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ANALYZING THE EFFECT OF CROSS-SECTIONAL CHANGE OF COLUMN ON MULTI STORIED BUILDING (G+10) USING STAAD PRO

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Abstract

In this article, the structural members with varying different cross sections of column that affect the structure's stability is analyzed using STAAD Pro (Structural Analysis And Designing Program). For the simple study of a G+10 residential system, beams under continuous beams with fixed supports with different column forms such as circle, rectangle and square along with dead, live, and wind loads used to execute the structural analysis. While the building is designed for dead load, live load, and wind loads as per IS 875 (part 1, 2,3 &5) -1987, the design wind pressure should be provided along height of building. The building is designed and analysed for the maximum bending moments and shear forces by trial and error. We have mentioned three cases to know the effect of shapes on continuous beam with fixed supports. And also, the comparisons of maximum bending moments, factored column load, shear forces, Ast values (Ast = Area of steel reinforcement), and Asc values (Asc = Area of compression steel reinforcement) through the graphs for all cases separately.

Keywords: Continuous beam with fixed supports, Different cross section of column, STAAD Pro v8i, Wind loads.

1. INTRODUCTION

This project entails the research and construction of a G+10 residential house, as well as the investigation of the impact of form on a structure using Staad Pro V8i. A structure must assess structural stresses, geometry, support requirements, and material properties in order to perform an effective analysis. The reactions, strains, and displacements are common outcomes of such study. This information is then compared to criteria that indicate the conditions of failure.

STAAD Pro V8i is a comprehensive and integrated finite element analysis and design process, includes international design loads. It is very powerful software that can be used for 3-D analysis and useful for the analysis and design of multi-storied buildings.

Aim, Scope of the study:

The aim of the research is to evaluate the performance and stability of the structure based on the influence of Different cross section of column (i.e. circle, rectangle and square) with Continuous beam with fixed supports for structure design and study.

2. LITERATURE REVIEW

Harman et al. (2017): This paper represents the effect of different cross- section of column on rcc frame structure. For study of G+3, G+7, G+1l storey buildings are developed and analysed using staad pro as well as loads used seismic forces. In results, it states total cost of concrete and steel of G+3, G+7, G+1l.

Kavya et al. (2019): In this article, the study and configuration of beams and columns under various end conditions, using dead and live loads, and designing beams and columns using STAAD Pro and AutoCAD tools. As a result, it is concluded that the reinforcement detailing is rendered in accordance with code requirements, resulting in ductility of the system and improved efficiency.

***Lakshmi Anuja et al. (2019*):** This paper speaks about the planning, designing, and analysis of residential building is done by using the limit state method with designs of a beam, column, footing and slab is done. It concluded the comparison with drawing, manual design, and geometrical model using staad pro the area of Ast required the beam, column footing, and slab are comparatively similar to that of the requirement.

Sanjaynath et al. (2018): This paper tells about the construction and detailing of a G+20 multi-storey building using Autocad and STAAD Pro applications, as well as load variations and manual calculations. They concluded that the study was performed in accordance with normal requirements for static and dynamic loads. The dimensions of structural members are defined, as are the loads such as dead load, live load, and wind load.

Dhanavath et al. (2017*):* This project deals with the analysis of a multi-story residential building of G+5 with 5 apartments on each floor. Dead and live loads are added, and designs for pillars, columns, and footings are collected. STAAD Pro, with its latest features, outperformed its contemporaries and competitors in terms of data sharing capabilities with other applications.

T. Sasidhar et al. (2017): The G+10 building using STAAD. Pro tools is analysed for shear forces, bending moments, deflections, and reinforcing specifics for the structural elements of the building such as beams, columns, and slabs. Finally, the maximal bending moment beams are defined in results with 1.2(DL+LL+WL).

3 DRAFTING AND MODELING

The RCC Framed Structure of (G+10) storey is Residential building or Apartment, in the ground floor, shops and parking is allotted and remaining floors planned with four 2BKH flats on each floor and corridor. The plans are designed with AUTOCAD 2018 software.

