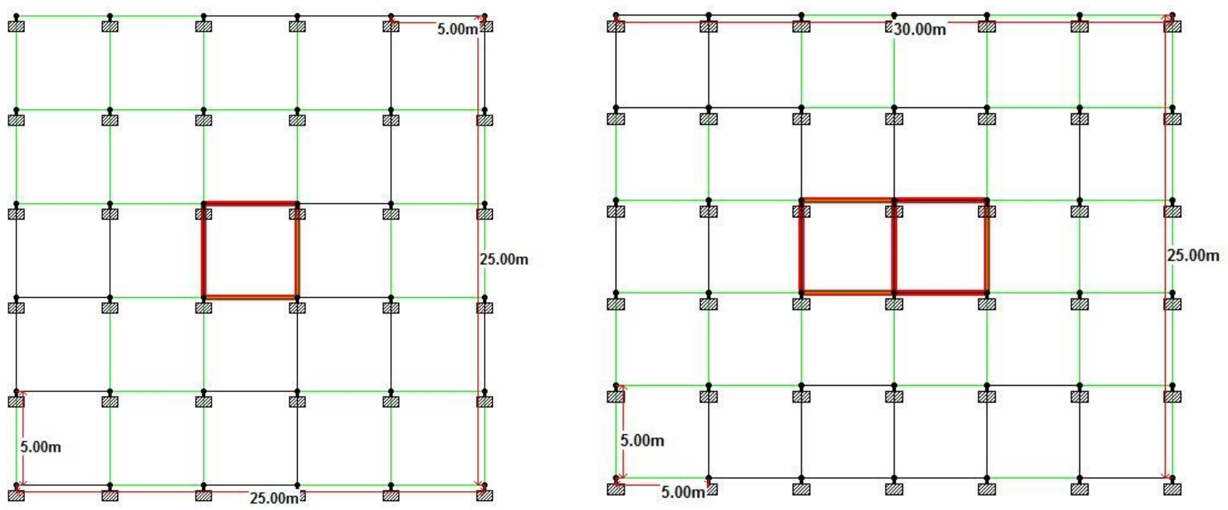


Fig 1: Plan of the building with Single Core and Dual Core

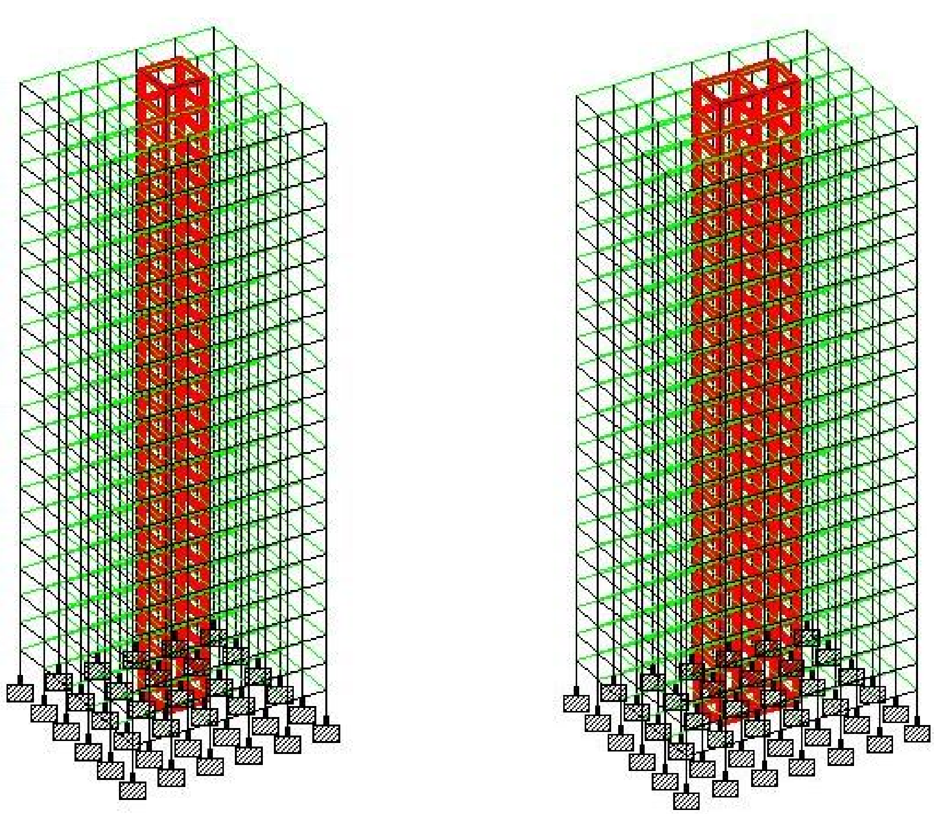


Fig 2: 3D view of the building with Single Core and Dual Core

Table 1: Model Description

Building configuration	G+20
No. of bays in X direction	6
No. of bays in Z direction	5
Height of building	73.5 M
Dimensions of building	25M X 25M (single core) and 30M X 25M (dual core)
Size of beam	0.45 X 0.60
Size of column	0.55 X 0.65
Concrete and Steel Grade	M 30 & FE415

Table 2: Details of Loading

Earthquake parameters	Zone III with RF 4 & 5% damping ratio
Period in X & Z direction	1.0655 & 1.0655 for both direction
Dead load for floor with waterproofing	1.2KN/m^2
Live load for floor and roof	4KN/M^2 & 1KN/M^2

