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Behaviour of Building Under Different Combination of Eccentricity

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***Abstract:** The study looks at the effect of eccentricity in load combinations, recognising the importance of non-uniform loading circumstances on structural behaviour. The combination of eccentricity factors and moment distribution not only improves structural analysis accuracy but also makes it easier to identify crucial spots prone to higher stresses. This holistic method strives to optimise structural designs while maintaining safety, efficiency, and adherence to applicable design requirements.Case studies and comparative analyses are used in the study to validate the efficiency of the suggested technique. The results show that using the combined technique of moment distribution and eccentricity considerations inside STAAD Pro software improves the accuracy and reliability of structural analysis. This study adds vital insights to the field of structural engineering by providing engineers with a more sophisticated technique.*
***Keywords:** Combination of Eccentricity, Moment distribution, Reinforced concrete, STAAD Pro.*

I. INTRODUCTION

Reinforced concrete (RC) buildings are critical components of modern construction, offering robustness, durability, and flexibility. The connections between beams and columns, which are integral to these constructions, play a key role in load transfer and overall structural stability. These connections must withstand a variety of forces, including gravity loads, lateral forces, and moments caused by eccentricities in loading or geometry. The effect of eccentricity on RC beam-column connections is a specific emphasis in structural engineering. The intersection of RC beams and columns is critical to the structural integrity and safety of a structure. Eccentricity, defined as the misalignment of applied loads with the centerline of a column, has emerged as an important topic in structural engineering. Understanding the effects of eccentricity on these linkages is critical, given the possible impact on a person's life. The purpose of this study work is to delve into the complex world of eccentricity in RC beam-column couplings. We will investigate the fundamental concerns surrounding this crucial part of structural design using STAAD Pro and moment distribution analysis. The key goals of this research are as follows:

Investigate the impact of various eccentricity combinations on the structural behaviour of RC beam-column connections, giving specific emphasis to load distribution, stress patterns, and deformation characteristics.

II. LITERATURE REVIEW

1) Salih Cengiz, Abdulkadir Solak, Alptug Unal, Mehmet Kamanli (2022) The influence of eccentricity was investigated by modelling a five-story reinforced concrete structure with the IdeCAD V10 programme, and the internal force changes in the columns were investigated by generating various eccentricity states. By changing the size of one of the corner columns, the centre of stiffness was moved away from the centre of mass while causing the eccentricity. Internal strength is being evaluated on the ground, third, and fifth levels of the structure's corner, edge, and inner columns. The bending moment and shear force values are largest in the bottom level columns, whereas the torsional moment values are highest on the third floor, according to the research.
2) Ayad Zeki Saber Agha1 and Mereen Hassan Fahmi Rashid (2018) investigates the effect of load eccentricity on reinforced concrete column strength while controlling for the following variables: amount of eccentricity ratio (e/h=0.1 and 1.0); amount of longitudinal reinforcement%=1% to 8%; concrete compressive strength ()'21, 28,35, 42,63 84 ; c f = and MPa steel yielding strength (f and MPa y=414 525 ;) steel reinforcement distance ratio loading condition (uniaxial and biaxial bending); Furthermore, the findings show that the load eccentricity ratio (e/h) and bending condition (uniaxial and biaxial) have a substantial influence on column strength decrease. The upper limit results and maximum column strength are obtained when the reinforcement is distributed on two opposite sides, as opposed to when the reinforcement is distributed on four sides and a rectangular section with circular reinforcement distribution, while circular columns yield lower limit results and minimum column strength when compared to the other cases mentioned above.

3) Takashi kashiwazaki and Hiroshi Noguchi (2004) investigated the effect of eccentricity on degradation of shear strength, stiffness and deformation capacity of beam column joints, nonlinear analysis using a three-dimensional finite element method (3-D FEM). This 3-D FEM analysis used reference specimens from the previous experimental work. In the tests, reference specimens failed in joint shear failure after beam flexural yielding. On the maximum story shear forces and failure modes, the FEM results accord well with the test data. The maximum narrative shear forces did not rise when the beam flexural yielding occurred. Furthermore, the internal stress fluxes of both concentric and eccentric joints acquired from analytical results were used to better understand the shear transfer mechanisms in an eccentric beam-column joint.
4) Ellobody and Young [2] The eccentricity of reinforced concrete (RC) beam-column connections is critical to structural behaviour. Researchers used ETABS software to explore the effect of eccentricity on deflection characteristics. The ETABS simulations provide a thorough knowledge of structure reaction under varied loads. According to the results of the analysis, correct detailing and strengthening may greatly reduce deflection problems in eccentric connections, assuring structural integrity. This literature emphasises the need of using modern methods like as ETABS for exact assessment and optimisation of RC beam-column couplings, especially when dealing with deflection concerns.

