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Comparative Approach to Enhance the Semi - Commercial Building by Changing Grade of Concrete in Shear Wall Member Provided at Corners with Fixed Thickness at Fixed Height

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Abstract: ***Stability of the structure is the main and foremost criteria for every high rise structures since it provides a huge impact in case of severe earthquake. When we provide the stability enhancing components of any type to multistoried building, it actually normalize the structure to a certain level. In this study we studied about optimization of stability of building by same thickness of shear wall at corners for varying concrete grade and there are 6 cases in building having same size in different component with shear wall members at corner and building having same and uniform thickness in shear wall components at corner with different grade. In this research work we study about which floor is suitable for concrete grade for accumulative stability increment of multistoried building. On the basis of numerous parametric results that are obtained from this comparative study, Case E and Case F are the best suited cases in overall research. The major outcome is in this research work we study that shear wall provided at corners of 0.135m thickness is suitable for M 35 and M 40 concrete grade for stability enhancement of semi commercial building.***

Keywords: Altered thickness, Concrete Grade, Dual system, Lateral load capacity, Optimization, Shear Wall.

I. AN OVERVIEW OF DUAL STRUCTURAL EFFECT

The theme of the current study describes about the concept that column is the vertical stiffness component and it transfers the load from level to level of the floor and ultimately transfers the same to the ground. As this component generally made up of R.C.C., steel, timber, composite materials, etc. as per the requirement of the uniformity. In R.C.C. structure, concrete is basically a key component and an artificial stone, well molded, transfer load as per its designed capacity.

R.C.C. column is the spinal cord when discussing specific on multistoried building. Changing grade of concrete has its own importance. Since if same grade of concrete has used in the structure, its behavior over the entire remains the same. But what if a multistoried building when having different grades in shear wall member shows different behaviour in terms of various parameters applied on it.

II. OBJECTIVES OF THE CURRENT STUDY

The study consists of change in grading of concrete in shear wall member with fixed thickness of outer shear wall (up to G+9 storey). A comparative analysis will be analysed on different parameters include shear forces, moments, displacements, base shear etc. in longitudinal and transverse direction. The apartment rests on medium soil under the existence of seismic forces as per Indian standard earthquake Zone III. The following objectives have been used in this study:-

- To find out the nodal displacement effect in both X and Z direction in terms of the grade change of the concrete member in the fixed shear wall at corners.
- To show the base shear effects in both X and Z direction in terms of the grade change of the concrete member in the fixed shear wall at corners.
- To discuss the axial force in column in terms of the grade change of the concrete member in the fixed shear wall at corners.
- To analyse the absolute shear forces and moment in column and beam member in terms of the grade change of the concrete member in the fixed shear wall at corners.
- To evaluate and compare torsional moment in beam
- To prove the overall behaviour of structure in terms of grade change of the concrete member in the fixed shear wall at corners.

III. PROCEDURE AND 3D MODELING OF THE STRUCTURE

The procedure of 3D modeling is based on the earthquake resistance design of structures, a semi commercial apartment (G+18) with plinth area 900 sq. m. has taken for analysis. The theoretical part has done in first stage and for the second stage, total of

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six different cases have been chosen for parametric analysis, its description shown below. Various dimensions of structure are shown in Table 1, seismic parameters taken have shown in Table 2 respectively.

Dead loads, Live loads, Response spectrum loads are applied on the structure with various load combinations. M20 grade to M 40 grade of concrete range has used with Fe 415 grade of steel is used. After then six building cases described and each of them abbreviated as A, B, C, D, E and F. Figure 1 shows typical floor plan as per selected grid system. After then, comparative results of various parameters shown in tabular form with graph is provided to compare each parameter figuratively.

Table 1: Dimensions of different components of building

Parameters	**Values**
Building configuration	G + 18
Building type	Semi Commercial Apartment
Total plinth area	900 m2
Building Length	6m @ 5 bays
Building Width	5m @ 6 bays
Height of building from Foundation level	77.54 m
Height of each floor	GF = 4.5 m & Each Floor = 3.66 m
Depth of footing	3.5 m
Beam dimensions	500 mm x 400 mm
Column dimensions	550 mm x 600 mm
Slab thickness	150 mm
Staircase waist slab	155 mm
Shear wall thickness	Lift Area = 0.130m
	At Corners = 0.135m,
Material properties	Concrete (M20), (M25), (M30), (M35), (M40) Steel (Fe 415)