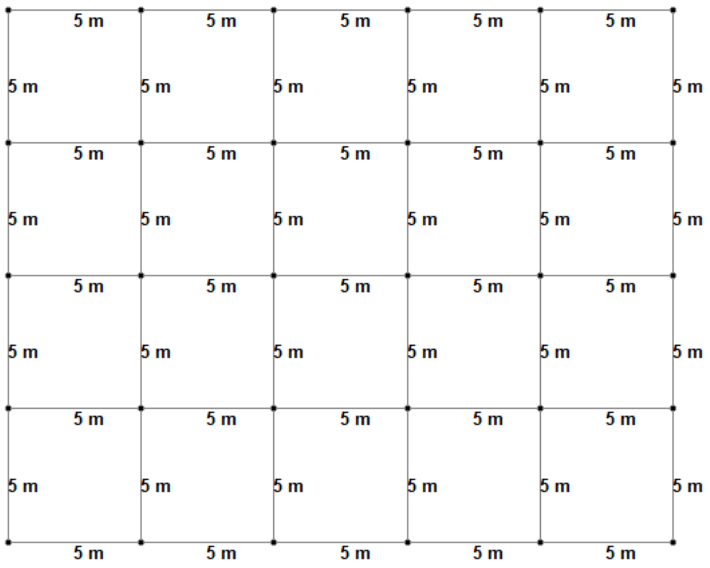
3.1 Continuous Beam with Fixed Supports:

A Continuous beam is a statically Indeterminate Multi-span beam or hinged support. The end spans may be cantilever, may be freely supported, or fixed supported. In this study, fixed supports at both ends with a 5 m span.

3.2 Loads:

The loads are evaluated separately, dead load, live load, wind load and load combinations are determined from IS 875(Part-1,2,3&5):1987. Combinations considered for the analysis includes 0.9DL+1.5WLX. Total 3 models are designed using staad pro G+10 Continuous beam with fixed supports with each floor height is 3.5, total no of bays is 5 on length wise and 4 on with wise with size 5 x 5 m. Plan and elevation of Continuous beam with Fixed supports is shown in Figure 1 and 2.