III. METHODOLOGY

To study the behaviour of building under different combination of eccentricity on different floors using STAAD Pro we will follow a systematic methodology. Here's a rundown of the steps we'll take:

1) *Model Creation:* In STAAD Pro, we will generate 9 comprehensive 3D models of structures, integrating all relevant geometric and material attributes. This will comprise defining the building measurements, laying out the columns and beams, and assigning column and beam attributes.
2) *Load assignments:* Based on the exact IS code, we will add dead loads, live loads, and different combinations of loads to the structure; these loads will simulate forces that the structure may face.
3) *Eccentricity projection modelling:* We will suitably mimic the eccentric projection of the structure on the top floors, i.e. the 5th and 4th floor of the building.
4) *Examination:* We will do an analysis in STAAD Pro using the model and load allocations given. The structure's reaction to eccentricity will be replicated in this study. The moment, displacement, and deformations of the structural response will be investigated.
5) *Evaluation of results:* We will examine and evaluate the results of the analysis. This will entail examining the structure's behaviour with different types and combinations of eccentricity projections. We will examine the reaction of structures with and without eccentricity to see if there are any significant differences in performance and draw conclusions.

IV. MODELING AND ANALYSIS

A. *Building Parameters*

Number of structures	9
Number of stories	5 story
Plan dimension	18m X 18m
The total height of the structure	15m
Height of each story	3m
Size of beam	450mm X 300mm
Size of column	600mm X 600mm
Slab thickness	150mm
Eccentricities	50mm, 100mm, 150mm on each floor with different combinations.

B. *Loads Considered*

Sr no.	LOADS	MEMBERS	CALCULATED LOADS
1	Dead Load (DL)	Column	0.60 X 0.60 X 25 = 9 kN/m^2
		Beam	0.45 X 0.30 X 25 = 3.37 kN/m^2

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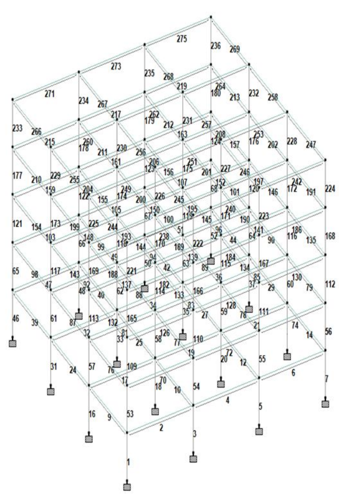
		Slab	0.15 X 25 = 3.75 kN/m^2
		Walls	0.12 X 20 X 3 = 7.2 kN/m^2 (internal wall) 0.23 x 20 x 3 = 13.8 kN/m^2 (main wall) 0.1 X 20 X 1.2 = 2.4 kN/m^2 (parapet wall)
2	Live load (LL)		2.5 kN/m^2
3	Floor load		kN/m^2

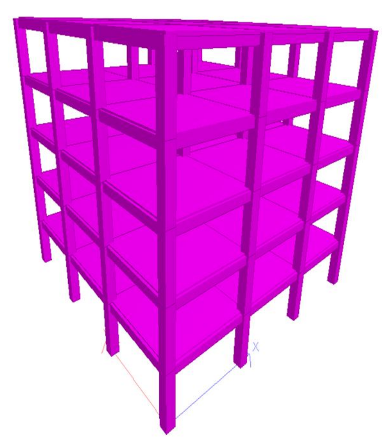
C. Eccentricity Provided

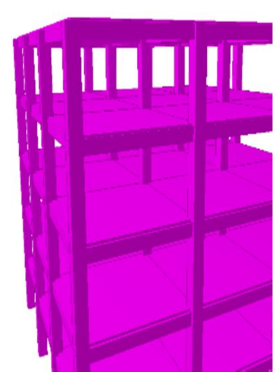
Structure	Eccentricity on 5th floor	Eccentricity on 4th floor
Structure 1	150mm	150mm
Structure 2	150mm	100mm
Structure 3	150mm	50mm
Structure 4	100mm	150mm
Structure 5	100mm	100mm
Structure 6	100mm	50mm
Structure 7	50mm	150mm
Structure 8	50mm	100mm
Structure 9	50mm	50mm

D. Structural Analysis

1) Top view of all four structures with different eccentricities on top 2 floors.







V. RESULT AND DISCUSSION

1) Bending and displacement in X and Y direction.