Table 2: Seismic parameters on the structure

Parameters	Values
Importance factor I	1.2
Fundamental natural period (Ta) in X and Z direction	1.2741 seconds
Response reduction factor R	4
Zone factor	0.16
Structure Type	RC frame Structure
Zone	III
Soil type	Medium soil

Different building model cases selected for analysis using software methodology

A. *Model Case A:* When no Shear Wall Provided at corners.
B. *Model Case B:* Shear Wall Provided at corners of 0.135m thickness (M20 Grade)
C. *Model Case C:* Shear Wall Provided at corners of 0.135m thickness (M25 Grade)
D. *Model Case D:* Shear Wall Provided at corners of 0.135m thickness (M30 Grade)
E. *Model Case E:* Shear Wall Provided at corners of 0.135m thickness (M35 Grade)
F. *Model Case F:* Shear Wall Provided at corners of 0.135m thickness (M40 Grade)

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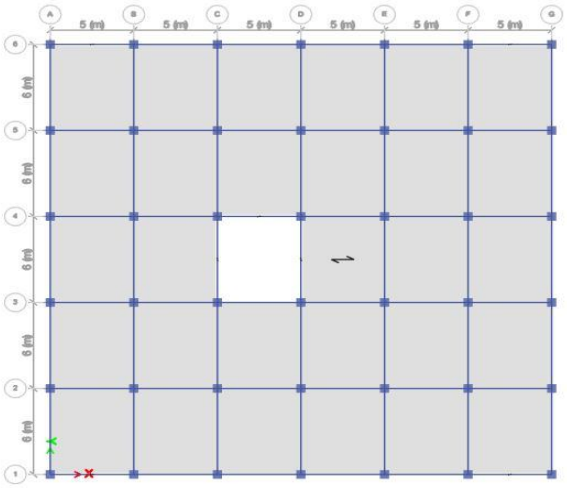


Fig 1: Typical floor plan

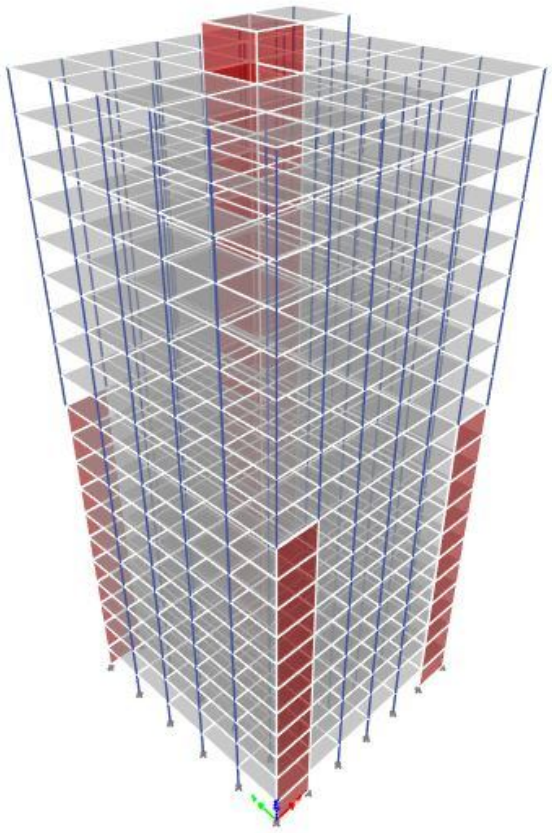


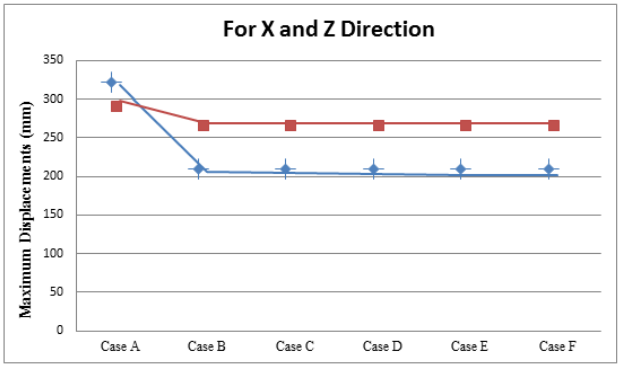
Fig 2: 3D View of the Structure with shear wall at corners

