Synopsis

Study of RC Jacketed Column and its Formwork

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Introduction:
The basic needs for human existence are food, clothing and shelter. From time immemorial, man has been making efforts in improving his standard of living. The point of these efforts has been to provide an economic and efficient shelter. The possession of shelter, besides being a basic necessity, gives a feeling of security, responsibility and shows the social status of man.

Design of a multi-storey building, suiting the requirements of the client and locality and study of RC jacketed column and developing a formwork for the same forms the foundation of our project.

Literature survey on the concept of retrofitting and the method of RC jacketing was carried out to give us more knowledge on the retrofitting methods adopted. Then started with the preparation of an architectural plan suiting the requirement using AutoCAD and the structural layout was prepared using the same. The plans imported to the ETABS software and a model was prepared. The model was analysed for different load combinations as per the IS 875 standard and the combination which gives maximum moment/load has been selected. The load combination which has given maximum moment/load is 1.2(DL+LL+EQX), hence the building has been analysed and designed.

During our survey on the failures leading to retrofitting of the member, it was noticed that the failure of compression member (column), due to the desired compressive strength of concrete was not achieved. Hence, chose the retrofitting of the column with by the RC Jacketing and have made a prototype to replicate the same and validated. Then the increase in strength of column achieved after retrofitting. A formwork mould has also been developed using the locally available materials and its usability in site is validated.

Objectives of the study:
1. To study the structural behaviour of the RC column elements.
2. To experimental study and validate the retrofitting scheme for RC Jacketed Columns
3. To develop the shuttering system for the RC Jacketing

Methodology:
- Based on reconnaissance survey and concept design, architectural plan of the building is prepared using AutoCAD software and the building is designed using ETABS software, which provides adequate strength, serviceability, and durability.
• Structure is modelled, and analysed for different load combinations, and is designed for worst case of load combination using ETABS software.

• Manual design of the building component is carried out and the results obtained from ETABS were verified.

• By assuming workmanship failure in a column (where the strength of concrete used for the column is less than that desired/designed), then provided a retrofitting scheme for the column by increase in strength.

• In ETABS, in order to study and understand the variation of load carrying capacity of column, grade of concrete is decreased and the design is checked. Percentage of tensile reinforcement increases in the column; hence a retrofitting scheme is suggested.

• In order to experimentally validate jacketing scheme, conducted several tests as per IS 456-2000. Compression test on cubes is carried to verify whether it is satisfying the sampling and acceptance criteria of IS 456-2000 or not. If not, further tests as per clause 17 of IS 456-2000 is conducted.

• Since due to the workmanship failure that it has been assumed, compression test on cubes will not abide by the sampling and acceptance criteria of IS456:2000. Hence, a 150mm diameter cylinder with 300mm height is casted and tested.

• Observing the results of compressive strength test on cylinder, then adopted the RC jacketing retrofitting scheme for the cylinder.

• For the cylinder, a 75mm RC jacket is provided, with epoxy used as a bonding agent between fresh and old concrete and the RC jacketed cylinder is tested and results are noted.

• Formwork for both original 150mm cylinder as well as RC jacketed cylinder is prepared using PVC pipe as inner covering and plywood as outer covering.

Results and Conclusions:

• The analysis and design results obtained from ETABS software are matching with manual calculations and design.

• From the compression test on cubes, we get to know that the strength of concrete achieved is less than the specified strength (target mean strength), hence a 150mm diameter cylinder is casted with the same material and tested.

• Achieved strength of the cylinder is less than 75% of grade of concrete specified as per IS 456-2000 Cl.17.4.3, therefore the result is not acceptable and hence retrofitting is done.

• Achieved strength of the RC jacketed cylinder is more than the 75% of grade of concrete specified. As per IS 456-2000, Cl. 17.4.3, the result is acceptable.

• Hence, we have experimentally validated that the retrofitting scheme provided by us is satisfactory.

• The formwork prepared and used has been found fit for the experiments conducted and also alterations in its shape and size can be done.

Table 1: Results of the compression tests conducted.

<table>
<thead>
<tr>
<th>SL. No.</th>
<th>Moulds casted</th>
<th>Age of the Cubes</th>
<th>Avg. Compressive Strength in N/mm²</th>
<th>Standard Deviation (SD) N/mm²</th>
<th>Coefficient of Variations (CoV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Cube 150 x 150 x 150mm</td>
<td>7 Days</td>
<td>16.74</td>
<td>0.42</td>
<td>0.025</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>28 Days</td>
<td>22.44</td>
<td>0.26</td>
<td>0.011</td>
</tr>
<tr>
<td>3.</td>
<td>Cylinder 150 mm diameter</td>
<td>28 Days</td>
<td>17.65</td>
<td>0.13</td>
<td>0.007</td>
</tr>
<tr>
<td>4.</td>
<td>Cylinder 300 mm diameter (Retrofitted)</td>
<td>28 Days</td>
<td>27.65</td>
<td>0.02</td>
<td>0.001</td>
</tr>
</tbody>
</table>
**Scope of Future Work:**

On the basis of the present work done, the scope for future study is identified on the following aspects:

- The present study is carried out on a residential building. Similar studies may be taken up with commercial and industrial buildings as well.

- Project work has focused on strengthening of a column in RCC buildings. There is a large scope to create awareness in the occupants/residents of the buildings which have completed the service period and or will probably be completing the service period in short future. All such buildings can be retrofitted with suitable techniques to save the lives and property.

- The design was implemented only for column. The project can be extended to strengthen beams, slabs, and other structural components.

- The same column in the RCC Building can be retrofitted using some different techniques like base isolation, steel bracings, shear wall, FRP Wrapping etc. and a comparative study can be done to find out the most efficient technique with respect to cost, aesthetics, durability and other such criteria.

- Retrofitting was done for Circular Column. The work can be extended for different shapes of column.

- Combined retrofitting of beams & columns can be studied.

- Research in the field of fire resistance of retrofitted structure is desirable to maximize their potential use and to clearly understand how steel and concrete progressively lose strength and stiffness at elevated temperatures.

- Research on the formwork prepared and used can be done and its validation for use in site can be studied upon.