Behavior and Strength of Concrete Confined by Ferro-Cement Boxes

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Abstract— The thesis presents the study on behavior and strength of concrete confined by Ferro-cement boxes under compression. A total of 24 prism specimens, which includes 6 plain concrete specimens were prepared and concentrically loaded in compression to failure. Six specimen were reinforced with Ferro-cement boxes. Another six specimens were reinforced with Ferro-cement boxes provided with longitudinal bars and hoop bars. A new set of six specimens were reinforced with longitudinal bars and hoop bars only. Since only core concrete was loaded, the height of Ferro-cement boxes was prepared shorter than core concrete to obtain gaps at both ends of specimens. After testing, the results indicate that Ferro-cement boxes offer significant enhancement in stiffness and strength.

Key words: Ferro-Cement Boxes, Concrete

I. INTRODUCTION

It is a type of thin wall reinforced concrete commonly constructed of hydraulic cement mortar, reinforced with closely spaced layers of continuous and relatively small wire mesh. The mesh may be made of metallic material. Ferro-cement composite consists of cement-sand mortar and single or multi layers of steel wire mesh. Mesh is usually 0.5-1.0mm in thickness.

Experimental and analytical works have been conducted extensively in the past on behavior of concrete confined by various types of lateral reinforcement. The confinement, as provided by the lateral reinforcement, such as hoops or ties, creates a state of multi-axial compression in the core concrete, which applies reactive pressure on concrete. This limits further deterioration of concrete and improves its ability to sustain high stresses and strain. Tests from the literature study have shown that the strength of concrete in compression are improved significantly when properly confined by suitable arrangement of reinforcement. Ferro-cement is a highly versatile construction material, and possess high-performance characteristic, especially in cracking, tensile strength, ductility, and impact resistance could lead Ferro-cement to become one of an ideal partial substitute for the transverse reinforcement. As its reinforcement uniformly distributed in both longitudinal and transverse directions and closely spaced through the thickness of the section, the confining of core concrete with Ferro-cement will be very effective.

II. OBJECTIVES

- To study the behavior and strength of concrete confined by Ferro-cement boxes under compression.
- To study the variation in the strength of concrete by providing suitable arrangement of reinforcement.
- To increase the life of detonating columns by providing the Ferro-cement jacket.

A. Specimen Details

<table>
<thead>
<tr>
<th>Specimen Sl. no</th>
<th>Type of specimen</th>
<th>Dimensions in mm</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plain concrete</td>
<td>120x120x300</td>
<td>06</td>
</tr>
<tr>
<td>2</td>
<td>Plain concrete confined with Ferro-cement box</td>
<td>120x120x300 and 8mm Ferro cement jacket</td>
<td>06</td>
</tr>
<tr>
<td>3</td>
<td>Plain concrete with Ferro-cement box and provided with 6mm longitudinal and 2mm hoop bars.</td>
<td>120x120x300 and 8mm Ferro cement jacket</td>
<td>06</td>
</tr>
<tr>
<td>4</td>
<td>Plain concrete with 6mm longitudinal bars and 2mm hoop bars.</td>
<td>120x120x300</td>
<td>06</td>
</tr>
</tbody>
</table>

Table 1: Four number of 6 mm diameter longitudinal bars are to be provided along with 2mm diameter hoop bars for specimen no. 3 and specimen no. -4. After failure of specimen no.4, provide Ferro-cement jacket with mortar and then cured. After curing, the jacketed specimen is tested under compression testing machine. And the strength of specimen no.4 and Ferro-cement jacketed specimen are compared.

