Experimental Investigation on Steel Concrete Composite Stubs

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Abstract:
This paper represents a Structural steel shape may be filled with concrete, or a structural steel member for reinforcing may be encased in concrete. The structural behavior of concrete filled steel tube (CFST) stubs has been investigated using experimental studies. Concrete filled tube system has many advantages. In this paper, the comparative study on the stainless steel tube, mild steel, pvc tube and reinforced composite member for M30 concrete. In terms, At the end, the results demonstrated that there is an improvement in the behavior and the load carrying capacity of CFST stub column. The strength of the stainless steel stub column increased by 10% compared to ordinary reinforced stub column. Axially the composite stub analyzed by staddpro.

Keywords: pvc tube, stainless steel tube, mild steel tube.

I. INTRODUCTION

Steel concrete composite columns were used for over a century. Nowadays, the composite structural elements are increasingly used in tall buildings, bridges and other types of structure. The steel concrete composite are considered as an advantageous system for carrying large axial load benefitting from the interaction between the concrete and the steel section. The steel section reinforces the concrete to resist any bending moments, tensile and shear forces. The concrete in a composite column reduces the potential for buckling of the steel–concrete composite columns which are commonly used in buildings. A column designed to combine two different materials or two different grades of material to form a structural member. A structural steel shape may be filled with concrete, or a structural steel member for reinforcing may be encased in concrete. Ordinary Portland cement (OPC) becomes an important material in the production of concrete which act as its binder to bind all the aggregate together. A structural steel shape may be filled with concrete, or a structural steel member for reinforcing may be encased in concrete. A Stub column is whose length is sufficiently small to prevent failure as a column, but long enough to contain the same residual stress pattern that in the column itself. column strength may be expressed as a function of the tangent modulus.

II. COMPOSITE ACTION BETWEEN STRUCTURAL ELEMENTS

Composite action between the various structural elements in a structure always exists when they are continuous. Depending on the size of the building, certain simplifications may be made to approximate their interaction, as isolated structural components, in a conservative manner. The use of higher strength materials and composite action are important factors in making entire systems work economically. Tall buildings require additional considerations such as slenderness, flexibility, and sensitivity to differential effects. Steel and concrete are the major materials used in composite systems. Although they have several dissimilar physical characteristics, it is possible to use them together, beneficially, in different ways. A number of systems have been developed in the last few decades which successfully combine steel and concrete.

![Figure 1. Reinforcement Details Of Composite Stub](image1)

Figure 2. Circular Cft Section after Filling the Mortar

III. MATERIALS AND METHODS

Cement: Cement is a binder that sets and hardens and can bind other materials together. Ordinary Portland Cement (OPC) 53 grade is used.

Fine aggregate: The specific gravity of fine aggregate was 2.6.

Coarse aggregate: Angular shape aggregate which passes through 20 mm sieve and retain on 10mm are used as coarse aggregate in this project work. The specific gravity of coarse aggregate was 2.74.

Mortar: The type of sand and cement mixture needed will dictate the exact ratio. This varies according to the needs of the...
task. Above ground is 5:1, below ground is 3:1, and internal wall is 8:1.

**Mild steel tube:** This type is widely used in construction industry for its ductility and malleability property. The diameter of the hollow pipe is 6mm rod. It is less brittle than stainless steel. It is alloyed with chromium, nickel, molybdenum and other elements to improve its mechanical and chemical properties. It is rusts when exposed to air and moisture. Most common steel used. It is easily welded. Pipeline in the world is created using mild steel. It is prevent brittle and cracking. It is a very popular material. Mainly used as an all purpose engineering material. Mild steels are steels with carbon content up to 2.1% by weight. The specified minimum for copper does not exceed 0.40%.carbon percentage content rises; steel has the ability to become harder and stronger. It becomes less ductile.

**Stainless steel tube:** Mild steel yield strength is typically 65-70% of the tensile strength. Steel alloy with a minimum of 11% chromium. It is not corrode or rust as easily as ordinary steel. It is not stain-proof. Also called corrosion resistant steel when the alloy type. It is high carbon steel. It is differs from carbon steel by the amount of chromium present and low maintenance. It is higher ductility, higher strength, hardness and a more attractive appearance. Then no need for painting or other protective coating. All stainless steels are iron based alloys but contain a minimum of around 10.5% chromium.

**PVC tube:** And the thermal conductivity of rigid PVC pipe is 0.14 to 0.28 W/(m·K).Yield strength is 4500 to 8700 psi. one of the disadvantage is only available in a small number of sizes. It is very lightweight which can be both an advantage and disadvantages. one of the advantages do not corrode. It is chemical resistance. Installation time is quicker and long service life.

