Experimental investigation and comparison of RCC composite column with ANSYS

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***Abstract**-reinforced concrete columns and a theoretical procedure for analysis of slender reinforced and composite columns of varied shaped cross section subjected to biaxial bending and axial load are presented. In the proposed procedure, nonlinear stress–strain relations are assumed for concrete, reinforcing steel and structural steel materials. The proposed procedure was compared with test results of 3 I-shape,3 cicular-shape,3 square-shape reinforced concrete columns subjected to short-term axial load and biaxial bending, and also some experimental results available in the literature for composite columns compared with the theoretical results obtained by the proposed procedure& ANSYS , good degree of accuracy was obtained. An experimental investigation on the structural behavior of steel tubular columns in-filled with plain and steel reinforced concrete is presented in this study. A total of 9 concrete-filled steel tubular columns were constructed and tested subjected to axial load. The main variables considered in the test study were the cross section, slenderness, concrete compressive strength and the load conventionally.*

Keywords-Reinforced concrete column; Composite column; Biaxial loading; Ultimate strength; Stress–strain models, ANSYS

I. INTRODUCTION

Concrete

In this section, concrete is synthetic construction material made by mixing cement, fine aggregate (river sand), coarse aggregate (gravel or crushed stone) and water in proper proportion. This mixture hardens into a rocklike mass as result of chemical reaction between cement and water. Concrete will continue to new to harden and gain strength as long as it is kept moist and worm. This condition allows the chemical reaction to continue and the process is known as curing

Rcc Purposes and Types Of Reinforcing Steel

Reinforced concrete was designed on the principle that steel and concrete act together in resisting force. Concrete is strong in compression but weak in tension. The tensile strength is generally rated about 10 percent of the compression strength. For this reason, concrete works well for columns and posts that are compression members in a structure. But, when it is used for tension members, such as beams, girders, foundation walls, or floors, concrete must be reinforced to attain the necessary tension strength.

Composite column

A steel-concrete composite column is a compression member, comprising either a concrete encased hot-rolled steel section or a concrete filled tubular section of hot-rolled steel and is generally used as a load-bearing member in a composite framed structure. Typical cross-sections of composite columns with fully and partially concrete encased steel sections are illustrated in Fig. a. Fig. b shows three typical cross-sections of concrete filled tubular sections. Note that there is no requirement to provide additional reinforcing steel for composite concrete filled tubular sections, except for requirements of fire resistance where appropriate.

II. METHODOLOGY

Experimental Study:-

In this experimental work, it is aimed to evaluating compressive strength of concrete cubes. For this purpose, total cubes concrete of concrete mix designs i.e. M30 were casted. This casting is done in 1 batches. It is done in specially prepared in cube of 150mmx150mmx150mm. These moulds were prepared for 7 days curing for testing compressive test and flexural test. From the test results load verses deflection graphs were drawn, form which comparison of nature of their failure is done. The detailed procedure for carrying out the above experimentation work is discussed below.

Casting

Casting is a manufacturing process by which a liquid material is usually poured into a mold, which contains a hollow cavity of the desired shape, and then allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the mold to complete the process. Casting materials are usually metals or various cold setting materials that cure after mixing two or more components together; examples are epoxy, concrete, plaster and clay. Casting is most often used for making complex shapes that would be otherwise difficult or uneconomical to make by other methods. Before concreting all the moulds were fully tightened. The junctions of vertical and bottom planks were coated with plaster of Paris to avoid any leakage of cement slurry. The inside of the mould was oiled to prevent adhesion of concrete.

III. PROBLEM STATEMENT

Tests on Steel RCC composite column structure:

For testing the column 12 columns are casted which are as follows:

- 3 no of RCC reinforced column with I-section.
- 3 no of RCC reinforced column with Square-section.
- 3 no of RCC reinforced column with Circular-section.

These above mentioned columns are tested for compression under UTM.

