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Design of A G+4 Building as A Steel-Framed Structure with A Symmetrical Building Plan with 3.2-M Floors Height.

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ABSTRACT—

Steel-concrete composite construction refers to the use of concrete to encase steel sections for use as columns and mechanical shear connectors to join the concrete slab or profiled deck slab to the steel beam so that they function as a one piece. In this present work, G+4 storey residential building located in earthquake zone IV is being compared to steel-concrete composite with R.C.C. and Steel alternatives. It employs the equivalent static method of analysis. STAADPro.V8i software is used to model composite and R.C.C. structures. The findings are compared, and it is discovered that composite structures are more cost-effective.

Keywords— STAAD-PRO, G+4 storey, structure, software, cost-effective, earthquake.

I. Introduction

A composite member subjected mainly to compression and bending is called as composite column. In a composition column both the steel and concrete would resists the external loading by interacting together by bond and friction. Additional reinforcement in the concrete encasement prevents excessive spalling of concrete both under normal load and fire conditions. Apart from speed and economy, the following other important advantages can be achieved. In comparison to many other emerging nations, India uses a fairly little amount of steel in the construction industry. Other nations' experiences suggest that this isn't because steel isn't economically viable as a building material. The volume of steel used in building has a lot of room to grow, especially given India's current growth needs. A significant loss for the nation results from not investigating steel as a substitute construction material and from not adopting it when it is cost-effective. Also, it is clear that modern composite sections made of steel and concrete are a time, money, and cost-effective alternative for important civil structures like bridges and tall skyscrapers.

II. Literature review

Rath et al. (2022) Due to its many benefits, the concrete-steel composite column, which can be fully or partially encased in steel, currently attracts more attention from the general public than a reinforced concrete column. The various codes' mandated formulae have all been used to forecast the maximum load-carrying capacity of composite columns. When examining the load-carrying capability of composite columns, many researchers frequently resort to EN 1994-1-1:2004 and JGJ 138-2016. These codes' formulas are based on the cross-sectional area and associated yield strength of the reinforcement bar, steel, and concrete. Other elements like the transversal reinforcement's diameter, tie spacing, column slenderness ratio, shape factor, etc. are not taken into account. With steel completely encased in the centre of the reinforced concrete column, the performance of concrete steel composite columns subjected to axial load was examined in this study. With three different composite column lengths and two different quantities of longitudinal reinforcement, a series of eighteen samples of concrete steel composite columns has been subjected to a parametric investigation technique. The test findings were compared to those found using the EN 1994-1-1:2004 and JGJ 138-2016 code's specified formulas. Results from the ABAQUS test and those produced using the formulae outlined in the aforementioned codes showed a significant discrepancy. These formulas have been appropriately updated in the current study by incorporating the length parameters and load variables using regression analysis.

Patton et al. (2022) Because of its exceptional characteristics with regard to loading in compression, torsion, and bending in all directions, hollow steel tubes (HST) are becoming more and more popular as structural elements. Moreover, concrete-filled steel tubes (CFST) are frequently employed as compression members in the construction industry because of their improved structural capabilities and financial benefits. When compared to reinforced cement concrete (RCC) columns, CFST offers the same economic benefits as an RCC column, causing a building project's overall structure to save a significant amount of money. This study, which focuses on HST, CFST, and RCC stub columns for which there is currently minimal research data, compares the results of experimental and finite element (FE) studies. The test observations are completely recorded. A total of six specimens were tested under uniform axial compression. Finite element (FE) models created using the FE software Abaqus were validated using the ultimate loads, load-displacement curves, and failure modes from the tests. After that, parametric finite element analyses were carried out. The findings demonstrated that adding concrete infill to the HST columns raises the strength capacity of the CFST columns by 2.9 and 2.4 times for stocky parts of square and circular sections, respectively, and by 2 times for thin sections of HST columns. Also, it was shown that the strength capacity of HST columns is around 0.45

times greater for thin sections and 1.35 times greater for stocky sections than RCC columns. And the CFST columns' strength capability is, on average, 1.3 times greater than that of RCC columns for stocky sections of steel tubes and 2.8 times greater than that of RCC columns for thin sections of steel tubes.

