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Research Paper

COMPARATIVE STUDY ON ANALYSIS OF RCC, STEEL AND COMPOSITE BUILDING FRAME (G+30) BY USING ETABS

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ABSTRACT *The availability of thing resources, the essential skill degree for construction, and the practicality of layout recommendations are the primary factors that have an impact on bolstered concrete, the most important construction approach for systems. The multiplied lifeless load and doubtlessly risky formwork of Reinforced Cement Concrete (R.C.C.) have rendered it uneconomical nowa days. Composite constructing is an innovative idea within the production industry. It may not be possible financially to put off the construction of each level whilst concrete columns are being cast, due to the use of present day composite technology that enable the short meeting of structural frameworks for several stories. Composite beam-columns have the benefit of being very proof against earthquakes, that's why they are significantly utilised in production in Japan.*

Based on the idea of linear fabric characteristics, this research does each static and dynamic research of a G+30 multi-story residential construction making use of ETABS for Response Spectrum Analysis. The results of the non-linear analysis monitor some of signs, including base shear, overall performance point, displacement, and tale drift. Every shape have to now be designed and tested to resist lateral hundreds, such as wind and seismic hobby. In multi-story structures, the distance required to accommodate the large quantity of steel and concrete had to make reinforced cement concrete (RCC) structural members—that have a big move-sectional region—is large. Due to its capacity to economically optimise useable area, lower structural member pass-sectional area, and successfully control seismic forces, a composite structure is the high-quality solution beneath these situations.

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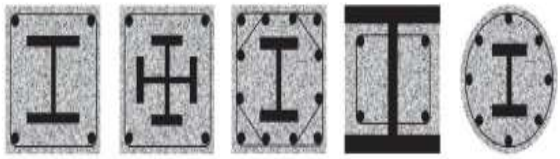
1. INTRODUCTION

Fire isn't often visible through structural engineers as a chance to building frameworks. Compared to other masses they ought to determine, this one is lighter. Assessing dangers, making adjustments to structural stiffness, and the usage of fashions are all essential additives of seismic design. Additional structural factors and wind tunnel tests are required for wind design. Incorporating insulating substances into the structure and engaging in fundamental, character detail opinions are essential components of fireplace design. Neither calculations nor engineering are usually finished for thermally generated forces.

Due to their better performance in fireplace conditions and simplicity of installation, composite columns are frequently used in creation. On-web page reinforced concrete is injected into metallic tubes to create concrete-crammed tubes. In a non-hearth situation, the column's bolstered concrete middle supports the general public of the load, however in a hearth, the composite creation takes over. This kind of column has been included in lots of print retailers, but their techniques are oversimplified. Importantly for locating the neutral axis of a circle's columns. It is commonplace exercise to disregard the column's shear resistance.

The picture under shows considered one of numerous feasible arrangements for composite columns. Composites are appealing due to the fact they combine the quality capabilities of two popular building materials: steel and urban. This might also bring about loads of resistance for a little move-sectional area, which could be ideal for making the maximum green use of the available floor space. When it comes to fires, they are simply tremendous.



Typical composite column cross sections

Objectives of the study

1. To conduct an analysis of the G+30 story structure employing several kinds of columns, including RCC, steel, and composite columns, in compliance with the requirements of IS1893:2002.
2. To use the ETABS program to perform building seismic analyses.
3. Results like story drift, story shear force, story bending, and building torsion are assessed using the pushover analysis.
4. Seismic design with ductility in mind, as per IS 13920.

2. LITERATURE REVIEW

Dr. K. R. C. Reddy, Sandip A. Tupa et., al. (2014)

This look at examines a multi-story building's seismic masses in various zones the use of the International Standard 1893 code, and its wind hundreds the use of the International Standard 875 code. The wind loads are decided by the use of the sector's layout wind speed and including a 20% margin of blunders. There has been a contrast among the earthquake masses and the wind hundreds that have been calculated for the constructing. Finally, it's been shown that wind loads are generally extra critical than earthquake loads.