IV. RESULTS ANALYSIS

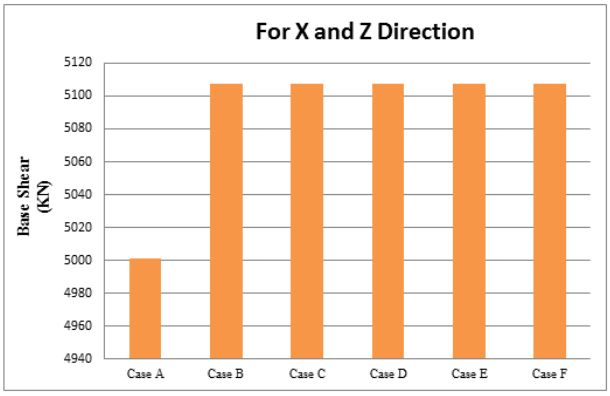
For the stability of the structure by changing the grade of concrete in shear wall at corners at particular height at different pairs, parameters such as the nodal displacement, base shear, column axial forces, column shear and moment values, beam shear and moment values and last but not the least beam torsion values.

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

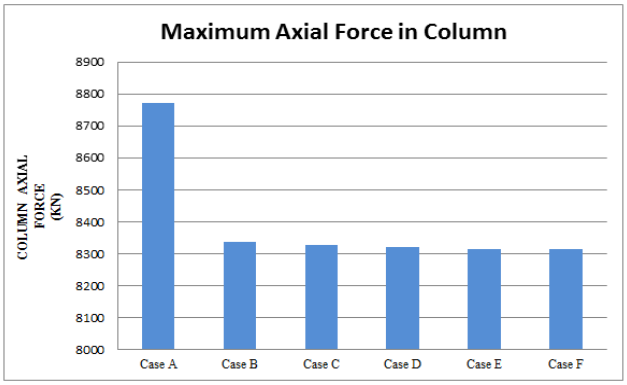
Result of each parameters has discussed with its representation in graphical form below:-



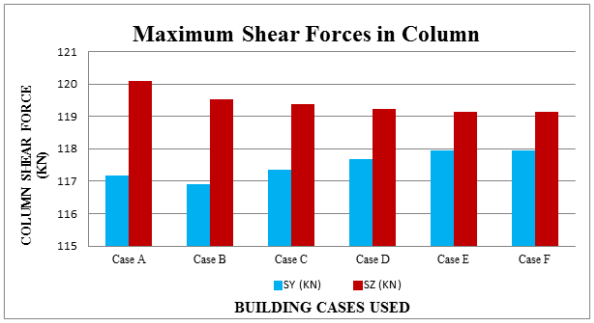
Graph 1: Maximum Displacement in X and Z direction for all Optimum Shear Wall Building Stability Cases



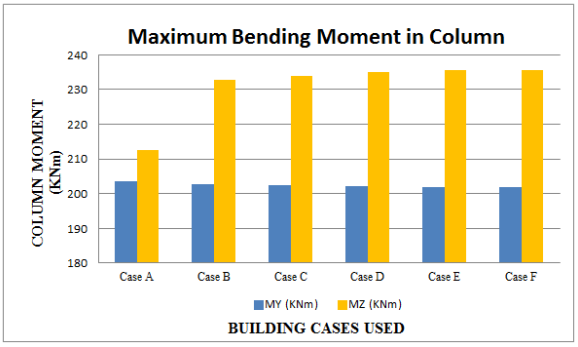
Graph 2: Base Shear in X and Z direction for all Optimum Shear Wall Building Stability Cases



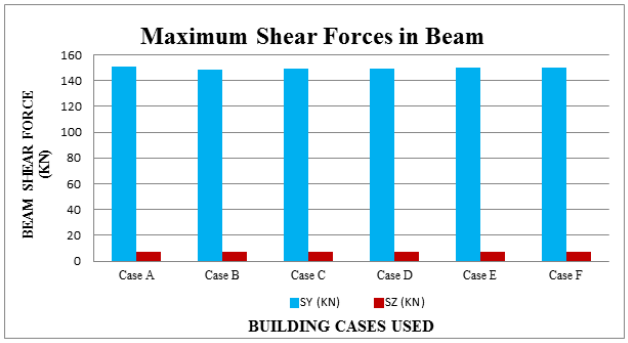
Graph 3: Maximum Axial Forces in Column for all Optimum Shear Wall Building Stability Cases