Shirsath and Rathi(2022) The non-residential multi-story construction sector in India is fast adopting composite structures. Consider composite construction for the straightforward reason that steel performs best in tension and concrete performs best in compression. When these two materials are combined, their structural qualities are strengthened, and this can be utilised to produce a highly efficient and lightweight design. Steel beams and profiled deck slabs are joined together using shear connectors to construct steel concrete composite building systems, and steel section for columns is enclosed in concrete. In the current work, the equivalent static method of analysis is used to compare the G+15 R.C.C. and composite multistorey commercial structure located in Earthquake Zone IV. The structure is modelled using ETABS 2018 software. Axial force, Bending moment, Storey Displacement, Storey Drift, Storey Shear, Self weight, and Shear Force are taken into consideration as factors. Comparing the findings reveals that the Composite structure is superior in every way.

Mehta and Bhandari (2023) This study compares 5-storey composite structures with and without bracings that are submitted to significant earthquake loads in order to demonstrate the usefulness of the bracing system with regard to the seismic performance of steel-concrete composite buildings. The unique building models taken into consideration for this study are subjected to the nonlinear time history analysis (NTHA). The effect of the bracing system is ascertained by comparing the seismic response in terms of various seismic response characteristics. Three earthquake reaction characteristics, including base shear, inter-storey drifts, and storey displacements, were compared between the findings produced by applying real earthquake records of various near-field and far-field earthquakes. When exposed to strong earthquakes, the bracing system is particularly successful in withstanding the seismic stress because it makes the building more rigid overall. The bracing system enhances the composite building's overall performance by lowering the maximum storey displacement and inter-story drifts during severe earthquakes.

Dhawane and Raut (2023) In the scope of this study, an effort was made to determine the impact of the rectangular construction plan columns' size, shape, and orientation on the overall stiffness and seismic response of the shaking building. Using ETABS software, a multistory RC building is modelled with various column sizes (varying cross-sectional area at building height), column forms (square and rectangular), and column orientations to ascertain the impact of each on the stiffness and seismic response of the building. In terms of base movement, overburden displacement, layer deflection, and time period, the analytical results of each model were contrasted.

III. Design Load Details

Load Type	**Intensity (kN/m^2)**
Load From Slab	4.75
Floor Finish	1
Total Dead Load(IS 875 (Part I)-1987)	5.75
Live Load(IS : 875 (Part II)-1987)	2
Total Load	7.75
Total Factored Load	11.65

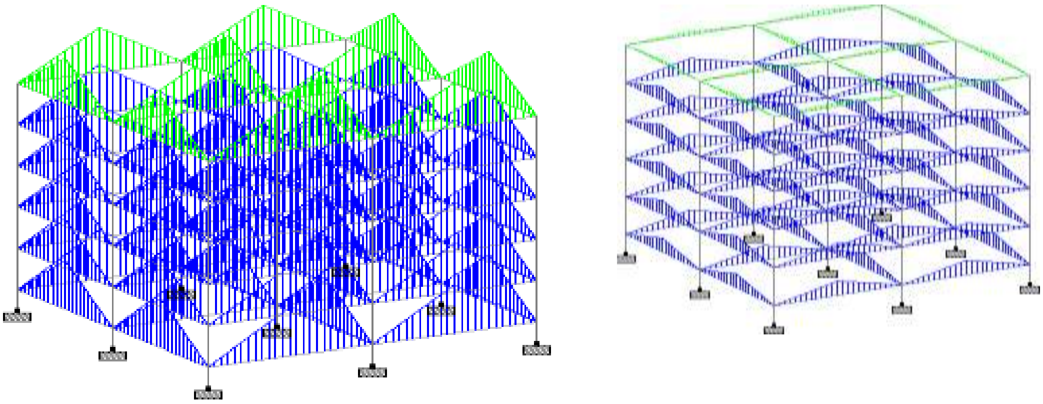

Figure 1 Dead load & Live load on Structure

IV. Conclusion

Based on the above study following conclusions can be made:

- Software called STAADPro-V8i has used for the analysis.
- The R.C.C. structure was made using a manual design procedure. The dimensions of the structure's components and reinforcements are given while taking the structure's economics into account.
- Enough understanding of the burgeoning field of steel-concrete composite structure design has been attained.
- The size of the foundation and the amount of reinforcing needed are lower for steel structures than for RCC structures.
- Steel members have a substantially lower bending moment than RCC members.

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