A twelve-story reinforced concrete shape's wind and seismic hundreds are computed. The effects that have been gathered cause the following conclusions. Elevation will increase the constructing's vulnerability to wind and seismic forces. When it comes to tall systems, wind masses are much more critical than seismic loads. In the case of great wind or seismic forces, structures must be constructed to resist hundreds that originate in opposite directions.

Gowda S L, Dr.Gopisiddappa, Sindhoora C, et al.,(2017)

Assuming the complete structure is built and subjected to full loads, this take a look at makes use of linear static analysis to evaluate the constructing in a single step. This take a look at examines the similarities and variations across different areas of India by means of comparing traditional columns with composite columns in flat slab structures. We use ETABS to do the analysis.

Composites are more inflexible than reinforced concrete homes, in line with the examine. Composite structures have a extremely decrease base shear than bolstered concrete structures. The x- and y-axis displacements produced via the earthquake are indistinguishable from each other.

3. BUILDING MODEL CONSIDERATIONS AND METHODOLOGY

In the present study, analysis of G+ 30 stories building in Zone V is carried out in ETABS.

Basic parameters considered for the analysis are

1. Grade of concrete : M40
2. Grade of Reinforcing steel : HYSD Fe500
3. Dimensions of beam : 230mmX460mm
4. Dimensions of column : 690mmX690mm
5. Thickness of slab : 180mm
6. Steel column :ISWB500
7. Composite column with angle section :0.69X0.69
8. Height of bottom story : 3m
9. Height of Remaining story : 3m
10. Live load : 5 KN/m^2
11. Dead load : 2 KN/m^2
12. Density of concrete : 25 KN/m^3
13. Seismic Zone : Zone IV
14. Site type : II
15. Importance factor : 1.5

16. Response reduction factor : 5
17. Damping Ratio : 5%
18. Structure class : B
19. Basic wind speed : 44m/s
20. Risk coefficient (K1) : 1.08
21. Terrain size coefficient (K2) : 1.14
22. Topography factor (K3) : 1.36
23. Wind design code : IS 875: 1987 (Part 3)
24. RCC design code : IS 456:2000
25. Steel design code : IS 800: 2007
26. Earth quake design code : IS 1893 : 2002 (Part 1)

4. Methodology Used

Response Spectrum Analysis

The modal approach and the mode superposition method are different names for this approach. The idea states that the response of a shape is the sum of its vibrational modes, which might be described with the aid of their unique distortions in shape, frequency, and modal damping.

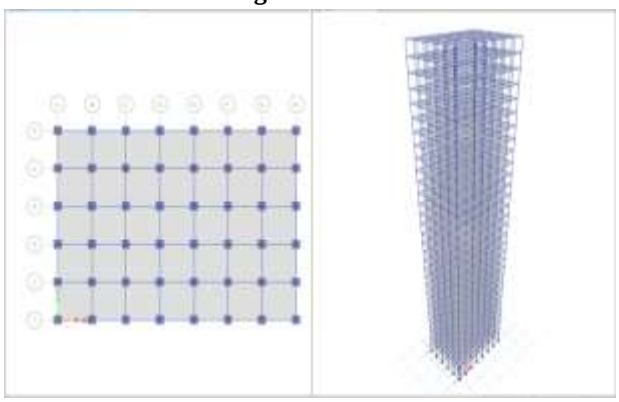
The reaction spectrum method, employing the design spectra proven in Figure 4.1, is needed for the assessment of high-upward thrust and irregular homes in step with IS-1893(Part-l):2002. Seismic analysis using reaction spectra gives giant computational benefits for structural gadget displacement and force prediction. The method is predicated on calculating the maximum displacements and member forces in each mode, averaging throughout several seismic occurrences with smooth spectra. To ensure that the 2 orthogonal number one horizontal directions account for at the least ninety% of the constructing's collaborating mass, it is critical to encompass ok modes in the analysis. The purpose of the studies is to decide the bottom shear for each mode via analysing floor motion spectra and unique constructing attributes.