III. RESULTS ANALYSIS

The result parameters obtained by the application of loads and their combinations on various cases as per Indian Standard 1893: 2016 code of practice. Result of each parameter has discussed with its representation in graphical form below:-

A. *Discussions for Single Core Cases*

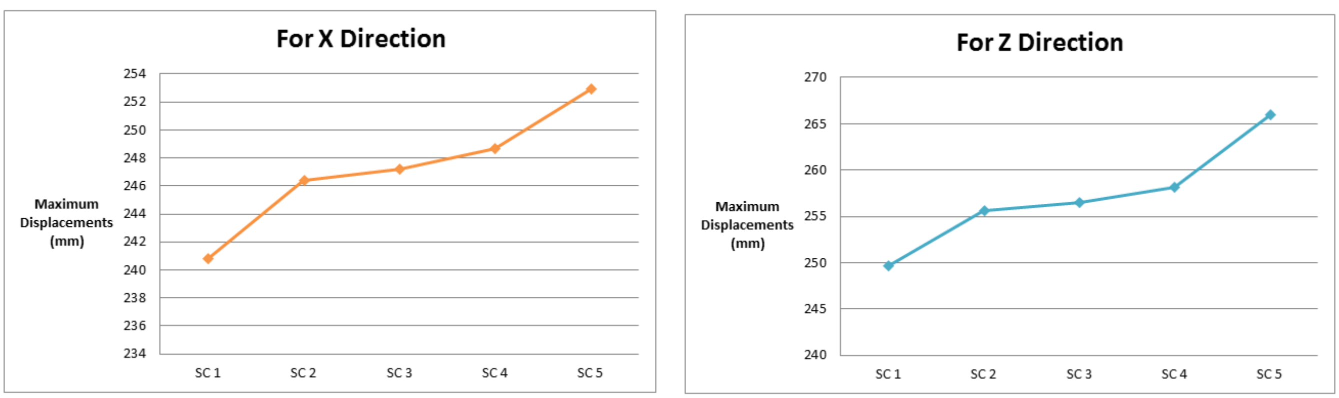


Fig. 3: Graphical Representation of Maximum Displacement in X and Z direction for all Single Core Cases

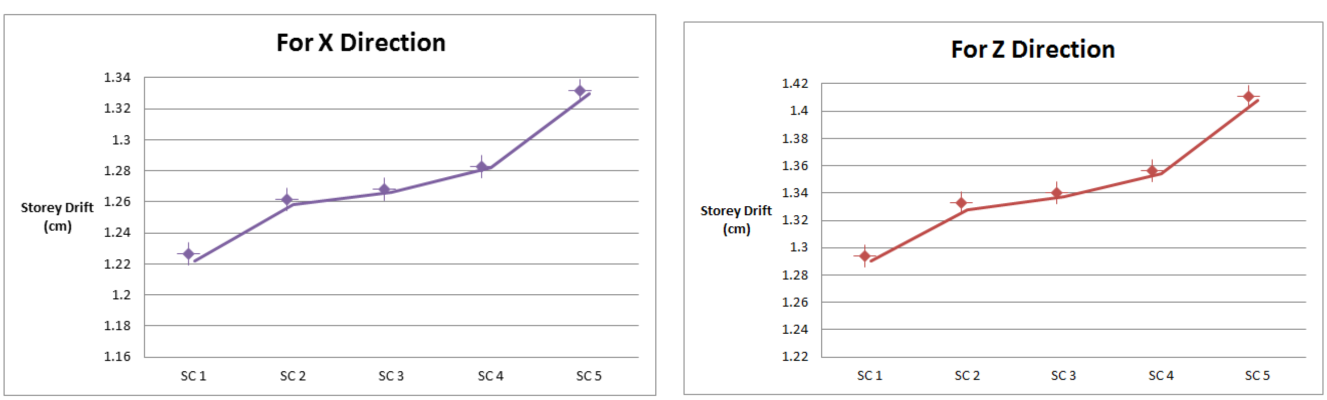


Fig. 4: Graphical Representation of Storey Drift in X and Z direction for all Single Core Cases

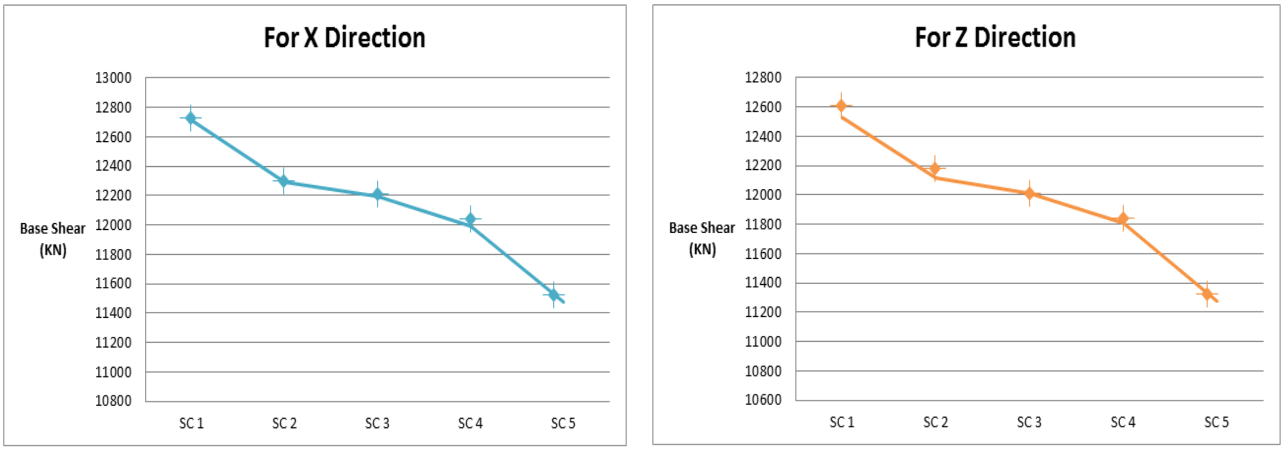


Fig. 5: Graphical Representation of Base Shear in X and Z direction for all Single Core Cases

