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Experimental and theoretical investigation of concrete filled and encased steel column under compression loading

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Abstract

Steel-concrete composite beams find extensive

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Steel-concrete composite beams find extensive usage in high-rise buildings and bridges. The primary advantages of composite beams are high strength, high ductility, and fire resistance. In this research, the effect of the position of steel tube such as concrete encased and filled steel tube column and concrete filled steel tube column. The author bought Fe250 grade steel from the local market. The steel tube comes in two shapes: circular and rectangular. The entire column was subjected to a concentrated load until it failed. Compared to the concrete encased and filled steel tube column, the concrete filled steel tube column has a higher value of Young's modulus. The theoretical load carrying capacity of CFST is 367.74 kN, which is 19.64% lower than the experimental load carrying capacity. The theoretical load carrying capacity of CFCT is 206.80 kN, which is 28.43% lower than experimental CFCT. Theoretical load carrying capacity of CFST is 26.05% higher than the theoretical load carrying capacity of CFEST. Theoretical load carrying capacity of CFCT is 60.29% higher than theoretical load carrying capacity of CFECT. The theoretical vs experimental load difference is not less than 0.72.

Introduction

Steel-concrete composite columns are widely used in construction, especially in seismic areas, tall buildings, and bridges. They offer numerous advantages over RC columns, including high compressive strength, low cost, good fire resistance, and high ductility. Researcher Lee [1] encased a steel column under the concentered load. The major parameters of the investigation are steel section type and column configuration. It observed that the experimental results are closer to the predicted value. Jingming Cai et al. [2] conducted the behavior of concrete encased steel column. The column is subjected to the axial force, and the encased column has higher load carrying capacity compare to the concrete filled column. The researchers discovered that the failure load carrying capacity of the beam is underestimated by the existing equation. Le Huang el al. [3] investigated the behavior of concrete encased steel column with FRP warping. In this investigation, concrete filled FRP sheet and FRP sheet warping with the I section. It observed that the over warping of steel I section shows better results compare to FRP sheet. Najia et al.[4] carried out the axial performance of concrete filled steel tube column using steel fibre. It observed that the

filled column. The researchers discovered that the failure load carrying capacity of the beam is underestimated by the existing equation. Le Huang el al. [3] investigated the behavior of concrete encased steel column with FRP warping. In this investigation, concrete filled FRP sheet and FRP sheet warping with the I section. It observed that the over warping of steel I section shows better results compare to FRP sheet. Najia et al.[4] carried out the axial performance of concrete filled steel tube column using steel fibre. It observed that the concrete filled column fails by buckling of column near bottom. The circular and square shown the closer behaviour. Aditya Tiwary [5] studied the experimental behaviour of double skin steel tube column subjected to axial load.

The author examined experimental and theoretical behavior and compared it to an empirical equation. HarpreetSingh et al. [6] investigated the behaviour of concrete filled steel tube column using nano materials. In this study, an angle plate strengthened the steel tube. By adding an angular bar, researchers found that the ultimate strength of the beam increased and its performance improved. Jingzhe Li et al. [7] investigated the experimental and numerical studies on elliptical shape steel tube column subjected to axial loading. Major parameter of studies is

study, an angle plate strengthened the steel tube. By adding an angular bar, researchers found that the ultimate strength of the beam increased and its performance improved. Jingzhe Li et al. [7] investigated the experimental and numerical studies on elliptical shape steel tube column subjected to axial loading. Major parameter of studies is hollow diameter, diameter to thickness ratio and aspect ratio. It observed that typical failure of the columnis, moreover same. Biao Li et al. [8], [9] studied the finite element analysis high strength concrete filled steel column. Constitutive modelis employed to analyze the composite column. Finite element analysis is performed using ABAQUS and the predicted values are compared with existing design equations. En Wang et al. [10] investigated the confinement effects of steel column under concentrated load. The major parameter of the study is recycled coarse aggregates. Naderpour et al. [11] carried out the load carrying capacity of the RC column using experimental and machine learning algorithm. Velrajkumar and muthuraj [12] conducted a test of a composite beam. Velrajkumar et al. [13] conducted the test to determine the performance of Geo polymer beam. This method is used to predict the seismic and retrofitting behavior of the RC column. It showed the cross section of view of

polymer beam. This method is used to predict the seismic and retrofitting behavior of the RC column. It showed the cross section of view of concrete filled steel–concrete composite column in Fig. 1.

Steel-concrete composite column is popular in construction sector. Various researches are conducted on concrete filled steel tube column and double skin steel tube column. It provides high strength and ductility. There are no literatures are available on concrete encased and filled steel tube column. In this study, is intends concrete is filled and encased with a steel tube column to measure its behaviour. The parameter of the study is the position of placing of steel tube like encased and filled with concrete. Theoretical equation is using to find the strength of the composite column.

Section snippets

Materials properties

The constituent material of concrete is tested and results are given in Table 1. The cement and aggregates were purchased from the local market. Concrete was designed as per IS 10262-2019 and the grade of concrete is M25. The mix

market. Concrete was designed as per IS 10262-2019 and the grade of concrete is M25. The mix ratio of concrete is 1:1.25:2.25:0.45 (Cement: fine aggregate: coarse aggregate: water). The concrete cube has an average compressive strength of 32.56MPa, the concrete cylinder has an average split tensile strength of 3.52MPa, and the concrete has an average…

Experimental investigation

Experimental investigation of columns is carried of using universal testing machine of 400 kN capacity. The test specimens are given in Table 2 and a schematic diagram of a composite column shown in Fig. 3. The steel section comprises mild steel and yield strength of steel is Fe250. Column is tested under the compression condition. The load was gradually applied at an interval of 8 kN and the corresponding change in length was also measured. The Casting and testing of beam is shown in Fig. 4.

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Theoretical studies

Theoretical load carrying capacity of column is carried as per IS 456-2000. As per

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Theoretical studies

Theoretical load carrying capacity of column is carried as per IS 456-2000. As per IndianStandard L/D ratio of column is less than 12 is considered as short column. The formula for determine the load carrying capacity is given below:

Short axially loaded members in compression as $P_u=0.4f_{ck}A_c+0.67\ f_yA_{sc}$....

Results and discussion

The mechanical behaviour of concrete filled and encased steel tube column is performed by experimental and theoretical. All the columns are subjected to central concentrated load were applied up to the failure. Experimental ultimate load carrying capacity of concrete filled square tube column (CFST) is 440 kN and the corresponding theoretical load is 367.74 kN. Theoretical load of concrete filled and encased column (CFEST) is 271.92 kN, which is lower than the theoretical ultimate load of CFST. ...

Conclusion

The following conclusion is made from the

Theoretical load of concrete filled and encased column (CFEST) is 271.92 kN, which is lower than the theoretical ultimate load of CFST. ...

Conclusion

The following conclusion is made from the research:

- Concrete filled rectangular steel tube column has higher value compared to Concrete filled encased rectangular steel tube column....
- Concrete filled encased steel tube column circular has lesser value compared to concrete filled square steel tube column....
- The concrete filled steel tube column has higher young's modulus value compared to concrete filled encased steel tube column....
- The CFST's theoretical load capacity is 367.74 kN, which is 19.64% less...

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper....

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