Using the SRSS method, we statistically combination the narrative forces, accelerations, and displacements for every mode. Base shears calculated using a essential period T and the layout base shear (VB) ought to be compared on this method. Members forces, displacements, story forces, story shears, and base reactions are all issue to multiplication by way of VB/Vb if V_B is much less than Vb. Specifically, the reaction spectrum technique, implemented to the layout spectrum, is required for the analysis. The decision to adopt a design spectrum that has been specifically created for a building at a positive venture website is in the end as much as the mission managers. The supposed five% spectra for dust and rocky environments are shown in Figure four.1.

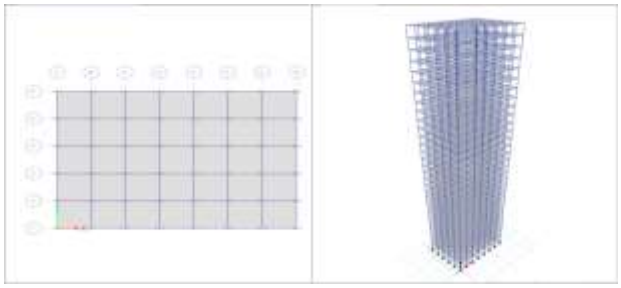
Response spectra analysis the use of the enter ground movements' reaction spectra and damping ratios calculated from Equation (3) may also be used to reap the seismic reaction envelopes for structures employing VE dampers. Analysed using the CQC technique, Figures 8a and 8b show the standard outcomes of the floor lateral displacement and story shear envelopes of a 5-story metal frame with VE dampers (4 = 15 zero/0) that turned into subjected to the 0.62 El Centro earthquake (Kiureghian 1981). When the earthquake hit, the building flexed. The effects of analytical and experimental time history analyses are also included in the figures. Relative to the viscoelastically dampened shape, the response spectra offer reliable estimations of the narrative shear envelopes and lateral displacements.

5.Models in ETABS Software

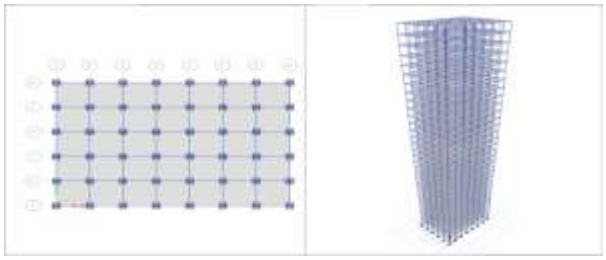
RCC Column Building



Steel Column Building



Composite column Building



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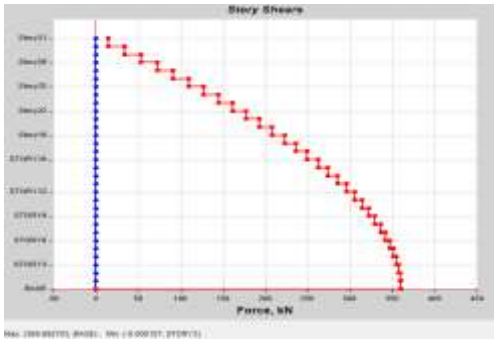
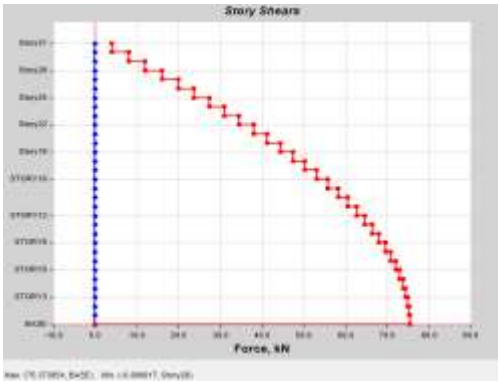
6. RESULTS AND ANALYSIS