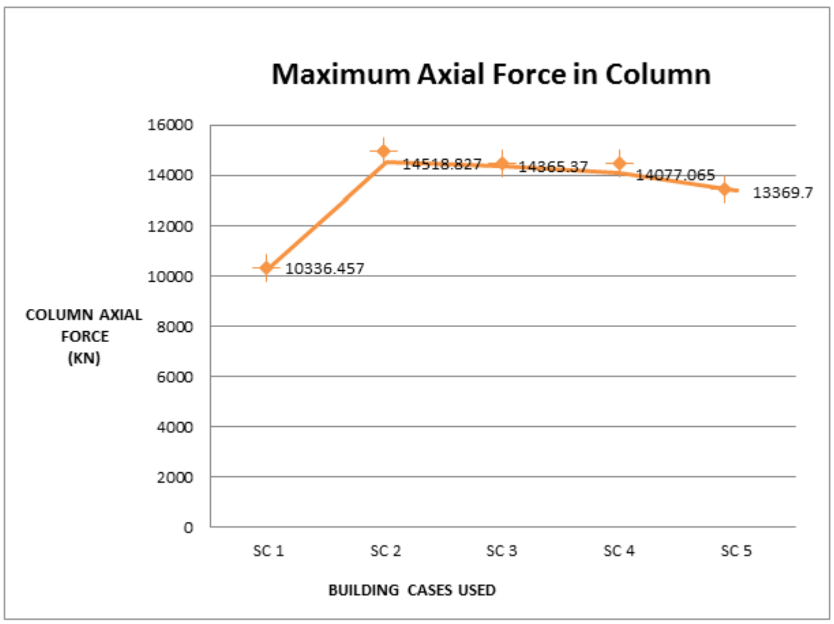


Fig. 6: Graphical Representation of Axial Forces in Column for all Single Core Cases

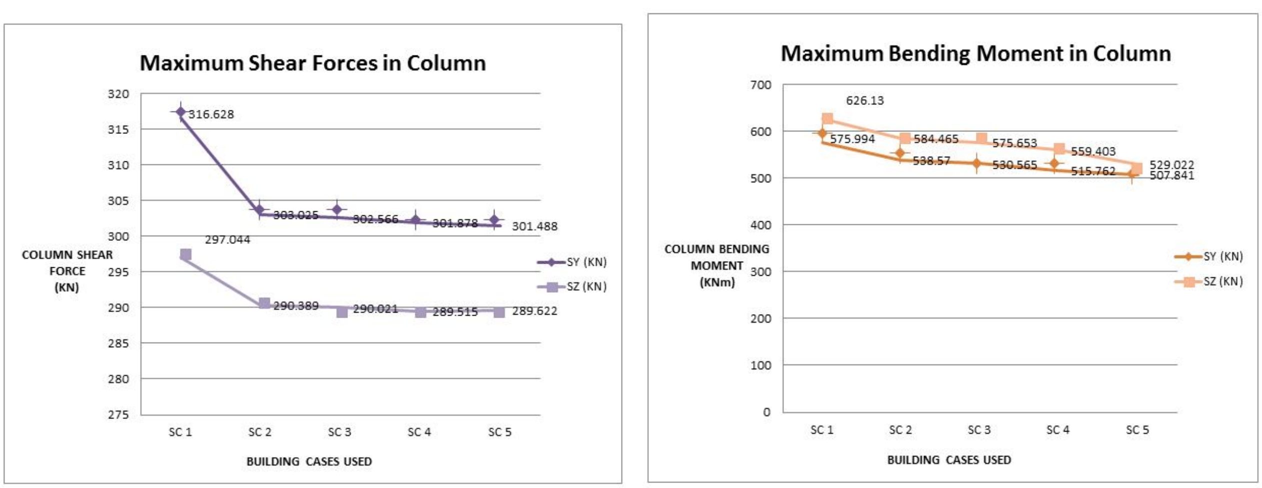


Fig. 7: Graphical Representation of Maximum Shear Forces and Bending Moments in Columns for all Single Core Cases