Analytical Method

For the ultimate strength analysis, the biaxial eccentric ultimate load Nu can be determined by

$$N_u = \sum_{k}^{l} \bar{A}_{ck}\sigma_{ck} - \frac{A_{st}}{m}\sum_{i}^{m} \sigma_{si} - \sum_{j}^{n} A_{ij}\sigma_{1j}.$$

ANSYS SOFTWARE MODELS

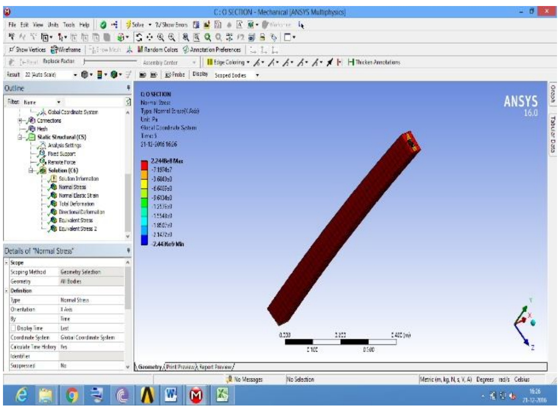
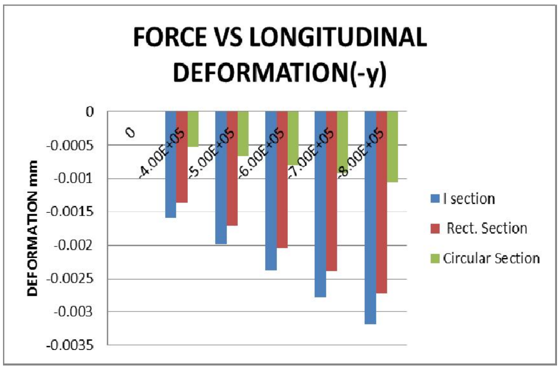
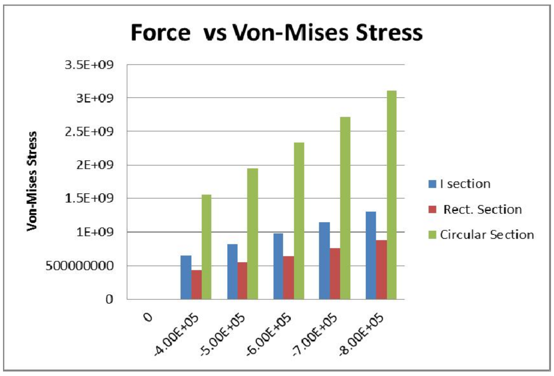


Fig 4.1



Graph no: 4.1



Graph no: 4.2

IV. RESULT AND DISCUSSION

COMPARISON BETWEEN NUMERICAL AND EXPERIMENTAL RESULTS
Normal stress is calculated by

σ =Ultimate load/Cross sectional area
= (127.23 x 1000)/ (65x65)
=38.055 N/mm^2

NORMAL STRESS		
EXPERIMENTAL	**ANSYS**	**% ERROR**
38.055	35.98	5.45

Table no: 5.1

NORMAL STRAIN		
EXPERIMENTAL	**ANSYS**	**% ERROR**
0.0035	0.003	2.3

Table no: 5.2

ULTIMATE LOAD		
EXPERIMENTAL	**ANSYS**	**% ERROR**
127.23	122.57	3.45

Table no: 5.3

V. CONCLUSION

1. Maximum load carring capacity is found in I-section @ 10-15% more than Circular section and Rectangular section of 800 mm length and 65 mm X 65 mm in cross section

2. In I-section specimen corner of column fails indicate shear failure due to axial load of UTM, therefore additional provisions should be made to avoid failure.

In later stage of study validation of specimen is carried out using FEA tool ANSYS.16, normal stress, strain and loading capacity of model is validated and error occurs @ 5% which is quite acceptable from ANSYS models total deformation, vonmises stress and normal stress and following results are obtained:

3. Total deformation and deformation in longitudinal direction is 15-20% less in I section as compared to Circular section and Rectangular section

4. Von mises stress and normal stress found maximum in Circular section therefore it should be avoided for heavier loads but due to reduction in concrete it can be used as floating column

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