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DENOUEMENT OF SECTION SHAPE ON THE THEWINESS OF RCC COLUMNS UNDER UNIAXIAL LOADING

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Abstract: *The holy grail of this study is to discern which cross sectional shape of column is the most brawny and will support the maximum weight under different loading conditions. The loading conditions wielded were concentric loadings with uniaxial bending. This research thrives an experimental program that will throng the chasm in dearth of knowledge regarding the behaviour of slender columns at odds with the cross- sectional shapes. For bye, it also envisages to culminate the prevailing velitation in literature about such slender columns. For this raison d'etre, 8 columns of different shapes were casted comprising of two columns of square cross section, two of circular section, two of rectangular section and two of hexagonal section. The area of cross section of all the columns, lengths, weight as well as the percentage of reinforcement was kept same. The columns were then tested on loading frame to find which shape of column will combat the most weight under different loading conditions i.e. concentric loading.*

Key Words: Concentric loading, Column, Eccentricity, Compression Test, Aspect Ratio, Section Modulus, Slenderness Ration, etc.

1. Introduction

Since being the most crucial structural element, there has been ceaseless scrutiny going on the columns under different conditions particularly eccentric loading. The recipe of reinforcing concrete columns with steel has been very efficacious under eccentric loading with the fact that the eccentric loaded reinforced concrete columns undergo more prominent wider cracks, spalling of concrete and buckling. In this research programme, due to extensive area of subject, each and every column has been examined and scrutinized under concentric and uniaxial loading only and juxtaposition has been done to recce the deportment and the effectiveness of each column specimen. Albeit a column is put through any load, stresses are prompted in steel and concrete which are in concord to their moduli of elasticity in the inceptive juncture of loading. Ergo, as the time contingent deformations viz, creep and shrinkage of concrete occur, stress in steel shoots up and stress in concrete tails off. With mushroom in load, steel will reify yield strength before concrete attains its ultimate strength. The column will prop up additional load because the steel will succour yield strength while the concrete will carry further load until it attains ultimate strength out-turning in its miscarriage either in brittle way or in ductile way.

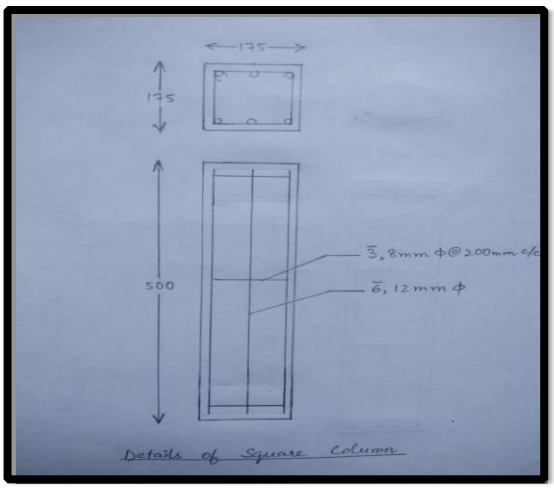
2. Details of Columns Casted

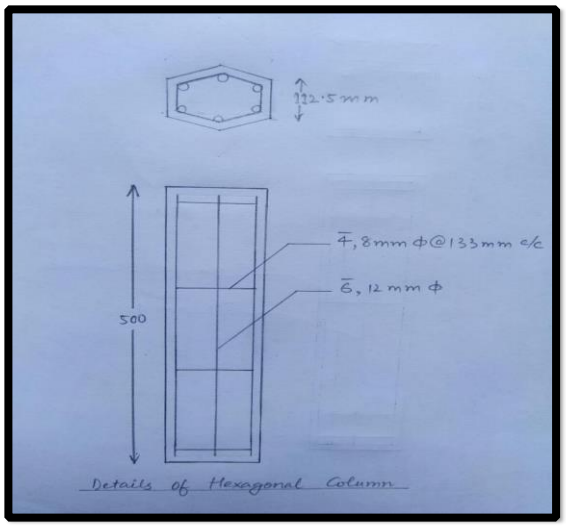
2.1. Square Columns: The size of such columns was 175 X 175 X 500 mm. The longitudinal reinforcement was 6-12 mm Ø. The cover to the reinforcement was 25mm. Lateral ties 3 in number were provided at a spacing of 200 mm c-c. The weight of the columns was 250 N each.