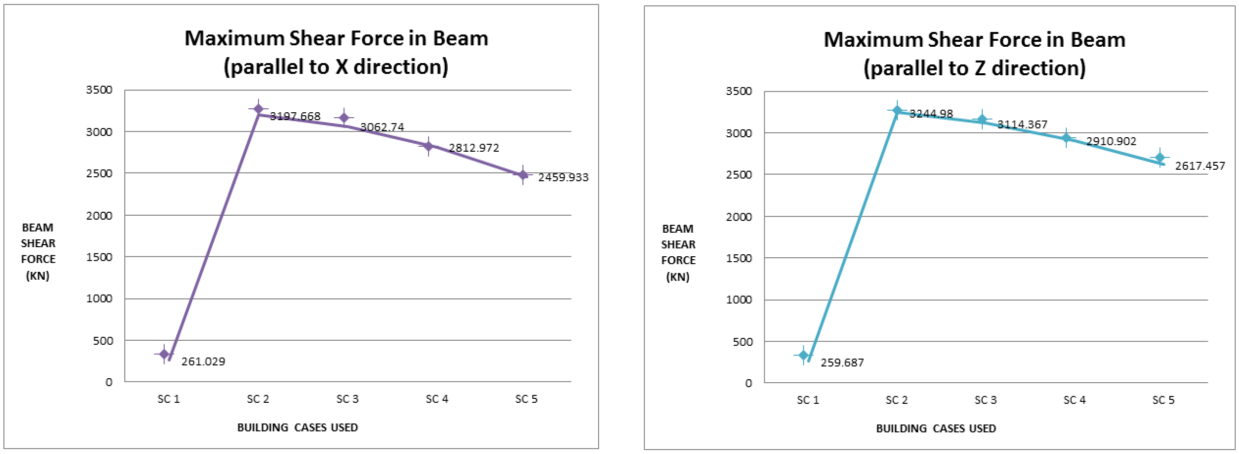


Fig. 8: Graphical Representation of Maximum Shear Forces in Beams parallel to X and Z direction for all Single Core Cases

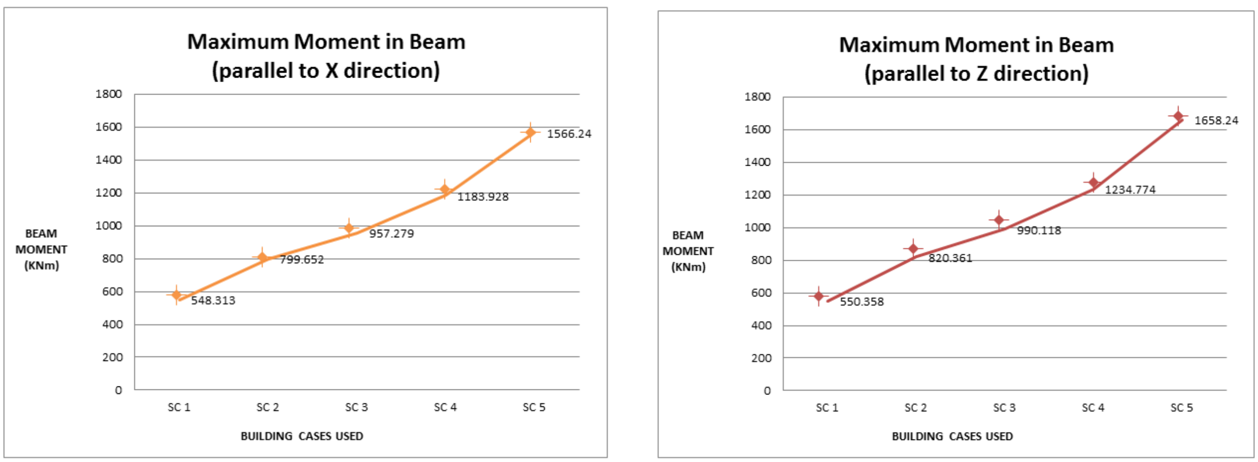


Fig. 9: Graphical Representation of Maximum Bending Moments in Beams parallel to X and Z direction for all Single Core Cases

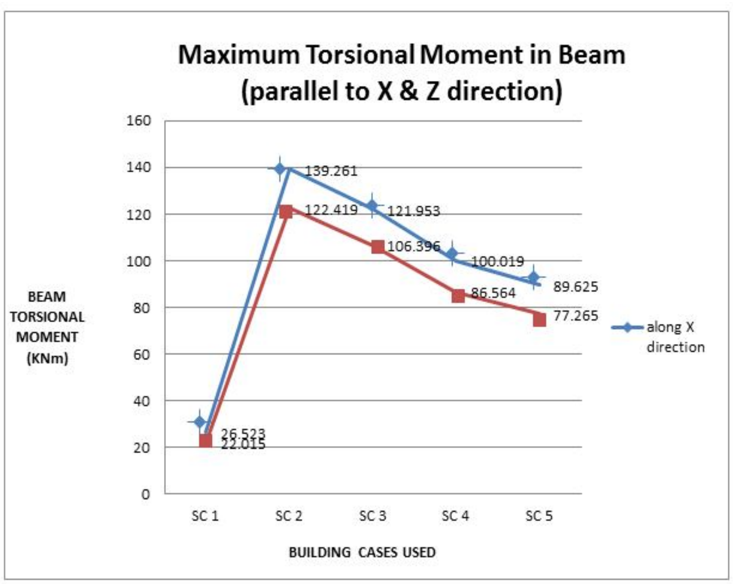
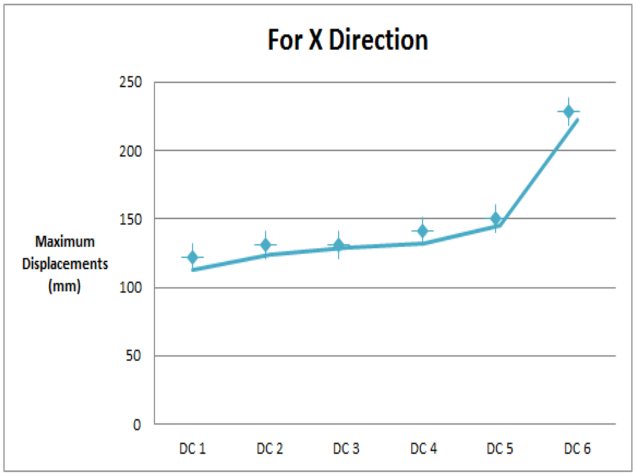