B. Results

<table>
<thead>
<tr>
<th>Series</th>
<th>Specimen details</th>
<th>Load in KN</th>
<th>Compressive strength in N/mm²</th>
<th>Average compressive strength in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Plain concrete</td>
<td>412.0200</td>
<td>28.6125</td>
<td>30.6562</td>
</tr>
<tr>
<td></td>
<td></td>
<td>461.0700</td>
<td>32.0187</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>441.4500</td>
<td>30.6562</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>490.5000</td>
<td>34.0625</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>461.0700</td>
<td>32.0187</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>382.2000</td>
<td>26.5687</td>
<td></td>
</tr>
</tbody>
</table>

Table 2: showing test results of series1 specimens

<table>
<thead>
<tr>
<th>Series</th>
<th>Specimen details</th>
<th>Load in KN</th>
<th>Compressive strength in N/mm²</th>
<th>Average compressive strength in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Plain concrete with Ferro-cement box</td>
<td>529.74</td>
<td>36.7875</td>
<td>36.5605</td>
</tr>
<tr>
<td></td>
<td></td>
<td>480.69</td>
<td>33.3812</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>500.31</td>
<td>34.7437</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>568.98</td>
<td>39.5125</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>549.36</td>
<td>38.1500</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>529.74</td>
<td>36.7875</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: showing test results of series2 specimens
Table 4: showing test results of series3 specimens

<table>
<thead>
<tr>
<th>Series</th>
<th>Specimen details</th>
<th>Load in KN</th>
<th>Compressive strength in N/mm²</th>
<th>Average compressive strength in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Plain concrete with Ferro-cement box and provided with 6mm longitudinal and 2mm hoop bars</td>
<td>559.1 7</td>
<td>38.8312</td>
<td>40.8749</td>
</tr>
<tr>
<td></td>
<td></td>
<td>578.7 9</td>
<td>40.1937</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>667.0 8</td>
<td>46.3250</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>618.0 3</td>
<td>42.9187</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>588.6 0</td>
<td>40.8750</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>519.9 3</td>
<td>36.1062</td>
<td></td>
</tr>
</tbody>
</table>

Table 5: showing test results of series4 specimens

<table>
<thead>
<tr>
<th>Series</th>
<th>Specimen details</th>
<th>Load in KN</th>
<th>Compressive strength in N/mm²</th>
<th>Average compressive strength in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Plain concrete with 6mm longitudinal and 2mm hoop bars</td>
<td>470.8 8</td>
<td>32.7100</td>
<td>36.5610</td>
</tr>
<tr>
<td></td>
<td></td>
<td>539.5 5</td>
<td>37.4700</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>559.1 7</td>
<td>38.8300</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>441.4 5</td>
<td>30.6560</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>578.7 9</td>
<td>40.1940</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>568.9 8</td>
<td>39.5130</td>
<td></td>
</tr>
</tbody>
</table>

Table 6: showing test results of failed series4 specimens provided Ferro-cement jacket

<table>
<thead>
<tr>
<th>Series</th>
<th>Specimen details</th>
<th>Load in KN</th>
<th>Compressive strength in N/mm²</th>
<th>Average compressive strength in N/mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>After failure of 4th series specimens, the specimens are provided with 8mm thick Ferro-cement jacket</td>
<td>480.690 0</td>
<td>33.3810</td>
<td>38.3770</td>
</tr>
<tr>
<td></td>
<td></td>
<td>578.790 0</td>
<td>40.1940</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>559.170 0</td>
<td>38.8300</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>451.260 0</td>
<td>31.3380</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>608.220 0</td>
<td>42.2380</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>637.650 0</td>
<td>44.2810</td>
<td></td>
</tr>
</tbody>
</table>

C. Graphs

Graphs showing the variation in the compressive strength

III. CONCLUSIONS

The following conclusion may be drawn from the discussion of the test results presented herein based on the specimens with relatively lower strength of mortar used as matrix for Ferro-cement boxes.

1) The compressive strength of concrete is increased by 19.25% by providing Ferro-cement jacket.
2) The compressive strength of concrete is increased by 33.33\% by providing Ferro-cement jacket with longitudinal bars and hoop bars.

3) The compressive strength of failed concrete specimens which is provided with longitudinal and hoop bars is increased by 4.96\% after providing Ferro-cement jacket.

4) Hence Ferro-cement jacketing is suitable for increasing the life of deteriorated columns.

REFERENCES