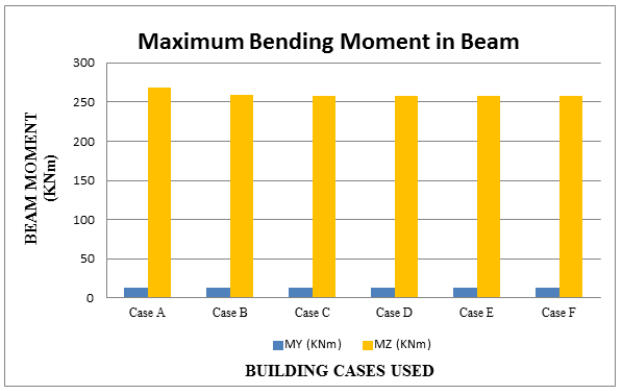
Graph 4: Maximum Shear Force in Column for all Optimum Shear Wall Building Stability Cases



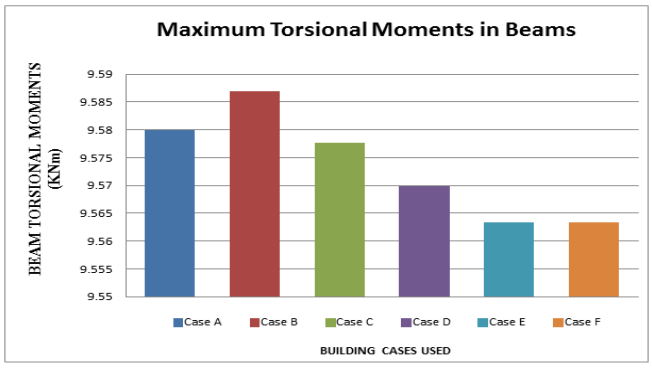
Graph 5: Maximum Moment in Columns for all five grade pair location cases in Zone III



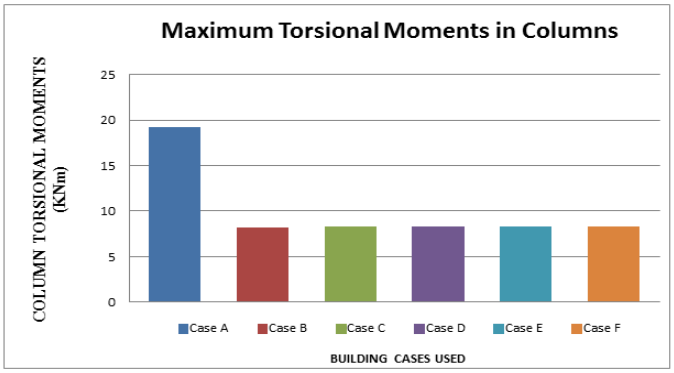
Graph 6: Maximum Shear Force in Beam for all Optimum Shear Wall Building Stability Cases



Graph 9: Maximum Bending Moment in Beam for all Optimum Shear Wall Building Stability Cases



Graph 10: Maximum Torsional Moments in Beam for all Optimum Shear Wall Building Stability Cases



Graph 11: Maximum Torsional Moments in Columns for all Optimum Shear Wall Building Stability Cases

V. CONCLUSIONS

Conclusions evolved by analysing the result data of various parameters for all cases are as follows:-

A. On comparing it has been concluded that the maximum displacement in X direction obtained for Case E and Case F respectively with a minimum value respectively in medium soil.

B. On comparing it has been concluded that the maximum displacement in Z direction again downfall obtained in Case E and Case F with a minimum value.

C. As per comparative results, Case A for base shear forces in X direction values are efficient among all cases since none of the changes in the structure takes place which increases the weight of the structure.

D. As per comparative results, Case A for base shear forces, values are efficient among all cases since none of the changes in the structure takes place which increases the weight of the structure in Z direction

E. As per comparative results in axial force, Case E and Case F are very effective than other cases.

F. Comparing the column shear force for all cases along Y and Z direction, the minimum values obtained in Case B for Sy and there is a decrement value observed in Sz obtained for Case F.

G. As per comparative results in column bending moment, Case E and Case F obtained most efficient in case of My and along Mz, the values increases with increase in grade change in shear wall at corners.