Fig. 10: Graphical Representation of Maximum Torsional Moment in beams along X and Z direction for all Single Core Cases

B. Discussions for Dual Core Cases



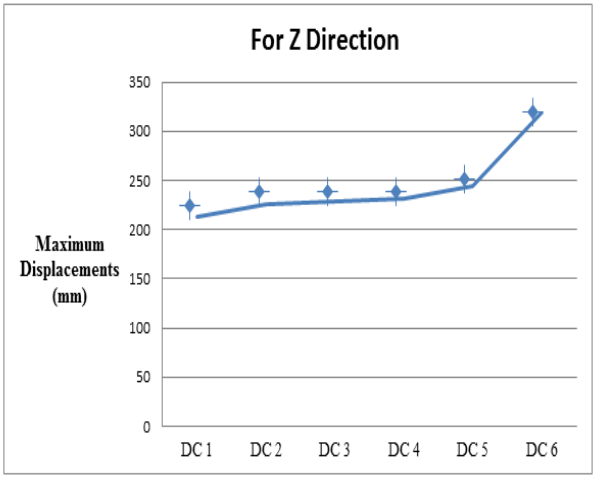
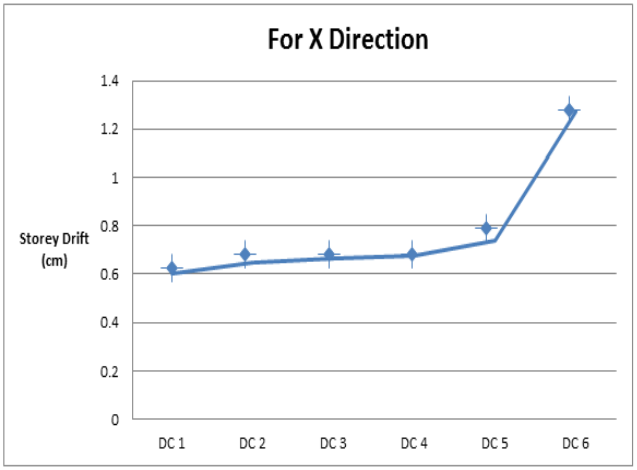


Fig. 11: Graphical Representation of Maximum Displacement in X and Z direction for all Dual Core Cases



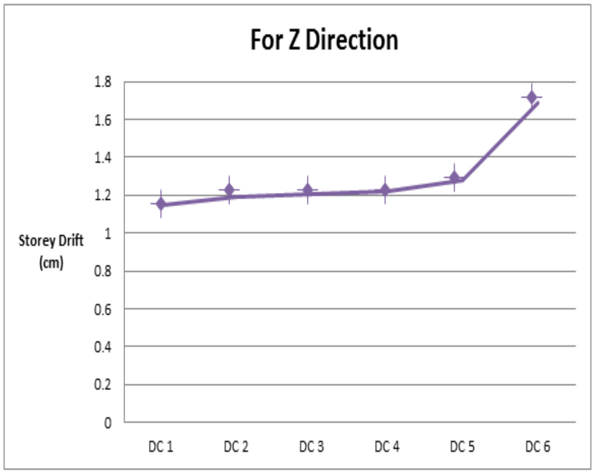
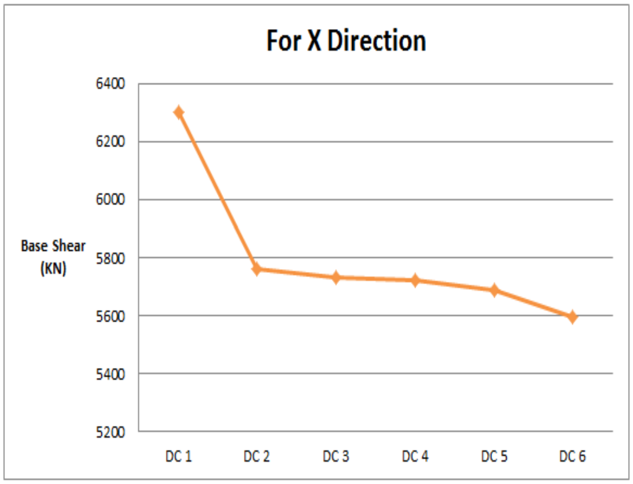


Fig. 12: Graphical Representation of Storey Drift in X and Z direction for all Dual Core Cases



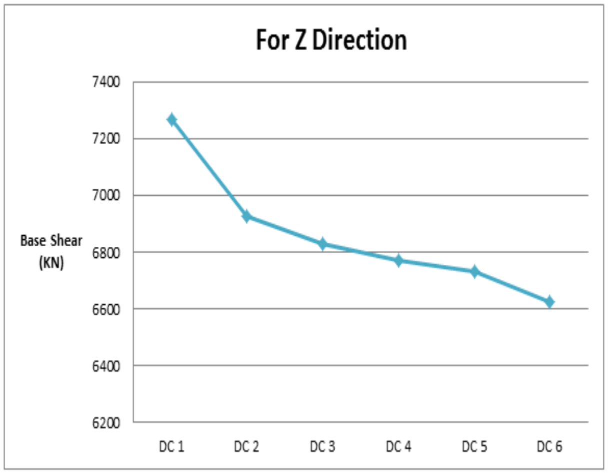


Fig. 13: Graphical Representation of Base Shear in X and Z direction for all Dual Core Cases