**Rebar:** Rebar also called reinforcing steel and reinforcement steel. Used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and hold the concrete in tension. Better bond with the concrete.

**Mix design:** The mix design of M30 grade concrete is calculated using IS 456-2000 and IS 10262-2009. The material required as per design are given in Table: 1

<table>
<thead>
<tr>
<th>Materials</th>
<th>W/C ratio</th>
<th>Cement</th>
<th>Fine aggregate</th>
<th>Coarse aggregate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratio</td>
<td>0.45</td>
<td>1</td>
<td>1.7</td>
<td>2.2</td>
</tr>
</tbody>
</table>

**IV. EXPERIMENTAL PROGRAM**

**PREPARATION OF SPECIMEN:**

Concrete specimens that are representative of a distinct batch of concrete must be sampled and analyzed for the purpose of quality control.

**TABLE 2. SPECIMEN ID**

<table>
<thead>
<tr>
<th>Specimen id</th>
<th>Number of specimen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composite stub</td>
<td>2</td>
</tr>
<tr>
<td>reinforcement steel -RS</td>
<td></td>
</tr>
<tr>
<td>Composite stub stainless steel -SS</td>
<td>2</td>
</tr>
<tr>
<td>Composite stub mild steel -MS</td>
<td>2</td>
</tr>
<tr>
<td>Composite stub</td>
<td>2</td>
</tr>
<tr>
<td>PVC tube -pvc</td>
<td></td>
</tr>
</tbody>
</table>
Testing methods:
Initially to determine the workability of concrete

Compression Test:
The compressive strength of concrete is given in terms of
the characteristic compressive strength of 150 mm size cubes
tested at 28 days (fck). The characteristic strength is defined as
the strength of the concrete below which not more than 5% of the
test results are expected to fall. These specimens are tested by
compression testing machine after 7 days curing or 28 days
curing. The size of the stub column includes 150mm diameter,
300mm height. The diameter of steel tube is 12mm.The dia of
stripes is 6mm then spacing of the each stripes is 75mm.The
strength achieved for ordinary reinforced concrete column is
30.7MPa.

Figure 6. Compressive Strength Of Composite Stub

V. RESULTS AND DISCUSSION
This paper represents the results on the compressive strength of
stubs by using various hollow steel. The results are

Figure 8. Compressive Strength Of Reinforcement Steel

Figure 9. Compressive Strength Of Stainless Steel

Figure 10. Compressive Strength Of Mild Steel

Figure 11. Compressive Strength Of Pvc Tube
Comparison of Compressive strength various composite stubs

Table 3. Comparison of Compressive Strength Various Composite Stubs

<table>
<thead>
<tr>
<th>S.N o</th>
<th>Specimens</th>
<th>Load (kN)</th>
<th>Compressive Strength (N/mm²)</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Composite stub RS</td>
<td>395</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>406</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Composite stub Stainless steel</td>
<td>560</td>
<td>32</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>587</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Composite stub Mild steel</td>
<td>410</td>
<td>23</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>438</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Composite stub Pvc tube</td>
<td>269</td>
<td>15</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>276</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This graph represents the compressive strength of concrete for 28 days from various steel with 12mm reinforcement steel, stainless steel, mild steel, pvc tube. Compare the compressive strength of mild steel, stainless steel, reinforcement steel. Stainless steel has the highest value of strength (33Mba).

VI. ANALYSIS THE STUB

Deflection analysis was carried out by stadd pro. The results are

Figure 14. Analysis Of Reinforcement Steel
Reinforcement stub will get deflection value of -0.309 due to the load case. The deflection was occurred in the reinforcement stub due to the load case.

Figure 15. Analysis Of Stainless Steel
Stainless steel stub will get deflection value of -0.438 due to the load case. The deflection was occurred in the stainless steel stub due to the load case.

Figure 16. Analysis Of Mild Steel
Mild steel stub will get deflection value of -0.321 due to the load case. The deflection was occurred in the mild steel stub due to the load case.

Figure 17. Analysis Of Pvc Tube
Pvc tube stub will get deflection value of -0.210 due to the load case. The deflection was occurred in the Pvc tube stub due to the load case.
VII. CONCLUSION

In order to find a replacement for reinforcement we done this project and got successful result. The strength of the stainless steel stub column increased by 10% compared to ordinary reinforced stub column. By comparing the compressive strength of reinforcement steel and mild steel, mild steel compressive strength has increased 1%. By comparing the Compressive strength of Reinforcement steel & PVC, Pvc compressive strength has decreased by 7% due to the poor strength of the pvc material. Hence the project is successful. Finally the deflection analysis was carried out by staddpro.

VIII. REFERENCE


[3]. Knowles, R B, Park, R “ Strength of Concrete filled Steel column” Journal of the structural division PP 2565-2587