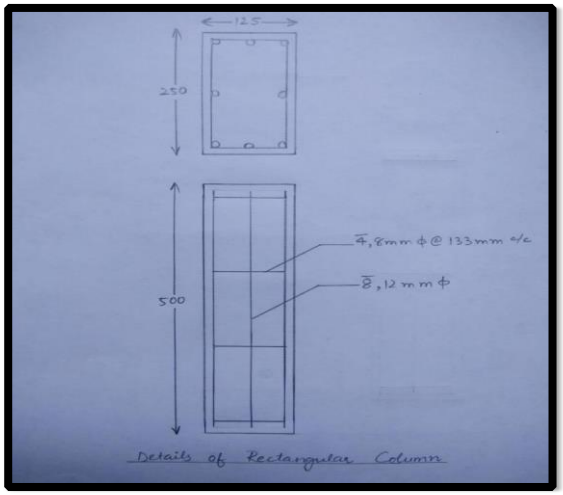
2.2. Rectangular Column: The size of such columns was 125 x 250 x 500 mm. The longitudinal reinforcement was 8-12mmØ. The cover to the reinforcement was 25mm. Lateral ties 4 in number were provided at a spacing of 133 mm c-c.

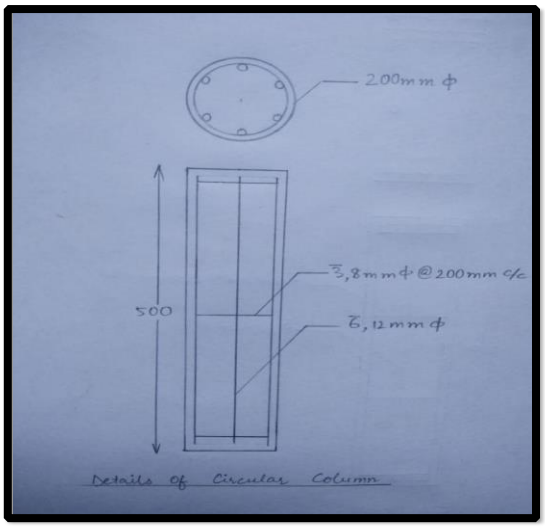
2.3. Circular Columns: The circular columns 500mm long were made with a diameter of 200 mm using PVC pipe as formwork. The reinforcement was 6—12 mm Ø. The cover to the reinforcement was 25mm. Lateral ties 3 in number were provided at a spacing of the lateral ties were 200mm c-c.

2.4. Hexagonal Columns: These were casted as regular hexagons with internal angle of 120°. The size of the side was 112.5 mm to get the same area of cross section as that of above two. Length was 500 mm. The reinforcement was 6—12 mm Ø. The cover to the reinforcement was 25mm. Lateral ties 4 in number were provided at a spacing of the lateral ties were 133mm c-c.









rectangular section. The area of cross section of all the columns, lengths, weight as well as the percentage of reinforcement was made same. The columns were then tested on loading frame to find which shape of column will bear the maximum loads. The reinforcement used was 12 mm TMT steel bars and the lateral ties were 8 mm. The compressive strength of the concrete used was 25 Mpa designed as per IS 2062 : 2009. Steel bars with nominal diameters 12 mm were used as longitudinal reinforcement, whereas 8 mm diameter bar has been used in lateral ties. There has been also required test has been performed to know the mechanical properties of the steel. Formworks for square, rectangular and hexagonal columns were prepared from ply board sheets of 12mm thickness and for circular columns PVC pipes were used. The steel used was TMT 415 steel.

