“SEISMIC ANALYSIS OF MULTI-STOREY BUILDINGS WITH COMPOSITE COLUMNS AND RCC BEAMS”

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Abstract - In this work, a study was conducted on the behavior of composite columns, which are called reinforced concrete columns (SCC). The structure is exposed to a zone 5 seismic load according to IS 1893: 2016 and combinations of dead loads have been considered. The results of the bending moment and the lateral deformation of the frame are compared with the SAP 2000 software.

In this study, an analysis of the two-span structure with a composite column with a seismic zone five according to IS 1893: 2016 was carried out and a comparison was made between bending moments, section modulus, deflections, shear force for seismic load and dead load.

Key words: composite section, steel girder, seismic load, SAP 2000, 5 story building, 9 columns, Fe-250.

I. INTRODUCTION

Designing multi-storey buildings has always been a social challenge. With the difficulty of land supply, modern society is shifting from single-family houses to skyscrapers. In the design of skyscrapers, lateral loads (i.e., wind loads and earthquakes) began to dominate, which led to an increase in the size of columns and beams. In earthquake-resistant structures, there is a new method of designing strong columns and weak beams so that they will not collapse immediately due to the fracture of the beam in an earthquake.

In large buildings, steel and concrete are usually combined in the form of composite beams or composite columns. Concrete can provide composite quality, stiffness and compressive strength, and reduce bending and vibration of the floor. The steel element gives the column tensile strength, the ratio of strength to weight is excellent, and the construction time is short.

Next, choose a combination of structural concrete and steel and built a composite structure called a composite structure. Civil engineers worked hard to keep the size of the cylinder small and make it strong. Therefore, composite columns can be used to overcome this requirement.

II. ADVANTAGES OF SCC STRUCTURE

➢ Most effective utilization of materials means concrete for compressive stress and steel for tensile stress.
➢ Steel is highly ductile in nature hence better seismic resistance of the composite section.
➢ Steel component has the ability to absorb the energy released due to earthquake forces.
➢ Ability to cover large column free area.
➢ Faster construction by utilizing rolled and/or prefabricated components.
➢ Keeping span and loading unaltered, smaller sections are required compared to non-composite construction. Minimum disturbance to traffic in bridge construction.

III. DESIGN OF PROPOSED WORK

Different structural systems is employed currently on a daily basis to fulfill performance and stability. Composite construction is wide utilized in structural systems to achieve

- Long spans
- Lower story heights
- Provide extra lateral stiffness
- More purposeful space by reducing the dimensions of columns.

Composite construction uses the structural and constructional benefits of each concrete and steel.

A model of 9 columns and 2 bay structures having 5 floors analysed. Foundation support conditions have been assumed to be fixed type. Modeling and analysis of the structure is done with advance structural engineering software SAP 2000 developed by CSI.
### Table 1: Geometry & Sectional Properties of Composite Sections

<table>
<thead>
<tr>
<th>Section</th>
<th>Material</th>
<th>Shape</th>
<th>Area</th>
<th>Torsion</th>
<th>Moment of inertia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Column Channel</td>
<td>M30</td>
<td>SD Section</td>
<td>0.6167</td>
<td>0.0170</td>
<td>0.014183</td>
</tr>
<tr>
<td>Column Concrete</td>
<td>M30</td>
<td>SD Section</td>
<td>0.25</td>
<td>0.0088</td>
<td>0.005208</td>
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<tr>
<td>Column Double</td>
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<td>SD Section</td>
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<td>0.0113</td>
<td>0.01085</td>
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<td>SD Section</td>
<td>0.6167</td>
<td>0.0129</td>
<td>0.014183</td>
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<tr>
<td>Column L Angle</td>
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<td>SD Section</td>
<td>0.5000</td>
<td>0.0133</td>
<td>0.009751</td>
</tr>
<tr>
<td>Column T</td>
<td>M30</td>
<td>SD Section</td>
<td>0.5000</td>
<td>0.0110</td>
<td>0.009751</td>
</tr>
<tr>
<td>Beam 500*500</td>
<td>M30</td>
<td>Square</td>
<td>0.25</td>
<td>0.0088</td>
<td>0.005208</td>
</tr>
</tbody>
</table>