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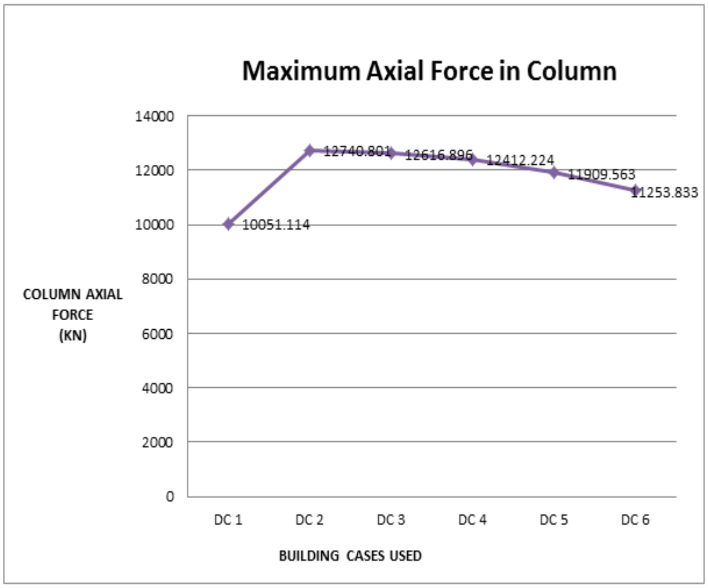

Fig. 14: Graphical Representation of Maximum Axial Forces in Column for all Dual Core Cases

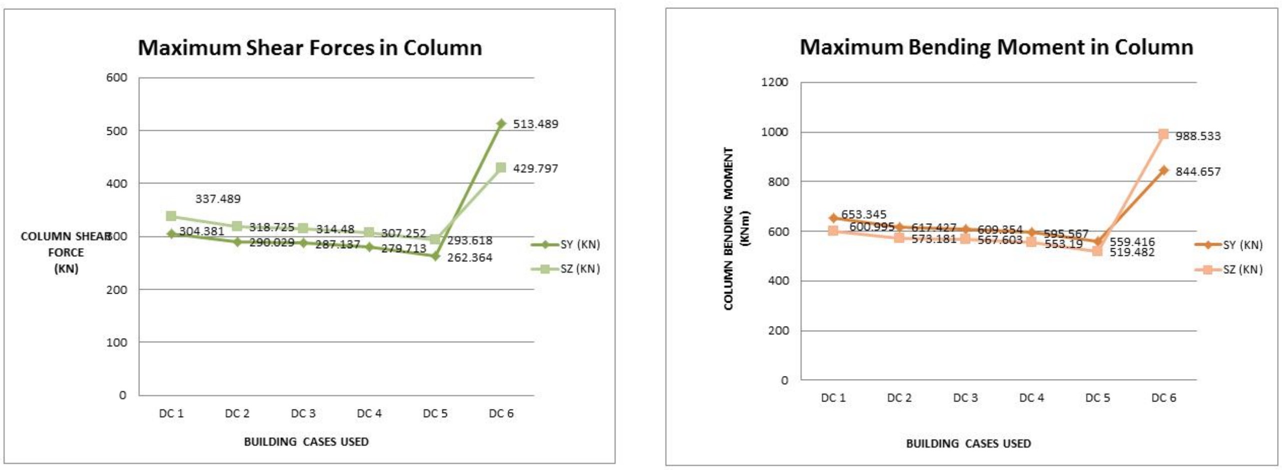

Fig. 15: Graphical Representation of Maximum Shear Forces and Bending Moments in Columns for all Dual Core Cases

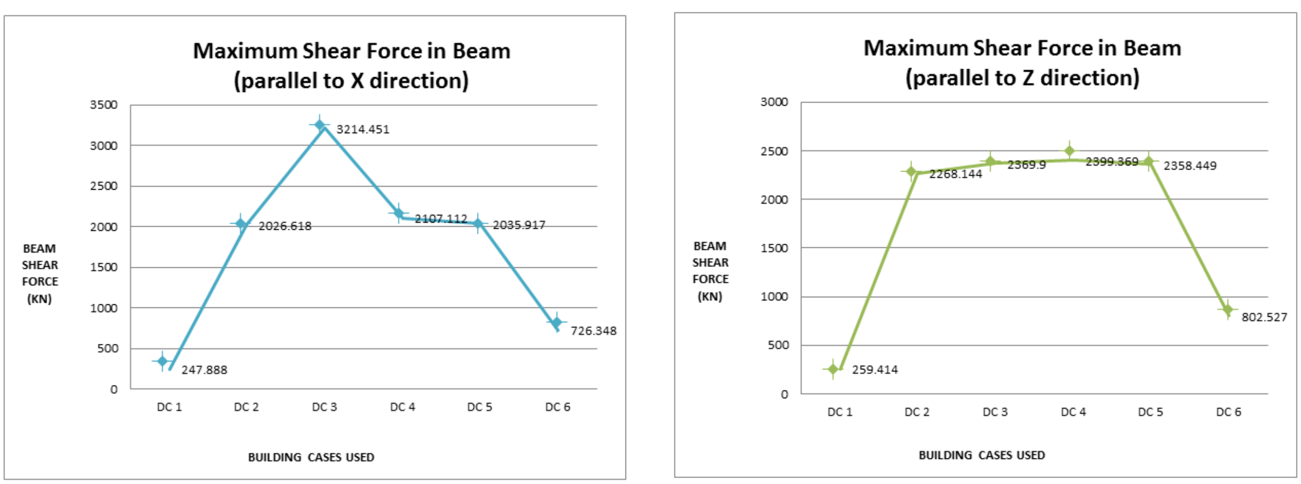

Fig. 16: Graphical Representation of Maximum Shear Forces in beams parallel to X and Z direction for all Dual Core Cases