Figure 1: Plan of building



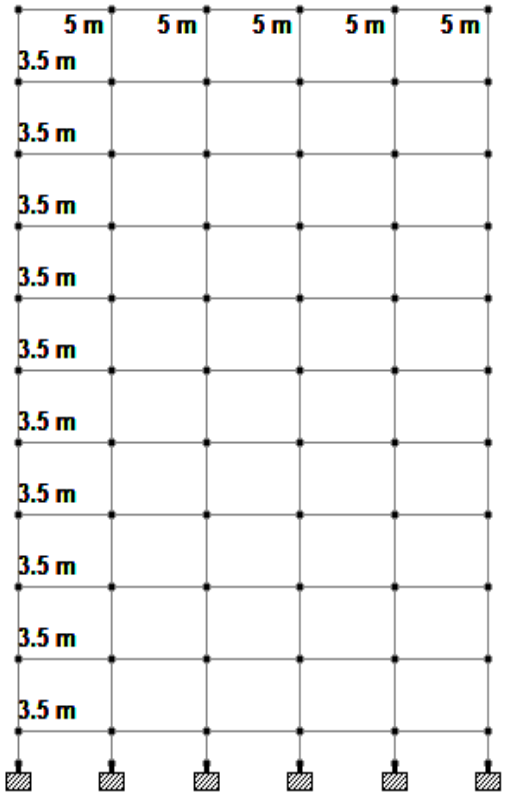


Figure 2: Elevation of building

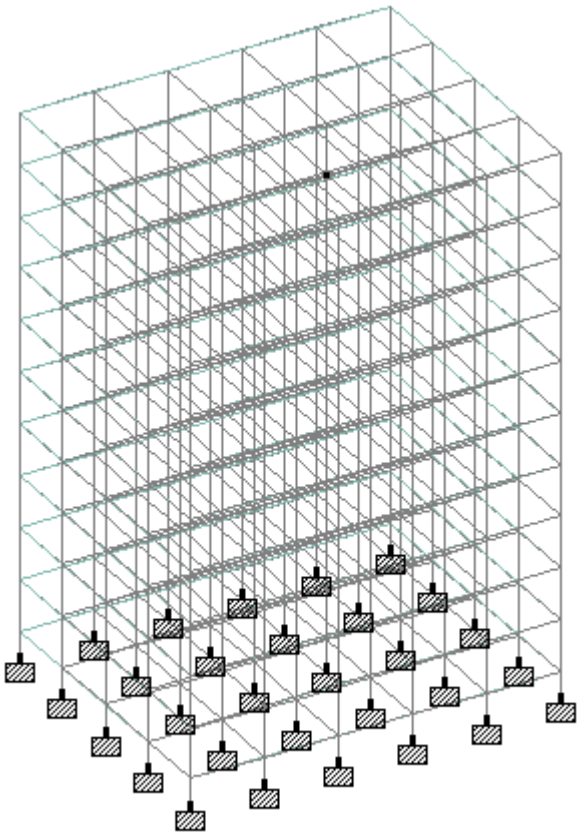


Figure 3: 3D view of building

4. DESIGN

STAAD PRO V8i, the software is designed to analyze different structures for different loadings in the above analysis. In this study, the structure is analyzed with Different cross sections of column like square, rectangle and circle on Continuous beam with fixed supports.

Input data for modelling of structure, design parameters are Concrete grade is M30 and grade of steel is Fe 415. Wind load parameters are basic wind speed is 39 m/sec in X direction in Chittoor area as per codal provision, Dead load, Live load is 4 kn/sqm. Concrete properties for G+10 building:

- Beam: 0.45x0.30 m
- Columns
  i. Rectangle columns:0.45x0.50m
  ii. Square Columns:0.50x0.50m
  iii. Circular Columns:0.625m

Create the models, given general properties, define properties and supports, and assigned them to the models; also apply a dead load, live load, wind load, and load combination to structure and assigning

the loads to structure. A Run analysis is done with zero errors and warnings. Then click on the design of concrete and add select parameters like compressive strength of concrete, hysd steel, maximum and minimum main reinforcement, torsion, etc and define the parameters we select for designing of concrete. Define the commands of the beam, column, slab/element, and take off as per IS 456 code. Assign parameters we select above to design of concrete and run the analysis with zero errors and warnings as results, and then we proceed to post-processing for bending moments, shear forces, axial forces, etc. Similarly, we do this analysis for all assumed cases, and after post-processing, we got the result data by using STAAD Pro.

5. ANALYSIS

On the basis of analysis, design carried along with STAAD Pro software analysis. The tables below are the results obtained by the cases used for different cross sections of column (i.e. circle, rectangle and square) with Continuous beam with fixed supports for structure. The results obtained in G+10 Building is represented in graphs and tables below:

Table 5.1: Analysis result of Maximum bending moment Continuous beam with fixed support

Sl.No	Detailing	Beam no	Maximum Bending moment (kN/m)
1	Continuous beam with fixed supports along with Circular column	50	128.6
2	Continuous beam with fixed supports along with Square column	50	143.8
3	Continuous beam with fixed supports along with Rectangle column	50	153.11