Fig 6  Window Tab in SAP2000 for Section Designer Double Angle Column

Fig 7  Window Tab in SAP2000 for Section Designer Column T Section

IV. RESULTS AND DISCUSSION

Fig 8  SAP2000 Showing Bending Moment Variation
**Fig 9**  Deflected Shape of Model Due To Various Loading

**Fig 10**  B11 Bending moment due to Dead Load and Seismic Load

**Fig 11**  B12 Bending moment due to Dead Load and Seismic Load

**Fig 12**  B13 Bending moment due to Dead Load and Seismic Load

**Fig 13**  B14 Bending moment due to Dead Load and Seismic Load

**Fig 14**  C11 Bending moment due to Dead Load and Seismic Load
Fig 15  C12 Bending moment due to Dead Load and Seismic
    Load

Fig 16  C13 Bending moment due to Dead Load and Seismic
    Load

Fig 17  C14 Bending moment due to Dead Load and Seismic
    Load.

Fig 18  C21 Bending moment due to Dead Load and Seismic
    Load

Fig 19  C31 Bending moment due to Dead Load and Seismic
    Load

Fig 20  C41 Bending moment due to Dead Load and Seismic
    Load
Fig 21  C51 Bending moment due to Dead Load and Seismic Load

Fig 22  M11 Bending moment due to Dead Load and Seismic Load

Fig 23  M12 Bending moment due to Dead Load and Seismic Load

Fig 24  M13 Bending moment due to Dead Load and Seismic Load

Fig 25  M14 Bending moment due to Dead Load and Seismic Load

Fig 26  B11 Shear Force due to Dead Load and Seismic Load
Fig 27  B12 Shear Force due to Dead Load and Seismic Load

Fig 28  B13 Shear Force due to Dead Load and Seismic Load

Fig 29  B14 Shear Force due to Dead Load and Seismic Load

Fig 30  C11 Shear Force due to Dead Load and Seismic Load

Fig 31  C12 Shear Force due to Dead Load and Seismic Load

Fig 32  C13 Shear Force due to Dead Load and Seismic Load
Fig 33  C14 Shear Force due to Dead Load and Seismic Load

Fig 34  C21 Shear Force due to Dead Load and Seismic Load

Fig 35  C31 Shear Force due to Dead Load and Seismic Load

Fig 36  C41 Shear Force due to Dead Load and Seismic Load

Fig 37  C51 Shear Force due to Dead Load and Seismic Load

Fig 38  M12 Shear Force due to Dead Load and Seismic Load
VI. CONCLUSION

Bending Moment:-

The maximum bending moment is observed due to combination of dead load and earthquake load in T section composite columns. The minimum bending moment is found in angle section composite columns. Due to applied load maximum bending moment occur at the end of the span and minimum to the near of center.Sections arrangement according to minimum to maximum bending moments results are:

1. Angle section (minimum)
2. Ordinary section
3. Channel section
4. T section (maximum)
Shear Force:

Maximum shear force is observed due to combination of dead load and earthquake load in ordinary section. Minimum shear force is found in angle section composite column. Due to applied load maximum shear force occur at the end of the span and minimum to the near of center. Section arrangement according to minimum to maximum to Shear force results are;

1. Angle section (minimum)
2. Channel section
3. T section
4. Ordinary section (maximum)

Deflection Results:

Maximum deflection is observed due to combination of Dead loads and Earthquake loads in ordinary concrete section. Minimum deflection is found in channel section composite columns. At same floor deflection is found nearly same. At bottom floor deflection is found minimum and maximum deflection is found at top floor which is quite evident under seismic load. Section arrangement according to minimum to maximum to deflection results.

1. Channel section (minimum)
2. Angle section
3. T section
4. Angle section (maximum)

REFERENCES


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