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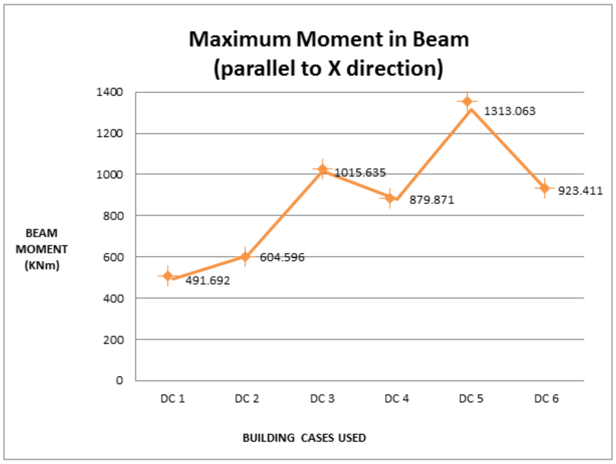

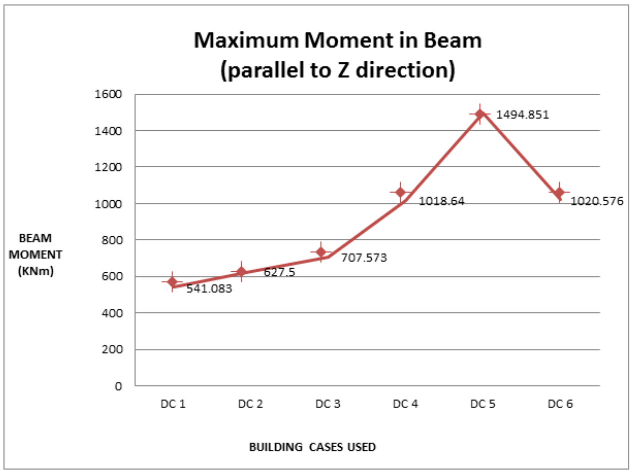

Fig. 17: Graphical Representation of Maximum Bending Moment in beams parallel to X and Z direction for all Dual Core Cases

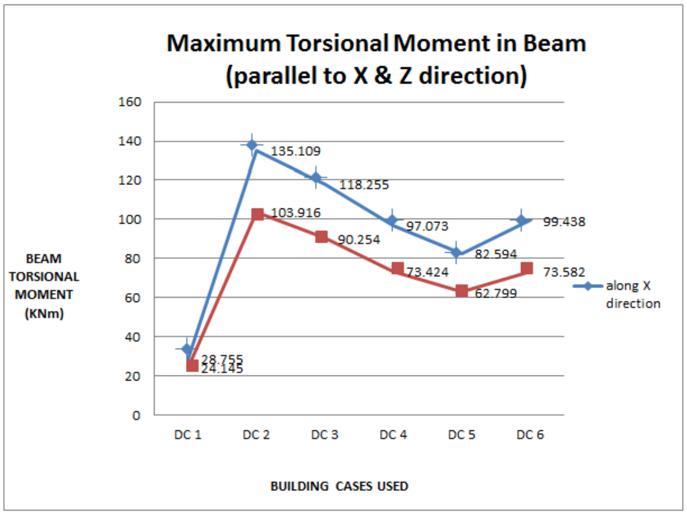

Fig. 18: Graphical Representation of Maximum Torsional Moment in beams along X and Z direction for all Dual Core Cases

IV. CONCLUSIONS

As we analysis about five diverse cases of single and dual core building which gives us variety of outcome regarding the building. In term of mentioned cases subsequent outcome are obtained from this comparative analysis.

A. Conclusion for Single Core

The conclusions for single core can be pointed out are as follows:-

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 single core cases.
2) The storey drift will behave same as displacement in both X and Z directions, since when shear wall used area is reduced, the drift of floor increases for single core cases.
3) 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 SC 5 shows the best parametric values at 25 % shear wall opening.
4) Values of Maximum Axial forces in column first increases from 0% to 10 % opening area and then the values constantly decreases and hence building SC 5 is economical among all.
5) Shear forces in column in both Y and Z axis in section constantly decreases with increment in Shear wall opening area, building SC 5 is economical among all.
6) There is a decrement in Maximum Bending Moment values in column from core case 1 to SC 5. Since in this parameter, building SC 5 is economical among all.

7) Drastic values observed in both longitudinal and transverse direction beams due to decrease in Shear wall usage area in multistoried structure. These values first increases and then it keeps on decrease. Building SC 5 is economical among all.
8) The values increases gradually and beyond the limit, it seems that up to the liming value of building SC 5, the structural components are safe in moment and beyond this, the beam fails, it applies for moments in beam in both X and Z direction.
9) Torsion in beam shows limiting parametric values up to building SC 5 when there will be deduction in shear wall area.

Due to Seismic effects, for single core structures, building SC 5 shows best parametric values among all.