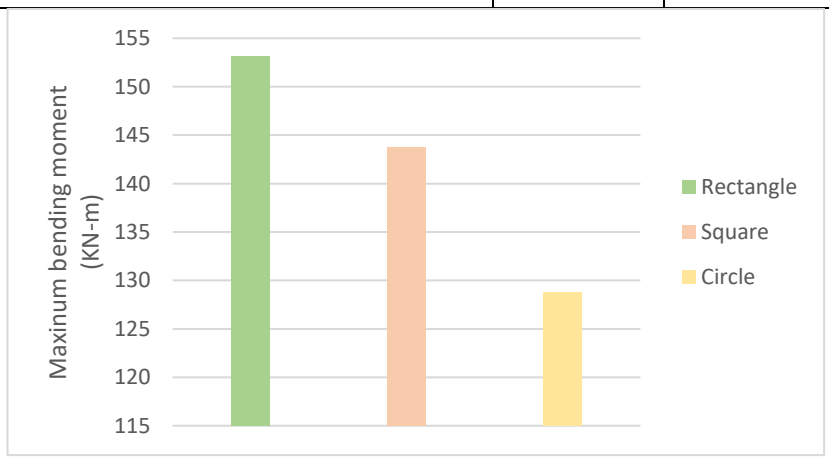


Figure 5.1: Maximum bending moments for different cross sections

- The table 5.1 shows the maximum bending moment values obtained from the analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 5.1 shows the Maximum bending moment in beams is more in rectangular cross sections when compared to both circle and square.

Table 5.2: Analysis result of Shear forces for Continuous beam with fixed supports

Sl.no	Detailing	Beam no	Shear force (kN)
1	Continuous beam with fixed supports along with Circular column	50	57.99
2	Continuous beam with fixed supports along with Square column	50	63.95
3	Continuous beam with fixed supports along with Rectangle column	50	67.71

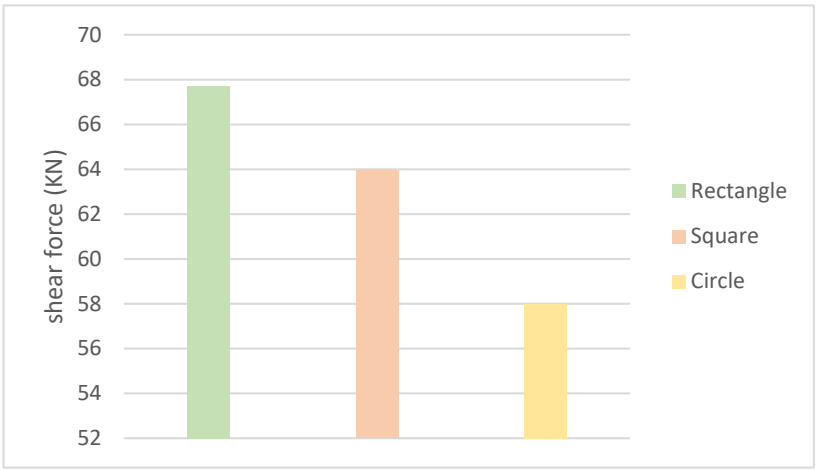


Figure 5.2: Shear force for different cross sections

- The table 5.2 shows the Shear force values obtained from the analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 5.2 shows the Shear force in beams is more in rectangular cross sections when compared to both circle and square.

Table 5.3: Design result of Ast values for Continuous beam with fixed supports

Sl.no	Detailing	Beam no	Ast (sq mm)
1	Continuous beam with fixed supports along with Circular column	50	868.86
2	Continuous beam with fixed supports along with Square column	50	984.35
3	Continuous beam with fixed supports along with Rectangle column	50	1056.81