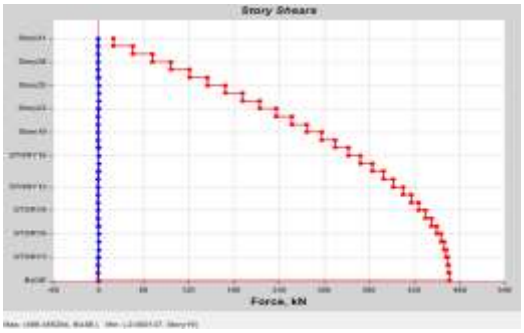
Storey shear Plots



General Building



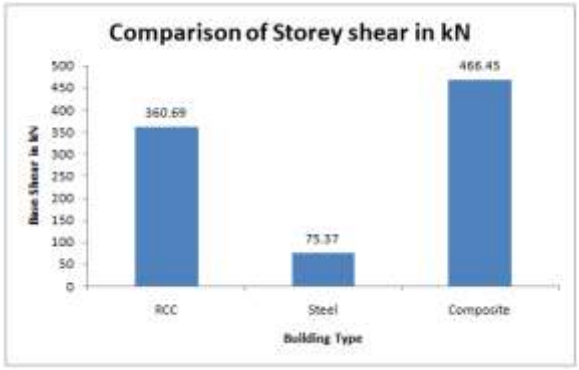
Steel Building



Composite Column Building

Comparison of Maximum Values of Storey Shear Values

S. No	Building Type	Base shear in kN
1	RCC	360.69
2	Steel	75.37
3	Composite	466.45

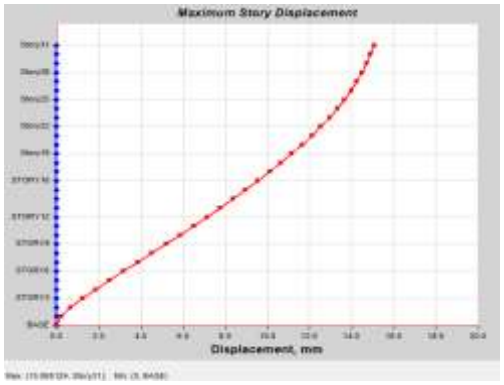


Comparison of Storey Shear Values

Displacement Plots

General Building

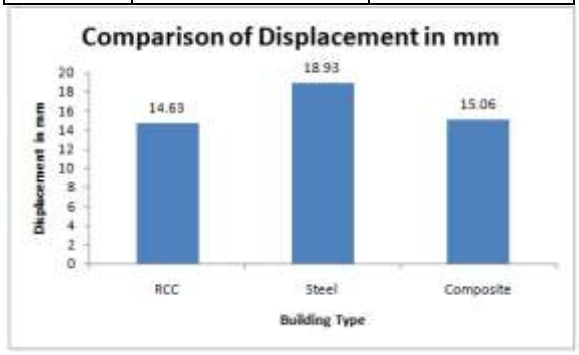
Steel Building



Composite Column Building

Comparison of Maximum Values of Displacement Values

S. No	Building Type	Displacement in mm
1	RCC	14.63
2	Steel	18.93
3	Composite	15.06



Comparison of Displacement Values

7. CONCLUSIONS

The effects are as follows.

1. In each the X and Y load situations, the steel constructing model has decrease story float values than the RCC building and composite column building models. Results from composite column designs provide the top bounds.

2. From the thirtieth degree to the lowest story, the values of shear, bending second, and constructing twist increase. When contrasted with RCC and composite column systems, the shear and bending values of the metallic column constructing are lower.

3. When subjected to pushover masses, composite column structures showcase better maximum base shear values within the X and Y instructions in assessment to RCC column and composite column models.

4. In evaluation to the RCC and composite column homes, the steel column constructing has decrease values for shear, bending, torsion, tale go with the flow, and other capabilities.

5. Steel frames have a higher X-path storey flow than composite and RCC structures.

6. The orientation of the column sections is responsible for the various storey waft throughout exclusive tiers in each the X and Y axes. You can see a bidirectional variant inside the moment of inertia of the column sections.

7. Compared to metal and composite frames, RCC frames have a higher base shear due to the fact to their larger weight. In comparison to the RCC frame, the composite and metal frames reduce base shear via 40% and 45%, respectively.

When compared to the RCC frame, the composite and metallic frames both show a 33% and 27% reduction in price, respectively. Expenses like fabrication, delivery, labour, and different related expenditures are not blanketed on this; it totally applies to fabric expenses.

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