H. Comparing the Beam shear forces, when grade of the concrete increases, there is an increase of Shear forces along Y direction and along Z direction, Case E and Case F obtained as the most efficient case.

I. As per comparative results, bending moment in beam along Y direction decreases when there is a grade change criteria and when comparing all the values along Z, Case E and Case F obtained more effective than other cases.

J. On analyzing the Torsional Moment in beams Case E and Case F are very efficient and for Torsional Moments in column when grade of the concrete increases in shear wall at corners, the same parameter also decreases.

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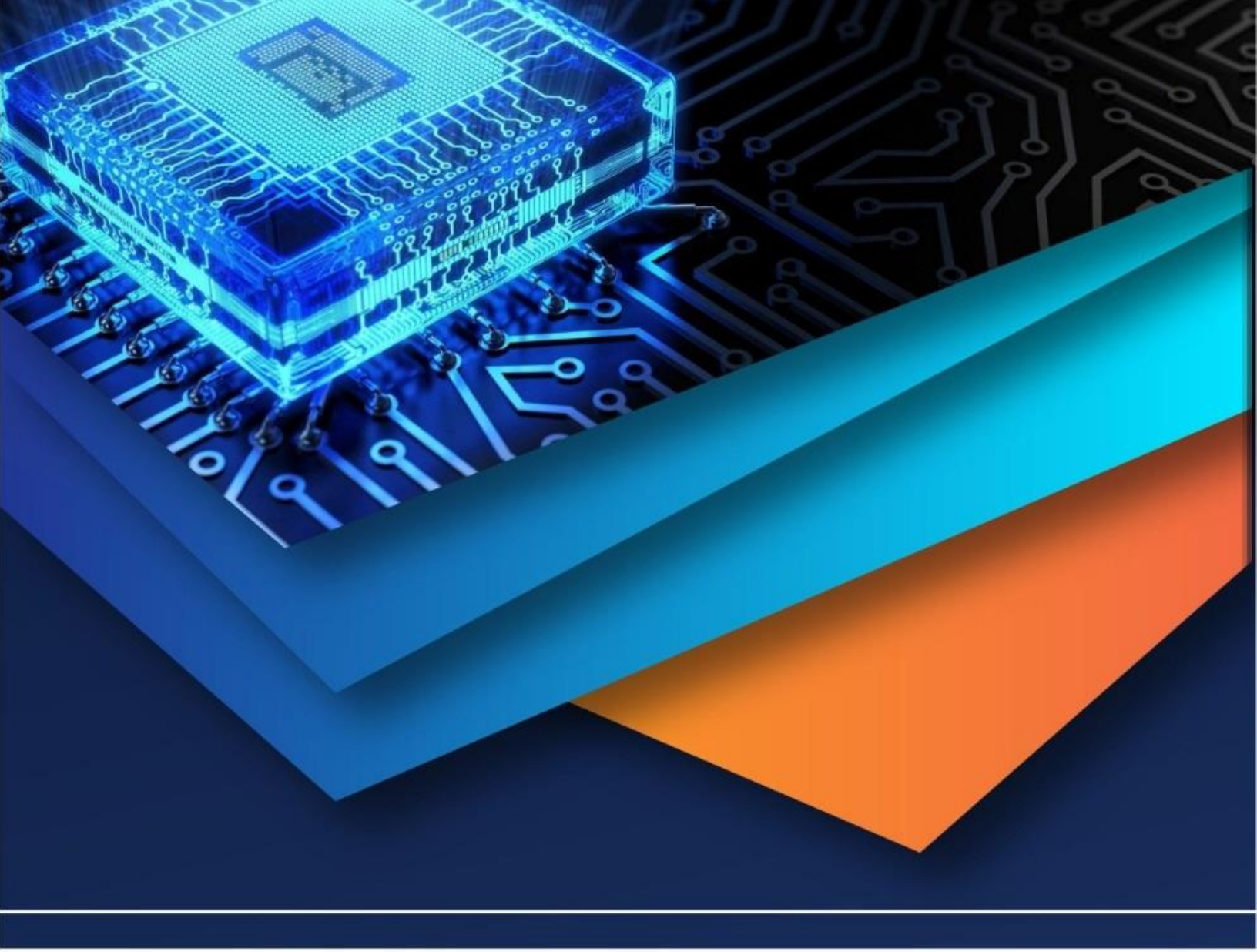

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