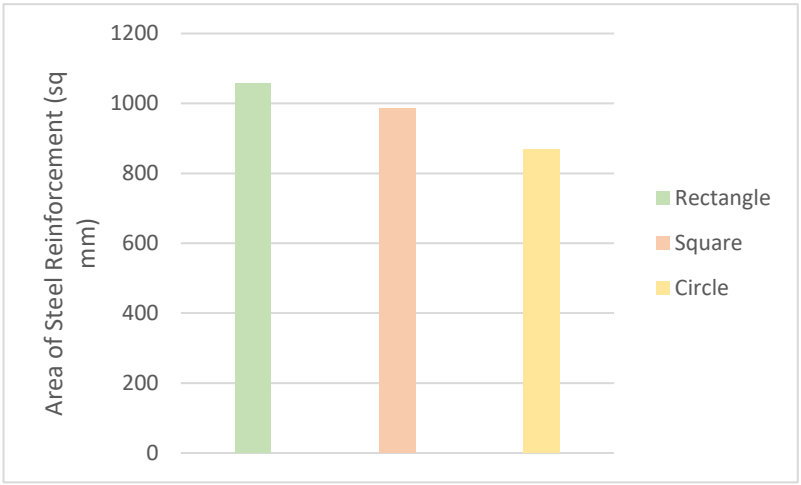


Figure 5.3: Area of steel reinforcement in beams for different cross section

- The table 5.3 shows the Area of steel reinforcement in beams obtained from the design analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 5.3 shows the Area of steel reinforcement in beams is more in rectangular cross sections when compared to both circle and square.

Table 5.4: Design result of Area of column for Continuous beam with fixed supports

Sl.no	Detailing	Beam no	Area of column (sq m)
1	Continuous beam with fixed supports along with Circular column	549	0.292
2	Continuous beam with fixed supports along with Square column	549	0.24
3	Continuous beam with fixed supports along with Rectangle column	549	0.217

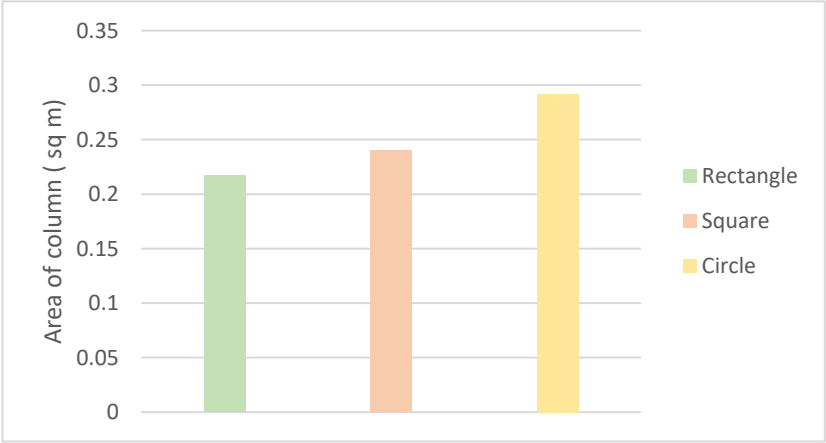


Figure 4.4: Area of Column for different cross sections

- The table 5.4 shows the Area of column obtained from the design analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 5.4 shows the Area of column obtained is more in Circular cross sections when compared to both rectangle and square.

Table 5.5: Design result of Asc values for Continuous beam with fixed supports

Sl.no	Detailing	Beam no	Asc (sq m)
1	Continuous beam with fixed supports along with Circular column	549	0.034
2	Continuous beam with fixed supports along with Square column	549	0.0025
3	Continuous beam with fixed supports along with Rectangle column	549	0.0022