B. Conclusion For Dual Core

The conclusions for dual core can be pointed out are as follows:-

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) The storey drift will behave same as displacement in both X and Z directions, since when shear wall used area is reduced, the drift of floor increases for dual core cases.
3) 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 DC 6 shows the best parametric values at 50 % shear wall opening.
4) Values of Maximum Axial forces in column first increases from 0% to 10 % opening area and then the values constantly decreases and hence building DC 6 is economical among all with 50% opening area.
5) Shear forces in column in both Y and Z axis in section constantly decreases with increment in Shear wall opening area, then drastic increment in parametric values. The building DC 5 is economical among all.
6) There is a decrement in Maximum Bending Moment values in column from DC 1 to DC 5. Since in this parameter, building DC 5 is economical among all.
7) Drastic values observed in longitudinal direction beams due to decrease in Shear wall usage area in multistoried structure. The peak value observed in DC 3 and the minimum value of precent decrease in wall area seems to be in DC 6.
8) The values observed in transverse direction beams due to decrease in Shear wall usage area in multistoried structure. The peak value observed in dual core case 5 and the parametric value of seems to be best in dual core case 6.
9) Again, fluctuating values behaves same as shear force increases gradually and beyond the limit, it seems that under the liming value of building DC 5, the structural components are safe in moment and beyond this, the beam fails, it applies for moments in beam in both X and Z direction.
10) Torsion in beam shows limiting parametric values under DC 2 when there will be deduction in shear wall area.

Due to Seismic effects, for dual core structures, building DC 6 shows best parametric values among all.

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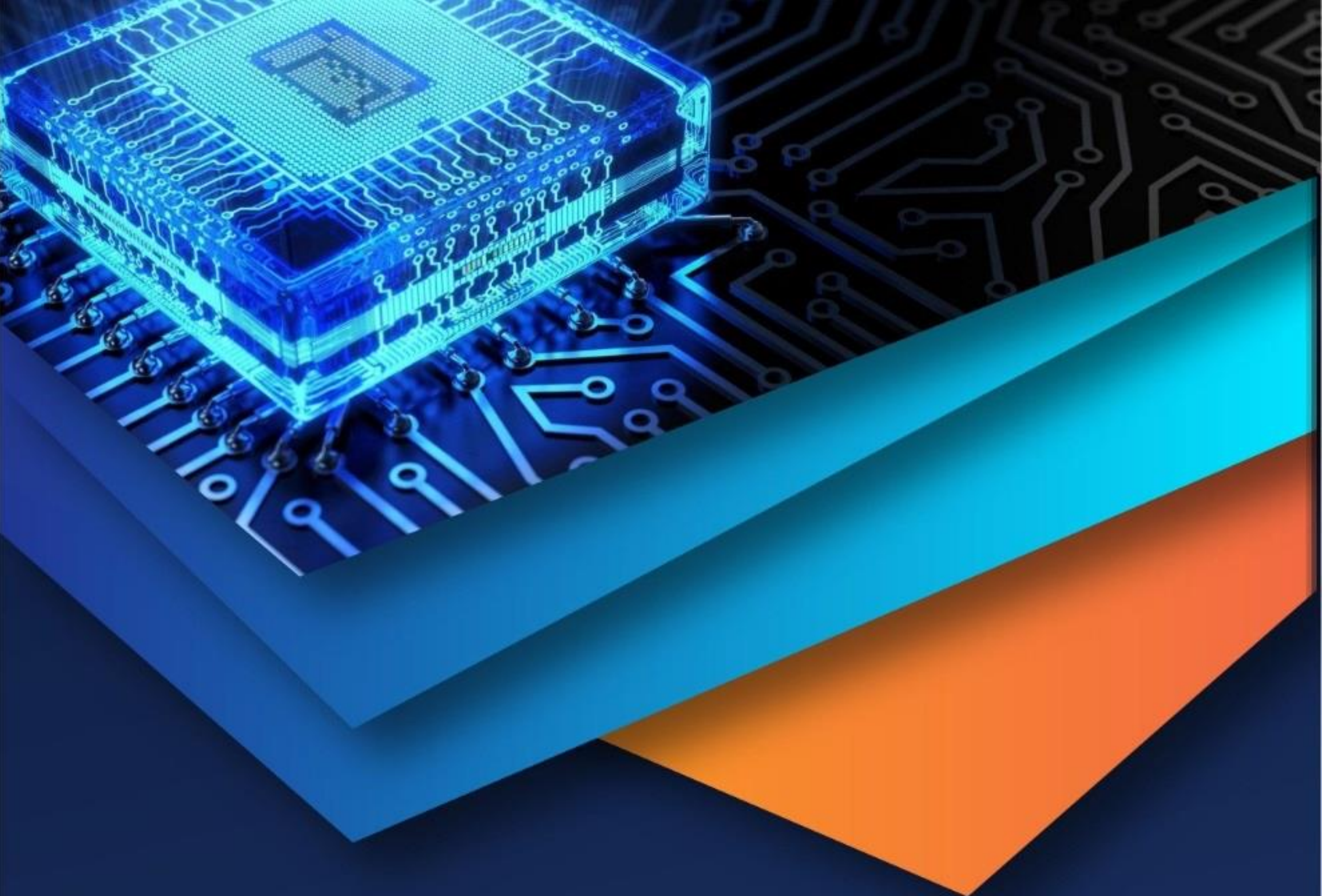

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