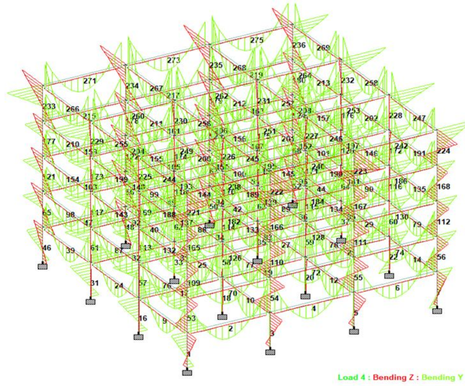


Fig1. Moment in Y & Z direction

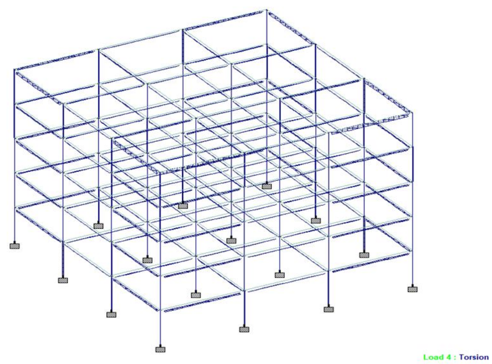


Fig2. Moment in X direction

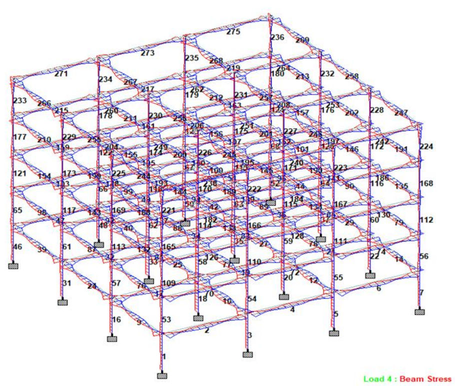


Fig3. Stress in X, Y, & Z direction

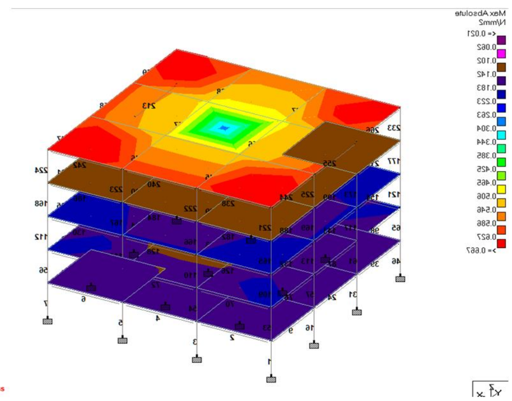


Fig4. Stress on plate

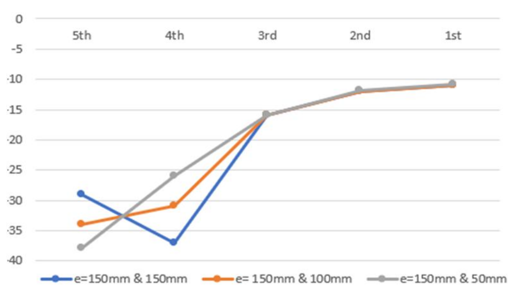


Fig5. Mz in centre column from top to bottom floor

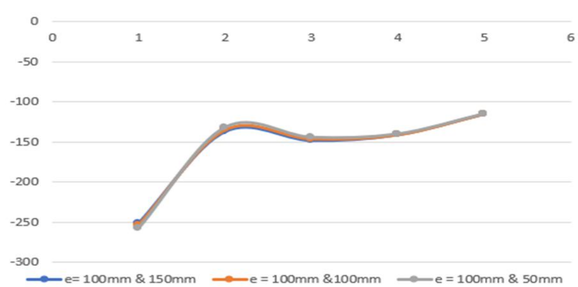


Fig6. Mz in corner column with e=100mm & e=150, 100, 50mm

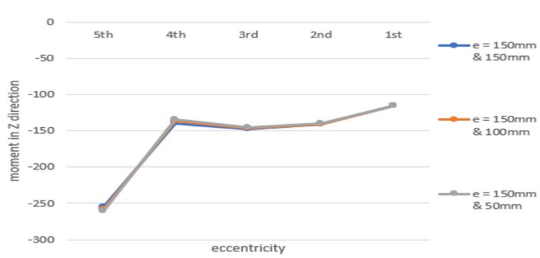


Fig 7. Mz in corner column, e=150mm & e=150, 100,50mm

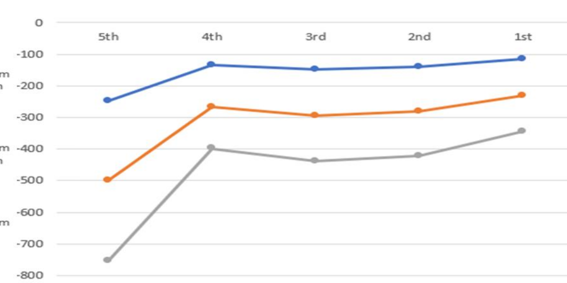


Fig 8. Mz in corner column, e=50mm & e=150, 100,50m

VI. CONCLUSIONS

1) The effect of eccentricity on the top two floor is carried to the next floor only it has no effect on the other lower floors.
2) The moment in the z direction increases dramatically from top to bottom on the second top floor, then decreases slightly on the next floor, and again increases from the next floors.
3) Moment in the Y direction decreases with a decrease in eccentricity.
4) Moment on the top floor is much greater than the moment on other floors.
5) The difference between changes in the value of moments is greater in centre columns than in corner columns, but moments in corner columns are much higher as compared to centre and edge columns.

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