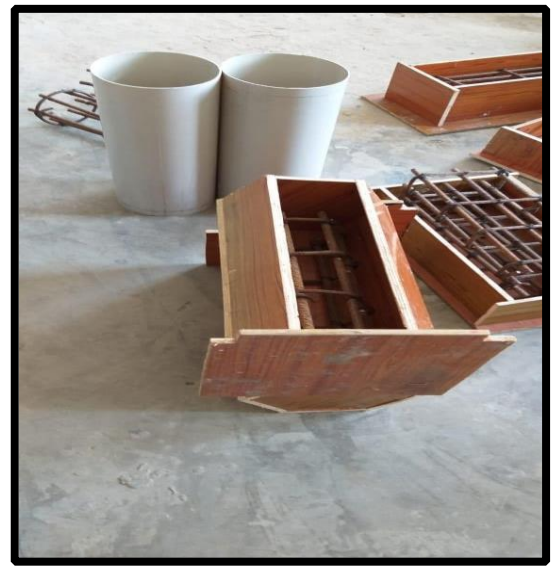


Fig. Formwork for different columns

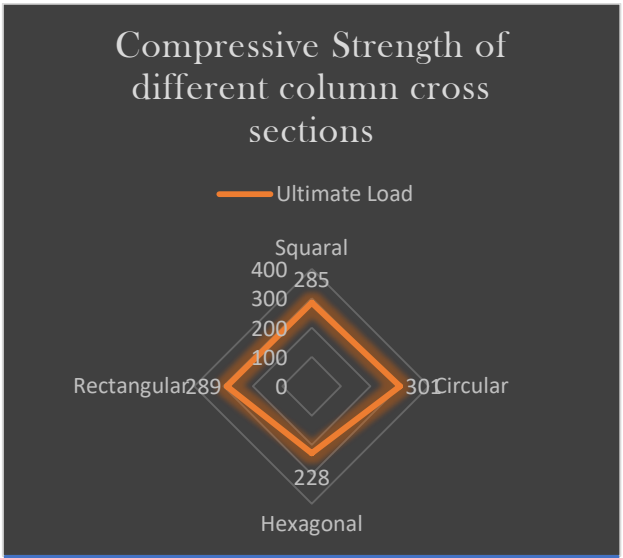
3. Experimental Programme

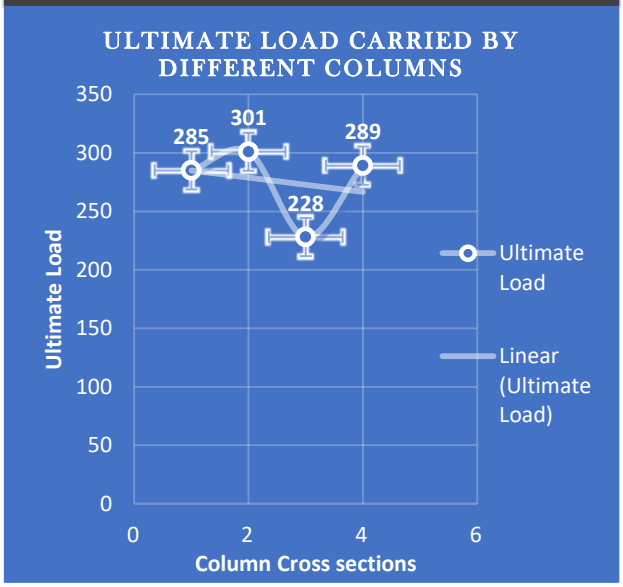
The whole research was based on 8 columns of different shapes. These were 2 columns of square cross section, 2 of circular section, 2 of hexagonal section and 2 of

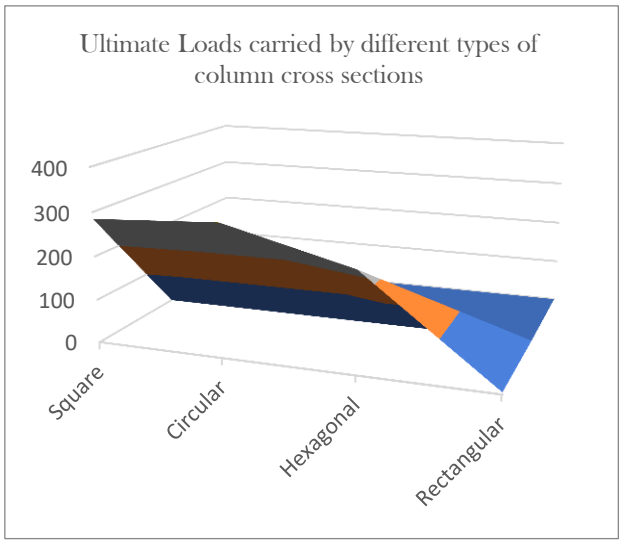
Fig. Casting of different columns

The different columns casted were tested for compression and the folloeing results were obtained.

S NO.	Column type	Ultimate load (KN)	Average
1	Square	289	285
		281	
2	Circular	307	301
		295	
3	Hexagonal	224	228
		232	
4	Rectangular	291	289
		287	







4. Conclusions and Recommendations

From the above sequels, the following inferences are drawn:-

1. Circular column has the highest load carrying capacity than the other three under concentric loading.

2. The collapse of circular column is ductile while that of square and hexagonal column, it is brittle. This can be due to following reasons-

- Circular columns are symmetric about any centroidal axis, while as square and hexagonal columns have only four axis of symmetry.
- Due to spiral reinforcement in circular columns, ductile failure occurs and hence the additional strength under strain hardening is used which ultimately increases its load carrying capacity.
- The load required to buckle a column with a circular cross section is the same around its perimeter. but a beam with a rectangular cross section may bend first in either of two axes.
- Circular cross-section columns are more resistant to buckling as compared to rectangular cross-section.
- Furthermore, circular sections will have uniform torsion characteristics. No weak corners in circular columns and no stress concentration.
- Columns having shear reinforcement in form of spirals gives better confinement than shear reinforcement in form of ties. A column is only as strong as its weakest point, and square columns have four lines of weakness – the folds. Cylinders don't have any folds, so they don't have any points of weakness and can spread the load they're bearing out evenly across the whole cylinder.

3. Under Concentric and Uniaxial loading- Square column also has satisfactory load carrying capacity but the load carrying capacity of hexagonal column is comparatively less.

4. The casting of hexagonal column like its formwork and other things is very difficult making it less economical. Likewise cylindrical column is a bit difficult to cast while as square column can be easily constructed.

5. Rectangular column was found to have more load carrying capacity than the square columns but less than the circular columns.

6. Circular column has more load carrying capacity among all the shapes.

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