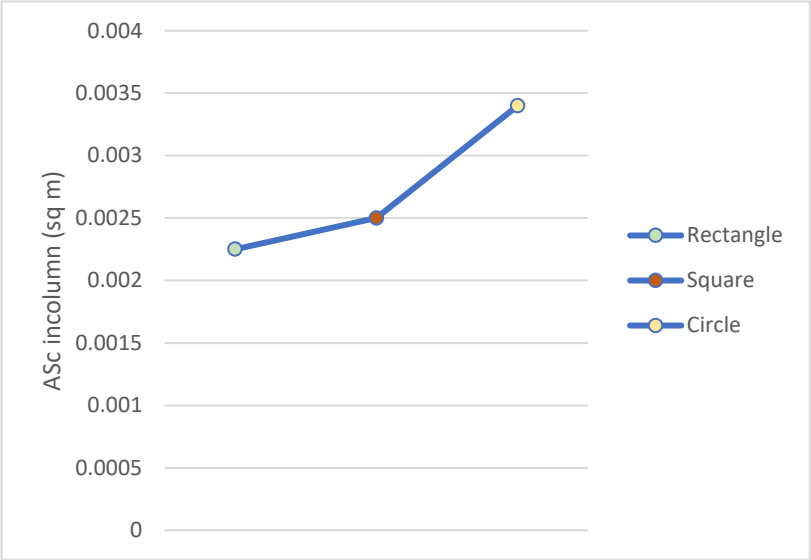


Figure 5.5: Asc in column for different cross sections

- The table 5.5 shows the Area of compression steel reinforcement in column obtained from the design analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 5.5 shows the Area of compression steel reinforcement in column obtained is more in Circular cross sections when compared to both rectangle and square.

Table 4.6: Design result of column load for Continuous beam with fixed supports

Sl.no	Detailing	Beam no	Factored column load, Pu (KN)
1	Continuous beam with fixed supports along with Circular column	549	4280.6
2	Continuous beam with fixed supports along with Square column	549	3530.57
3	Continuous beam with fixed supports along with Rectangle column	549	3191.59

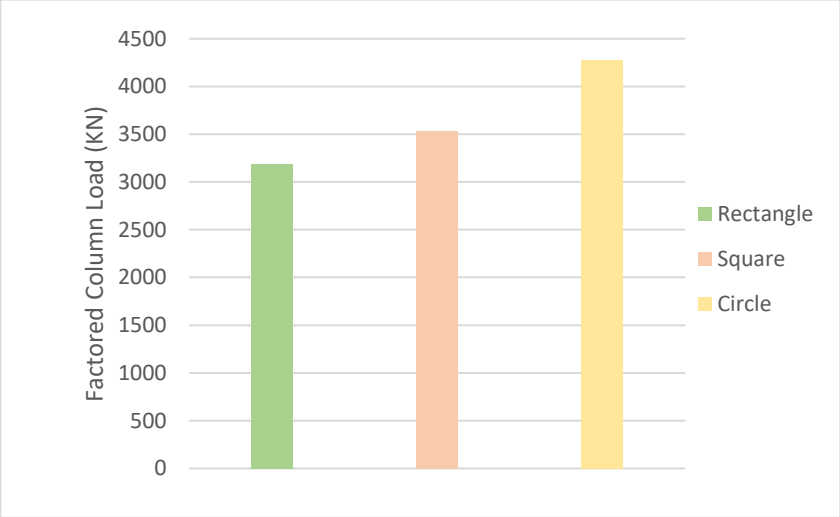


Figure 4.6: Column load for different cross sections

- The table 4.6 shows the column load obtained from the design analysis of Continuous beam with fixed supports with different cross sections of column
- Figure 4.6 shows the column load obtained is more in Circular cross sections when compared to both rectangle and square.

CONCLUSION

The G+10 multi-stored residential building is subjected to dead, live and wind loads with combination loads analyzed using STAAD Pro software.

- The Maximum bending moment in Rectangular cross section is more when compared to Square and Circle.
- The Shear force in Rectangular cross section is more when compared to Square and Circle.
- The Area of Column in Circular cross section is more when compared to Square and Rectangle.
- The Area of compressive steel reinforcement in Column for Circular cross section is more when compared to Square and Rectangle.
- The Factored column load in Circular cross section is more when compared to Square and Rectangle.
- The Area of steel reinforcement in Rectangular cross section is more when compared to Square and Circle.

Future scope of study

Further, this project can be done with other end conditions like simply supported beam along with changing shape of column to evaluate with strength and stability of structure. We can use wind loads and earthquake loads with load combinations for safety analysis for multi stored building with more floors and analyse the results for further study.

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